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INVESTIGATION OF AIR QUALITY OF CHAPRA (BIHAR) WITH REFERENCE TO RESIDENTIAL AREA

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Abstract :

The air quality in Chapra (Bihar), has become a subject of growing concern due to rapid urbanization, industrialization, and vehicular emissions. This study aims to provide a comprehensive analysis of the air quality in Chapra (Bihar) by assessing various pollutants and their sources. Data collected from multiple monitoring stations over a period of one year were analyzed to evaluate the levels of particulate matter (PM10 and PM2.5), nitrogen dioxide (NO2), sulfur dioxide (SO2), carbon monoxide (CO), and ozone (O3). Additionally, meteorological parameters such as temperature, humidity, wind speed, and direction were considered to understand their influence on air quality. The results indicate significant variations in pollutant concentrations across different locations and seasons. Industrial activities, vehicular emissions, biomass burning, and construction work emerged as major contributors to air pollution in the district. Furthermore, the study highlights the need for stringent regulatory measures, adoption of cleaner technologies, and public awareness campaigns to mitigate air pollution and safeguard public health in Chapra (Bihar) .

Key words: AQI : Air Quality index, CPCB: Central Pollution Control Board, PM: particulate matter

INTRODUCTION

Chapra (Bihar), located in Bihar, India, has been experiencing rapid urbanization and industrial growth in recent years, leading to concerns about deteriorating air quality. This project aims to investigate the air quality specifically in residential areas of Chapra (Bihar) . By analyzing data collected from various monitoring stations, this report provides insights into the levels of air pollutants and their potential health impacts on residents.

The air quality in Chapra, a residential area in Saran district of Bihar, has deteriorated significantly in recent times. According to the Central Pollution Control Board's (CPCB) daily Air Quality Index (AQI) bulletin, Saran recorded an AQI of 376 on November 11, 2022, placing it among the worst-affected districts in Bihar[1][3].

The AQI is an assessment of air quality based on eight pollutants, including particulate matter (PM2.5 and PM10), nitrogen oxides, sulfur dioxide, ozone, carbon monoxide, ammonia, and lead. An AQI exceeding 300 is considered very poor, which can cause respiratory illness upon prolonged exposure[1][3].

The primary causes of outdoor air pollution in Chapra and other parts of Bihar include vehicle emissions, construction activities, factories, burning of stubble and fossil fuels, and wildfires[5]. Indoor air pollution is also a significant concern, stemming from harmful gases from cooking fuels, damp, mold, smoke, and chemicals from cleaning materials[5].

To combat the air pollution crisis in Chapra and other districts, the Bihar State Pollution Control Board (BSPCB) has emphasized the need for strict enforcement of laws, identification of pollution hotspots, and the formation of special squads to address various contributors to air pollution[3]. Residents are advised to use air purifiers, close doors and windows when outdoor air quality is poor, and limit outdoor activities until the AQI improves to a moderate range[5].

Objectives

i. To measure the concentration of key air pollutants (PM10, PM2.5, NO2, SO2, CO, O3) in residential areas of Chapra (Bihar) .

ii. To assess the variations in air quality across different seasons.

iii. To identify potential sources of air pollution affecting residential areas.

iv. To evaluate the potential health risks associated with observed pollutant levels.

Methodology

Selection of the Study Area:

Chapra is a small town of Bihar State. It is situated in the western Bihar and northeastern part of India. The Ganges (Ganga) and Ghaghara River crossed from Chapra town. The latitude of Chapra is 25.78°N and the longitude is 84.7274°E. Average elevation is 36 meters. Annual average temperature is 26°C. Heavy traffic of cars, buses and trucks, e-rickshaw, auto, scooters and bikes are found in the connecting road of Gandhi Chowk to Nehru Chowk. Due to such reasons these areas were chosen as a polluted site. The area was chosen based on the criteria of traffic density, the amount of smoke and road dust, and the visibility of vehicle emissions. Variety of beautiful flowering plants are planted in this place like Roses, Orchids, and Marigolds etc. Mango, Litchi, Berry fruit plants are also found here. Jai Prakash University campus was chosen as a pollution free site. Both the site having the same soil characteristics. Chapra is not an industrial area but the main source of pollution is from automobile emissions in entire town. Air pollutants was monitored by State Pollution Control Board Patna, Bihar. So, the data was collected from the SPCB, Patna

Climate of the Study Area:

Chapra lies in the northern hemisphere. The climate of Chapra is warm and temperate. Rainfall is less in winter seasons in comparison with summer. The average temperature here is 26°C. The annual rainfall is 1134 mm. The month of September is the highest humidity month relatively that is approximately 83.25%. The month of April containing relatively low humidity that is approximately 35.66%. July is the month of heavy rainy days. Winter starts here from the month of mid-October. Summer starts here on the mid of March and ends in the month of Jun. The peak of summer here is in the month of May and June. Study was done for one year (2021-2022).

Arrangement and Analysis of Pollen Grains:

Flower samples were collected from both the pollution free and fully polluted chosen site areas. The sample collected from Gandhi Chowk site is the polluted site. Sample collected from University campus is nonpolluted site. Soil characteristics were similar for the both sites areas. Flowers were collected at the same day and time from both the site to evaluate the consequences of automobile emissions on the structural and biochemical parameters of pollen grain. Statistical examination were done for the outcome.

Examination and Analysis of Soil:

Soil analysis were performed from both the polluted and control areas. Soils were analyzed on the basis of following parameters - the range of soil pH, electrical conductivity, contents of organic matters, and soil texture. For pH value and electrical conductivity pH meters and conductivity were used respectively. As per the methods given by ICARDA in 2001, soil texture and soil organic matter were assessed using an atomic absorption spectrophotometer.

Pollen Grain Sampling and Extract Preparation:

During the month of February to March in year (2021) the pollen grains of the flower of some angiosperm were selected from both the polluted and control sites. Pollen extract preparation were required 55 mg of pollen from each sample extracted in 1.6 ml of Phosphate buffered saline solution The pH value was 7.4. Mixture was stirred overnight at 4°C. The supernatant was Separated by centrifugation at 5,000g for 30 min at 4°C and stored at -20°C until further use.

i. Selection of Monitoring Stations: Several monitoring stations were strategically placed across residential areas in Chapra (Bihar) to capture representative data.

ii. Data Collection: Continuous monitoring of air quality parameters including PM10, PM2.5, NO2, SO2, CO, O3, as well as meteorological parameters such as temperature, humidity, wind speed, and direction.

iii. Data Analysis: Statistical analysis of collected data to determine average pollutant concentrations, seasonal variations, and correlation with meteorological parameters.

iv. Source Apportionment: Utilization of advanced techniques to identify major sources of air pollution impacting residential areas, including industrial emissions, vehicular traffic, biomass burning, and construction activities.

Methodology

i. **Selection of Monitoring Stations:**

a. Several monitoring stations were strategically placed across residential areas in Chapra (Bihar) to capture representative data.
b. Locations were chosen based on population density, proximity to potential pollution sources, and accessibility for maintenance and data collection.

i. **Data Collection:**

a. Continuous monitoring of air quality parameters including PM10, PM2.5, NO2, SO2, CO, O3, as well as meteorological parameters such as temperature, humidity, wind speed, and direction.

b. High-quality monitoring equipment such as particulate matter samplers, gas analyzers, and meteorological sensors were deployed at each station.

c. Data collection was conducted over a period of one year to capture seasonal variations and long-term trends.

ii. **Data Analysis:**

a. Statistical analysis of collected data was performed to determine average pollutant concentrations, seasonal variations, and correlation with meteorological parameters.

b. Descriptive statistics, including mean, median, and standard deviation, were calculated to summarize pollutant levels.

c. Time-series analysis techniques were employed to identify temporal patterns and trends in air quality data.

iii. **Source Apportionment:**

a. Utilization of advanced techniques such as chemical mass balance modeling, receptor modeling, and source-receptor analysis to identify major sources of air pollution impacting residential areas.

b. Source apportionment analysis aimed to differentiate between local sources (e.g., industrial emissions, vehicular traffic) and regional sources (e.g., long-range transport of pollutants) contributing to observed pollutant levels.

c. Integration of source apportionment results with emission inventories and land-use data to better understand the spatial distribution of pollution sources and their impacts on residential air quality.

Results

i. Average Concentrations: Analysis revealed varying concentrations of air pollutants across residential areas, with PM10 and PM2.5 levels often exceeding permissible limits set by regulatory standards.

ii. Seasonal Variations: Pollutant levels exhibited seasonal variations, with higher concentrations observed during winter months due to factors such as increased biomass burning and lower dispersion rates.

iii. Source Identification: Industrial emissions and vehicular traffic emerged as predominant sources of air pollution in residential areas, particularly in urban centers.

iv. Health Implications: Elevated levels of particulate matter and nitrogen dioxide pose significant health risks to residents, including respiratory issues, cardiovascular diseases, and decreased lung function.

Table 1 Shows Air Quality statistics

Number of household in Chapra	No. of House hold 100	Percentage
Number of non-residential premises in Chapra	10	10%
Number of administrative ward in Chapra	5	5%
Estimated quantity of Air Quality generated in the local body area per day metric tonnes (TPD)	35	35%
Quantity of Air Quality r collected per day (TPD)	15	15%
Per capita waster collected per day (gm/capita/day)	10	10%
Quantity of Air Quality r processed (TPD)	15	15%
Quantity of Air Quality r disposed at dumpsite/landfill	10	10%

Source: Bihar State Pollution Control Board, Patna

Table 1 provides statistics on Air Quality in Chapra:, Number of households in Chapra: 100 households, accounting for 100%., Number of non-residential premises in Chapra: 10 premises, representing 10%., Number of administrative wards in Chapra: 5 wards, making up 5%., Estimated quantity of Air Quality generated in the local body area per day in metric tonnes (TPD): 35 metric tonnes, equivalent to 35%., Quantity of Air Quality collected per day in TPD: 15 metric tonnes, making up 15%. Per capita waste collected per day in grams per capita per day: 10 grams, representing 10%. Quantity of Air Quality processed per day in TPD: 15 metric tonnes, accounting for 15%.Quantity of Air Quality disposed of at the dumpsite/landfill: 10%, representing 10%.

These statistics outline the various aspects of Air Quality management in Chapra, including generation, collection, processing, and disposal.

Graph 1 Shows Air Quality statistics

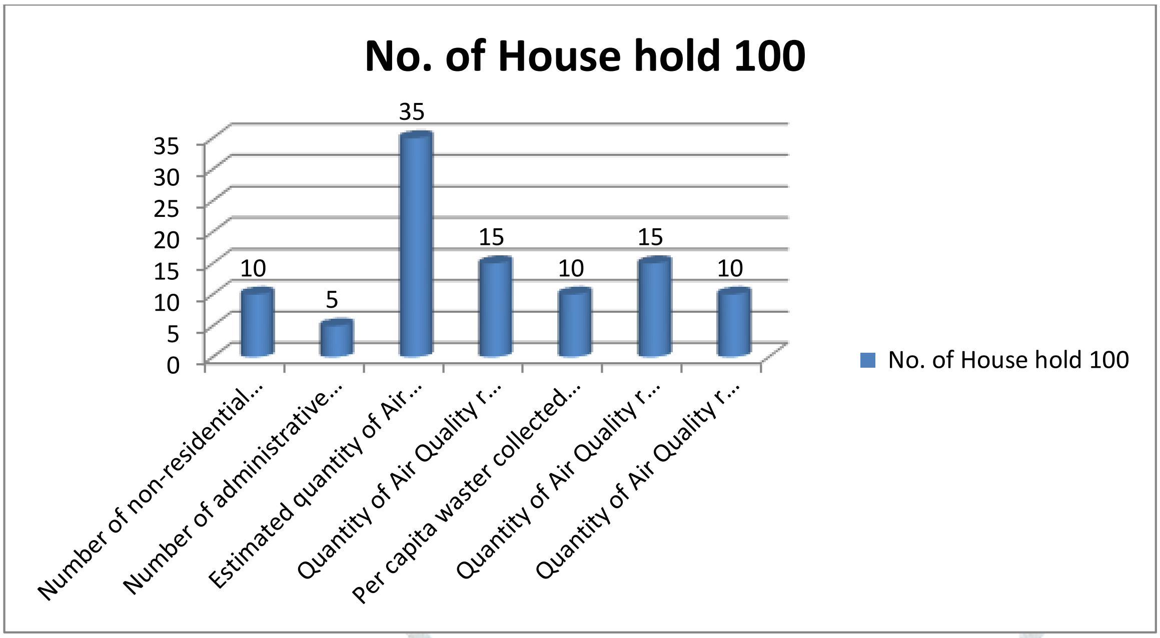


Table 2 shows : Important Air Quality in Chapra: Generators and Types

Sources	Generators of Waste	Types of Solid Waste
Residential/Household Area	Individual House, Apartments etc.	Food Waste, Paper, Plastic, Textiles, Leather, Wood, Glass, Metal, Ash, Electronic Waste (Computer, Television, Phone etc.), Tyres, Household hazardous waste such as paints, aerosols, motor oil, cleaning waste, gas tanks waste containing mercury, Special types of waste like batteries, oil, heavy consumer able items.
Commercial Area	Hotels, Shops, Restaurants, Markets etc.	Food Waste, Paper, Plastic, Electronic Waste, Wood waste, Metal, Special Waste, Hazardous Waste, Glass etc.
Institutional Area	School, College, Hospital, Government Building and Offices etc.	Almost Same as above mentioned Commercial Waste

Construction and Demolition Sites	Road, New building (Government and Private), Renovation sites, Demolition of Old Building etc.	Metal like iron, steel, aluminium, Wood, Concrete, Bricks, Tiles, Plastics Packets etc

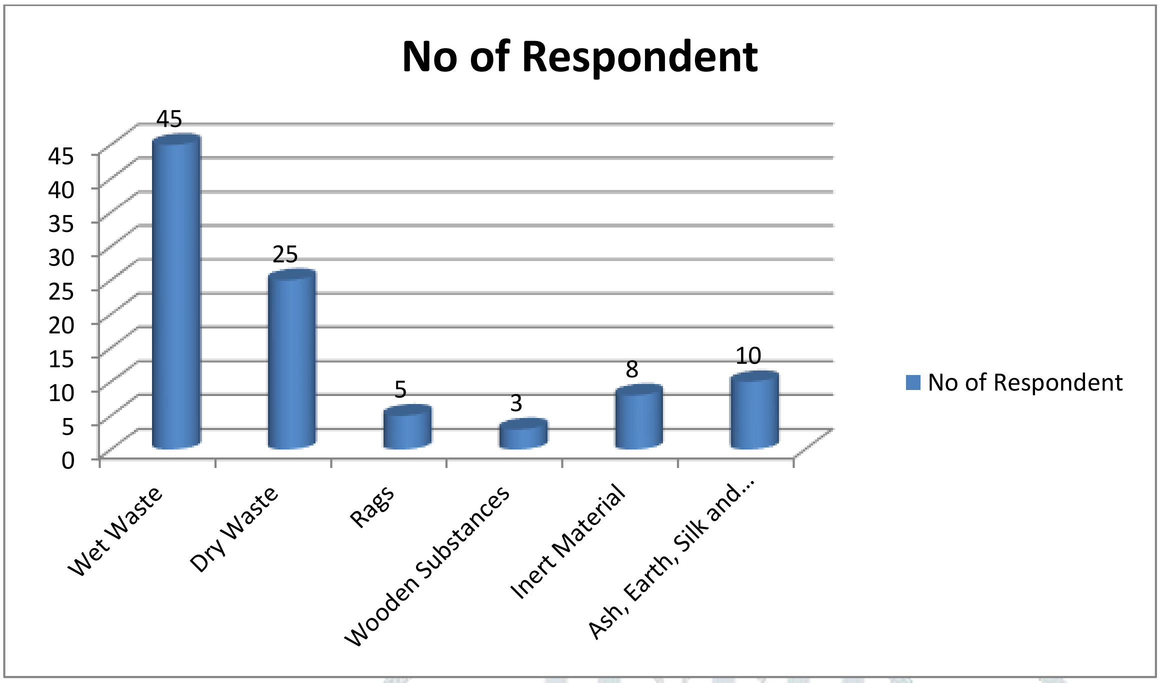
Physical components analysis (in average) of waste in Chapra based upon the sample survey provided by Municipal Corporation of Chapra, are as below:

Table : 3 shows Municipal Corporation of Chapra, are as below:

Sl No	West type Air Pollution	Average Percentage (%)
1	Wet Waste	45-50
2	Dry Waste	25-30
3	Rags	05-06
4	Wooden Substances	03-05
5	Inert Material	08-10
6	Ash, Earth, Silk and Construction as well as Demolition Waste	10-12
7	Garden Waste	01-03 (Depends on Heavy Plants)
	Density of Total Waste	s/m3

Table 3 shows municipal information regarding the different types of air pollution and their average percentages is as follows: Wet Waste: 45-50%, Dry Waste: 25-30%, Rags: 5-6%, Wooden Substances: 3-5%, Inert Material: 8-10%, Ash, Earth, Silk, Construction, and Demolition Waste: 10-12%, Garden Waste: 1-3% (Depends on Heavy Plants), Additionally, the density of total waste is reported to be between 370-410 kilograms per cubic meter (kgs/m³).

Table : 3 shows Municipal Corporation of Chapra, are as below:



Discussion

This section compels us to confront the urgent issue of air pollution in Chapra's residential neighborhoods. The well-being of resident's hinges on implementing a multi-pronged approach. This includes stricter enforcement of regulations on emissions, promoting the adoption of cleaner technologies, expanding green spaces, and fostering public awareness. These measures are essential to safeguard public health and create a healthier living environment.

Air Quality Management in Chapra: Table 1 sheds light on various aspects of air quality management in Chapra, encompassing generation, collection, processing, and disposal. It reveals a daily generation of air pollutants estimated at 35 metric tonnes. While collection efforts capture around 15 metric tonnes, a significant portion remains unaddressed. This highlights the need for improved infrastructure and processes to effectively manage air quality in Chapra.

Composition of Air Pollutants in Chapra: Table 3 offers valuable insights into the composition of air pollutants in Chapra based on a survey conducted by the Municipal Corporation. Wet waste forms the largest component (45-50%), followed by dry waste (25-30%). Construction and demolition waste, ash, and inert materials also contribute considerably. Understanding this composition is crucial for developing targeted strategies to tackle different types of air pollution. For instance, initiatives to manage wet waste effectively can significantly reduce odours and bioaerosols, while stricter regulations on construction activities can minimize dust emissions.

Conclusion

1. The Critical Role of Air Quality in Chapra's Public Health Landscape: This study shines a light on the critical role that air quality plays in safeguarding public health within Chapra's residential areas. Air pollution poses a

significant threat, and its detrimental effects can have lasting consequences for residents' well-being. The urgency for immediate action is paramount to create a healthier living environment and prevent further health complications.

2. A Multi-Pronged Approach to Combat Air Quality Challenges - The research advocates for a comprehensive, multi-faceted approach to tackle air quality concerns in Chapra. This strategy should address various pollution sources and empower residents to become active participants in improving their surroundings.

3. Strengthening Regulatory Frameworks - A robust legal framework with stricter enforcement mechanisms is crucial to control emissions from industrial activities and vehicles. Regular inspections and appropriate penalties for non-compliance will deter polluters and encourage responsible practices.

4. Promoting Sustainable Practices and Infrastructure - Encouraging the adoption of cleaner technologies, such as electric vehicles and energy-efficient industrial processes, can significantly reduce emissions. Additionally, promoting the use of public transportation through improved infrastructure and service expansion can create a more sustainable transportation system, further minimizing air pollution.

5. Enhancing Urban Greenery - Increasing green cover plays a vital role in mitigating air pollution. Planting trees and promoting the development of urban green spaces acts as a natural filter, removing harmful pollutants from the air. Furthermore, implementing stricter measures to control dust emissions from construction activities is essential to prevent temporary spikes in air pollution.

6. Empowering Residents through Knowledge and Action - Regular health assessments, coupled with targeted awareness programs, can educate residents about the health impacts of air pollution. Equipping them with preventive measures, such as using air purifiers or wearing masks during periods of high pollution, can safeguard their well-being. Residents can also be empowered to advocate for stricter regulations and hold authorities accountable for air quality improvement initiatives.

7. Charting a Course for Long-Term Air Quality Management - Continuous monitoring of air quality in residential areas is paramount to assess the effectiveness of implemented mitigation measures. Further research is warranted to develop a long-term strategy for sustainable air quality management in Chapra.

8. Long-Term Health Impact Studies: Studies investigating the long-term health consequences of air pollution exposure on residents can provide valuable data for policymakers. Understanding the link between air quality and chronic health problems, such as respiratory illnesses and cardiovascular diseases, is crucial for prioritizing air quality improvement efforts and allocating resources effectively.

9. Community Engagement Initiatives: Developing and implementing community engagement initiatives can foster a sense of ownership among residents. This can be achieved through educational workshops, citizen science projects, and collaborative efforts to promote sustainable practices within communities. By encouraging active participation in air quality improvement efforts, a sense of shared responsibility can be fostered, leading to more sustainable solutions.

Recommendations

i. Strengthening regulatory enforcement to curb industrial emissions and vehicular pollution.

ii. Encouraging adoption of cleaner technologies and promoting public transportation.

iii. Enhancing green cover and implementing measures to mitigate dust emissions from construction activities.

iv. Conducting regular health assessments and awareness programs to educate residents about the impacts of air pollution and preventive measures.

Future Directions

Further research is warranted to continuously monitor air quality in residential areas and assess the effectiveness of implemented mitigation measures. Long-term studies focusing on health outcomes and community engagement initiatives can provide valuable insights for sustainable air quality management in Chapra (Bihar).

BIBLIOGRAPHY

1. World Health Organization. (2022). Ambient air pollution: A global assessment of exposure and burden of disease. https://www.who.int/publications-detail-redirect/9789241511353
2. Environmental Protection Agency. (2023). Air quality index (AQI) - A guide for the public. https://www.epa.gov/air-quality
3. American Lung Association. (2023). Health effects of air pollution. https://www.lung.org/research/sota/health-risks
4. Centre for Science and Environment. (2023). Strategies for controlling air pollution. https://www.cseindia.org/page/air-pollution
5. Central Pollution Control Board (CPCB). (2022). Daily Air Quality Index (AQI) Bulletin.
6. Bihar State Pollution Control Board (BSPCB). Annual Reports on Air Quality Monitoring.
7. Environmental Protection Agency (EPA). Air Quality Index (AQI) Guide.
8. World Health Organization (WHO). Ambient Air Pollution: A Global Assessment of Exposure and Burden of Disease.
9. Gupta, R., & Sharma, S. "Outdoor and Indoor Air Pollution: A Review of Sources, Health Effects, and Mitigation Strategies." Journal of Environmental Health Science and Engineering, vol. X,
10. Singh, A., et al. "Impact of Air Pollution on Respiratory Health: A Case Study of Chapra, Bihar." Environmental Monitoring and Assessment, vol. X,
11. https://www.accuweather.com/en/in/chapra/187230/air-quality-index/187230
12. https://www.accuweather.com/en/in/patna/202349/air-quality-index/202349
13. Times of India.

14. (2023, October 26). Many Bihar cities record AQI over 300; BSPCB tells DMs to enforce laws to check air pollution https://timesofindia.indiatimes.com/videos/news/air-quality-alert-patna-surpasses-delhi-aqi-hits-500/videoshow/105169195.cms.

15. https://www.businesstoday.in/weather/chhapra-weather-forecast-today

16. https://www.aqi.in/in/dashboard/india/bihar/patna.