



Urbanization and its Impact on Ambient Air Quality: A Case Study of Patna Municipal Area

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1. Introduction:

Ambient air quality means the concentration of pollutants suspended in outdoor air. Urban air quality is a big concern because the large number of people resides in the big cities. Environmental pollution is a common problem in both developed and developing countries. (Ghosh et al 2005). Every year large quantities of toxins waste are discharged into the environment from production of goods, burning of fossil fuels, industries and domestic activities. Sulphur dioxide, Nitrogen dioxide and Particulate Matter (PM₁₀ and PM_{2.5}) are regarded as major air pollutants in India (Agarwal and Singh 2000). The man-made activities such as combustion of fossil fuels and use of nitrogen fertilizers are the leading producers of hydrocarbons, carbon dioxide and nitrogen oxide, which finally enter into the environment. The increase in concentration of the air pollutants adversely affects the living organisms and also the heat budget of the lower atmosphere (Anusha Pawar et al). Air pollution being a serious threat has led to over 3.7 million premature deaths because of outdoor air pollution and 3.8 million premature deaths because of household air pollution (WHO). Worldwide in 2016 the urban population is mainly exposed to high levels of air pollution, increasing metals as well as fine and ultrafine particles from the vehicle emission (Sharma et al 2006). Due to rapid urbanization and our growing needs, majority of regions in India, especially state capitals, have become major centers for commerce and industries. These activities are leading to unplanned growth and hence impose notable adverse impacts on the local and regional air quality (Bihar State Disaster Management Authority Safar 2018). Uncontrolled urbanization, including construction activities, transportation activities, fossil fuel combustions in industries, vehicle engine emissions, domestic burning of biofuels, disposal practices including open biomass burning, poor road conditions, wind-blown dust from unpaved road sides are some of the major pollution sources which can be easily located in Patna city. (Sources EMIT) Various hazardous pollutants enter into the atmosphere including PM₁₀, PM_{2.5}, NO₂ and SO₂, Carbon Dioxide etcetera which can cause an adverse effect on the human body. These pollutants exceed certain levels and show some negative impact on human health, especially children and elderly people suffer more by this various infectious pollutant. Patna is the second largest city in the East India after the metropolitan city of Kolkata. In the recent years Patna has recorded the highest level of PM₁₀ and PM_{2.5} concentrations which exceed the NAAQS standard limit. The CPCB report 2012 shows that Patna is the most polluted city in India after Delhi, the survey calculating the PM_{2.5} in the state capitals. (Source: CPCB 2012) Ambient air to be 149 µg/m³ in 2016 in 2015 level of PM₁₀ in Patna was 355 µg/m³ that is three and half times higher than the prescribed limit of 100 µg/m³. The occurrence of high numbers is due to higher vehicle and industrial emissions and construction activities in the city. (Bihar pollution control board 2018 report)

2. Aim and Objectives of the Research:

1. The primary purpose of this study is to assess the ambient air quality on the basis of PM₁₀, PM_{2.5}, SO₂ and NO₂ in the festival and non-festival season.

2. To analyze the impact of ambient air quality and recommend some measures to improve the air quality of the study area.

3. Methodology:

For the present research paper secondary data has been collected on the basis of temporal basis from 2020 to 2022. In this

time period the pollutant of PM 2.5, PM 10, SO₂ and NO₂ is monetarized. The data is obtained from Bihar pollution control board and Central Pollution Control Board. There

are two monitoring sites which is taken on the basis of activities i.e. Commercial and Residential.

Table 1: Details of site and period of monitoring

S.No.	Site Name	Period	Type	Latitude	Longitude
1	Taramandal (Maurya Lok Complex)	2020-22	Commercial cum Tri Junction	25.609°N	85'.1343°E
2	BIT Mesra, Samanpura	2020-22	Residential cum Educational	25.595°N	85.086°E

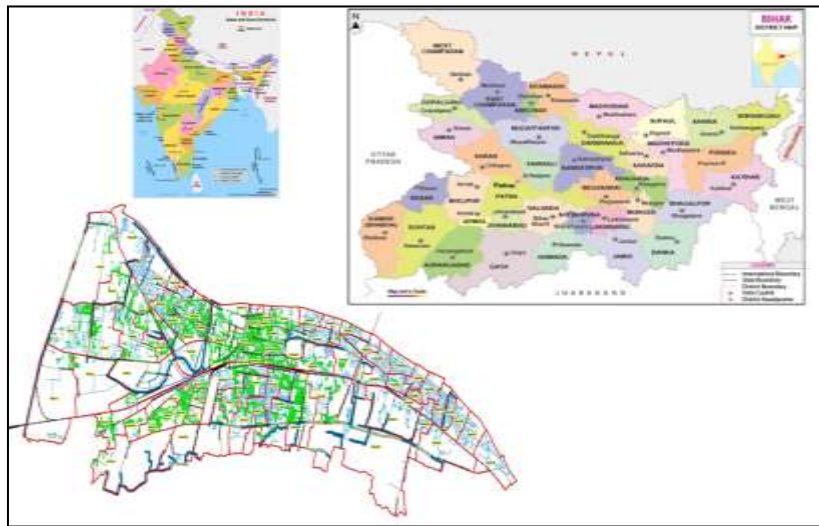
Table 1 shows the details of site and period of monitoring current status of ambient air quality in the City. The main objective was to generate the robust database on the concentration of hazardous pollutants PM 10, PM 2.5, NO₂ SO₂ in the air. For measuring the air quality of the particular place an AQI index is coined which is easily understood by the common man this is based on the international norms. The AQI categories is based on ambient concentrations value of air pollutants and their impact on health is known as health break points. Higher numbers of AQI index through Southern West monsoon between the periods of June to September in the City.

shows the greater risk and the lower number shows the lowest risk of the health associated with air quality.

4. Study Area:

Patna city is a saucer shaped, situated on the southern bank of river ganga's the township is based on thick fluvial sediments deposited by rivers and its tributaries. The climate of the Patna city is tropical humid type in the summer and monsoon season. Chilly winter nights and foggy or sunny days from October to February. The annual rainfall of 1109.8 mm is received

Map 1: Location of Patna Municipal Area



5. Air quality index (AQI):

The AQI is a scale designed to indicate the air quality around us in terms of its effect on an individual health. AQI primarily community a unit less number divided in to several ranges as 0-50,51-100,101-200,201-300,301-400 and 401-500+and classified as levels of pollutants as

good, satisfactory, moderate, poor, very poor and severe respectively. The higher in the number the greater is the health risk associated with air quality. The AQI and its corresponding breakpoints design for Indian cities are listed in table 2 and the health effect shows in table 3 respectively.

Table 2: AQI and its corresponding breakpoints

AQI Category (Range)	PM 10	PM 2.5	NO ₂	SO ₂
Good (0-50)	0-50	0-30	0-40	0-40
Satisfactory (51-100)	51-100	31-60	41-80	41-80
Moderate (101-200)	101-250	61-90	81-180	81-380
Poor (201-300)	251-350	91-120	181-280	381-800
Very Poor (301-400)	351-430	121-250	281-400	801-1600
Severe (401-500)	430+	250+	400+	1600+

Source: Beig et al. MoES Technical Scientific Report, 2010 and CPCB, 2014

Table 3: AQI and its health effect shows

Air Quality Index (AQI)	Associated Health Impact
Good (0-50)	Minimal Impact
Satisfactory (51-100)	May cause minor breathing discomfort to sensitive people
Moderate (101-200)	May cause breathing discomfort to the people with lung disease such as asthma and discomfort to people with heart disease.
Poor (201-300)	May cause breathing discomfort to people on prolonged exposure and discomfort to people with heart disease with short exposure.
Very Poor (301-400)	May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart disease.
Severe (401-Above)	May cause respiratory effects even on healthy people and serious health impacts on people with lung/heart diseases. The health impacts may be experienced even during light physical activity.

6. Result and discussion:

Patna is most populous and polluted city of Bihar there are so many commercial and industrial activities performed in the City. The

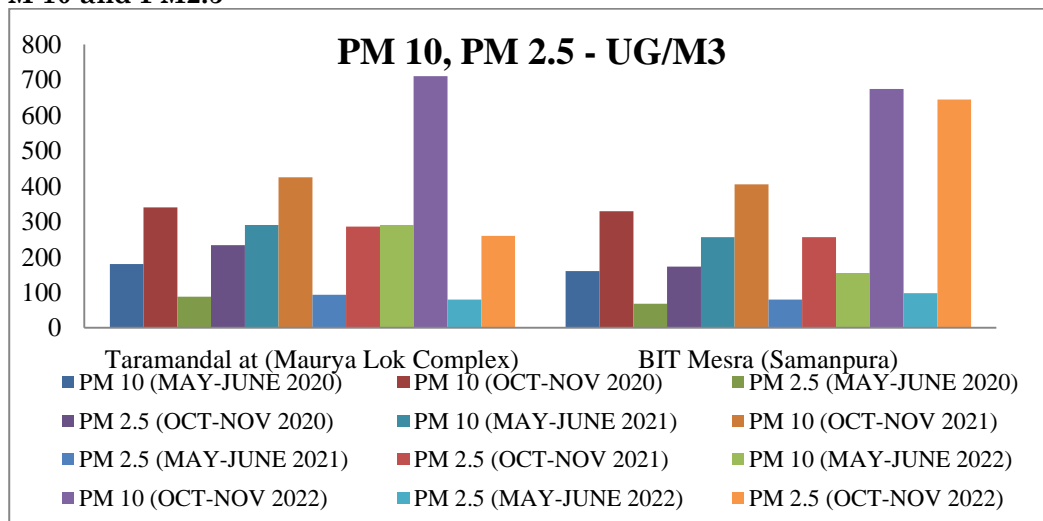
table 4 shows their average concentration values of pollutants for monitoring period at each location of Patna city.

Table 4: Average concentration values of pollutants

Location	PM 10	PM 2.5	NO ₂	SO ₂
Taramandal (Maurya Lok Compex)	340.24 (festive season) 190 (summer)	294 (festive season) 202 (summer)	148.22 (festive season) 182 (summer)	15.03 (festive season) 10.3 (summer)
BIT Mesra, Samanpura	281.20 (festive season)	254 (festive season)	54 (festive season)	12.4 (festive season)

Data is in unit of ug/m³

a. PM 10 and PM2.5



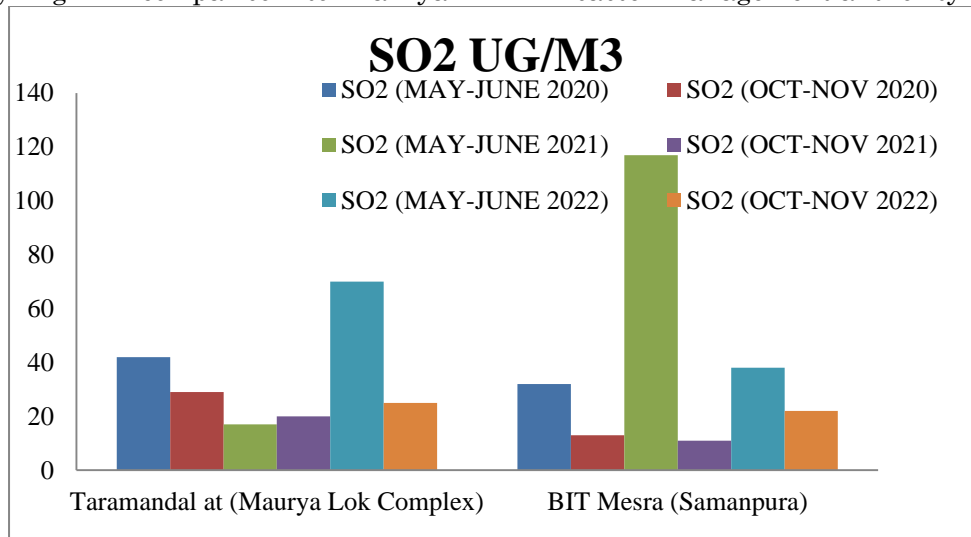
Status of the ambient air quality in the City. The data is collected from secondary sources between 2020 to 2022. The Taramandal site is located near Maurya complex which is a commercial hub of the Patna. The second site is located at Samanpura near BIT Mesra which is one of the residential site as well as educational center. Every year between 2020 to 2022 in the festive period of Diwali at Maurya complex the average value of PM 10 is 340.24 and value of PM 2.5 is 294 the NO₂ is 148.22 and SO₂ is 15.03 but when we saw the pollutants in summer season PM₁₀ is 190 and value of PM 2.5 is 202, NO₂ is quiet high i.e.182 and SO₂ is 10.3 respectively. The variation was observed in this season because of burning of firecrackers and burning of paddy extract in the field during the winter season. In the year 2020 and 2021 the level of pollutant is recorded low respectively because of lockdown.

In the year 2020 the region of Samanpura near BIT Mesra the level of pollutants during festive season is respectively high in comparison to Maurya

complex i.e. PM 10 is 281.20, PM 2.5 is 254 the NO₂ is 54 and SO₂ is 12.4 the PM 2.5 and PM 10 is quite high from the Maurya complex because this is a residential site as well as an outer area of Patna where there are some kind of forest is available. The level of pollutants is low because of COVID-19 also. In the non-festival season i.e. during May -June the concentration of pollutants is normal in range. i.e. PM 10 is 148, PM 2.5 is 51 and SO₂ is 5.6. The data between 2017 and 2019 is not available because of not establishing the monitoring site at that time.(Bihar pollution control board 2018,SAFAR report).

b. Sulfur dioxide SO₂:

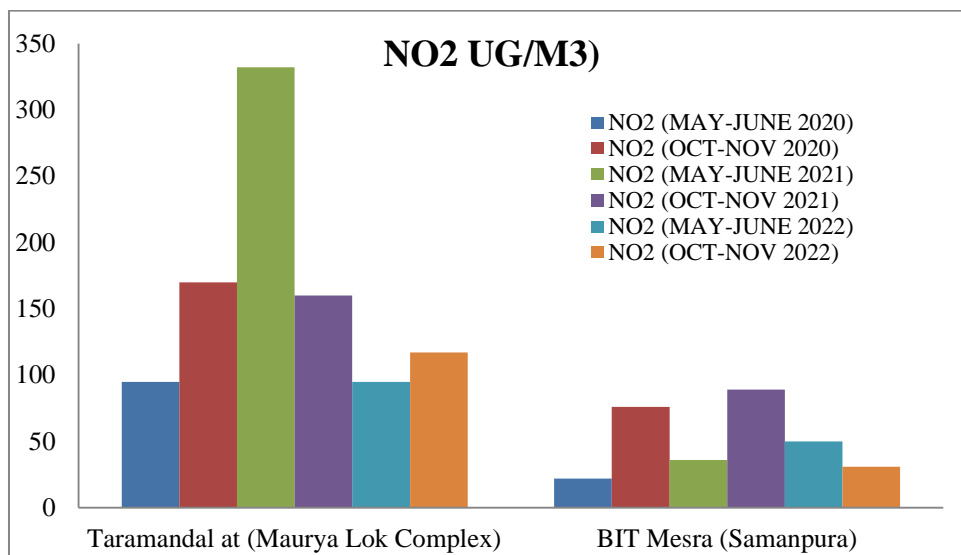
In the Taramandal area (Maurya complex) the highest level of SO₂ is 25 ug/m³ and near BIT Mesra the SO₂ range is 15 ug/m³ in the festival season but on the non-festival season the rate is respectively low. All the values are almost similar to the NAAQS limit which is 20 ug/m³ or 30.53ppb. AQI category for all the location is in "Moderate" range. (source: Bihar State Disaster Management authority 2018.)



c. Nitrogen dioxide NO₂

During the month of October and November the NO₂ level in the festive session is well higher the NAAQS limit of 30 ug/m³ at all monitoring location. In Maurya complex near Taramandal the level of NO₂ is 45 ug/m³ the lowest level concentration and the higher level is 332ug/m³ in the month of May between 2020 to 2022. In the festive

session of November October, the highest level of NO₂ is 160ug/m³ and the lowest is 49ug/m³. In the station of Sammanpura BIT Mesra the lowest level of NO₂ is 5.8 and highest level is 50ug/m³ in the season of May -June 2020 to 2022. In the month of October i.e. festive session, the highest level of NO₂ is 89 and the lowest is 14ug/m³.



d. Effect on health

The increase level of pollutant has adverse effect on human health. All pollutants accumulated through inhalation process to the human being. The pollutant is responsible for cardiovascular and respiratory diseases such as asthma, bronchitis and reproductive development increase risk of premature birth and even mortality and morbidity rate. (source: Ahmad Atiq 2015).

In the present study the concentration of PM 10 And PM 2.5 is above the prescribed limit. While NO₂ is higher the permissible limit of NAAQS. Whereas the concentration of pollutants causes severe disease like lung cancer. NO₂ is mainly exposed by vehicular traffic congestions (source: MoEF 2019)

7. Recommendations

Technology is required for improving the air quality of any places for this a long term measures must be taken, in general we can say that rapid industrializations, emissions from vehicles, construction activities, dust from unpaved road and cooking for domestic purposes are some of the major pollution source in Patna. This research paper shows that some adverse effect of deteriorated air quality which is discussed in this section.

1. Proper maintenance of vehicle is necessary.
2. Green the paved road and unpaved road.
3. Proper maintenance of traffic congestions so that emission of pollutant must be reduced.
4. Emissions from constructions activities can be minimized by adopting best practices such

as stabilizing completed part with vegetation stabilizing earth works with stone soil geo textile use of water spray and dust separations create regions to prevent dust compact disturbed soil.

5. Technology advancement to improve Indian technology is the key handle fossil fuel emissions and it is high time that we continue to strive forever own new and better technology to minimize emissions from any type of fuel.

6. Improve public transport and use green fuel such as CNG, electricity in this sector.

7. For domestic purpose use clean and green energy. (source clean the air for children the impact of air pollutions on children October 2016 UNICEF).

References

1. Ahmad. Atiqand Bano Nikhat: ambient air quality of Firozabad City- A spatial- temporal Analysis. Journal of Global Bio Sciences volume.4 (2),2015pp.1488-1496, ISSN 2320-1355.
2. Anusha.C.Pawar et.al.: Assessment of ambient air quality in urban environments of Hyderabad India. Nature environment and pollution technology and international quarterly scientific journal. Volume 11 no. 3 (2012) pp457-459. ISSN:0972-6268.
3. Prakash Mamta and bassin JK: analysis of ambient air quality using air quality index a case study. International Journal of advance engineering technology. E-ISSN0976-3945.
4. CPCB (Central pollution control board) 2000. Air Quality Status and Trends in India.
5. Agrawal m and je Singh: impact of coal power plant emission on the Fourier alimantal concentration in plants in low

- rainfall tropical region. Environmental monitoring assesses 60, 261- 282(2000).
6. Burman.S.C, Kumar.N. and R.Singh: assessment of urban air pollution and its probable health impact journal of environment biolog,31,(6),931-920(2010).
7. Bihar state disaster management authority. February 2018, assessment of air quality of Patna town at different micro environment. Project report SAFAR.
8. Joshi.G and MishraA:The Ambient Air Quality of Indore Madhya Pradesh.Poll.Res,17(1):21-24.(1998).
9. Hemavathi.C and Jagannath.S ambient air quality in Mysore city: study with reference to regular exhaust poll.Res.23(1)173-177. (2004)
10. Singh Pratima, guttiKunda k Sarath and Banerjee Anirban: comprehensive clean air action plan for city of Patna. Centre for study of science technology and policy December 2019
- 11.Bihar Disaster management authority board2018, SAFAR report.