

Trends of Air Quality Deterioration and Industrial Polluting Activities in Indian Weaver city, Panipat

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Abstract

The IPCC (AR6) report predicts a global temperature rise of 1.5°C over the next 20 years, leading to climate-related changes. Fossil fuels, such as coal, oil, and gas, contribute significantly to greenhouse gas emissions, reducing the built environment's capacity to absorb negative externalities. Human activities like industrialisation, urbanisation, and poor waste management exacerbate environmental health risks and pollution, particularly in less developed nations. India's air quality has deteriorated from 8th place in 2022 to 3rd place in 2023, as shown in the World Air Quality Report, with Haryana scoring highest in the northern region. Addressing these hazards necessitates local risk identification and mapping. This study investigates the impact of hazardous polluting activities in Panipat, India's "City of Weavers" or "Textile City." Through trade openness, the city generates 192 crore turnovers for the state government and exports worldwide. The study collects reports like the Comprehensive Environmental Pollution Index and the WHO's Air Quality Life Index to analyse the impacts on residents. A primary survey was also conducted in Panipat City from 2022 to 2023, revealing medical expenditure and deterioration in health conditions due to pollution and bad weather conditions. The study aims to identify the causes and extent of industrial hazardous polluting activities responsible for these issues. Local-level problems can be resolved through active stakeholder participation, like the Panchayat, industry personnel, government officials, Public awareness and strict complaint rules for polluting activities.

Keywords: Air Quality, CEPI, Pollution, Case study, Textile city Panipat, India

1. Introduction

“Industrialization causes not only global environmental problems but also severe local environmental problems. The processes that increase greenhouse gas emissions also lead to other types of air pollution whose impact is more local”- **World Bank Report (2013)**

Pollution is a leading environmental risk factor for disease and premature death worldwide (Lancet Commission on Pollution and Health Report, 2015), accounting for 9 million premature deaths and fatalities annually (Global Burden of Diseases Report, 2019). Industrial activities have significantly impacted the environment through waste generation, resource greenhouse gas emissions, and consumption, causing harm to surrounding environments from hazardous industrial production processes (Taiwo et al., 2014). The continuous increase in atmospheric particulate matter (PM_{2.5}) negatively impacts environmental conditions, air quality, and human well-being, particularly in less developed nations (Di et al., 2020; Feng et al., 2023).

As per the Particulate Matter (PM) basics directory of US EPA (2024), a combination of solid and liquid airborne particles, such as dust, dirt, soot, and smoke, is known as particulate matter, or PM and some solid airborne particles are visible to the naked eye. Still, some can only be seen by electron microscopes. The primary source of airborne pollutants in the environment is anthropogenic activities like production processes in thermal power plants, industries, and vehicles. The Intergovernmental Panel on Climate Change (IPCC) sixth assessment report released in 2021 predicts a global temperature rise of 1.5°C over the next 20 years, leading to climate-related changes. Fossil fuels, such as coal, oil, and gas, contribute significantly to greenhouse gas emissions, reducing the built environment's capacity to absorb negative externalities. As a

result, climate-related changes occur. Various anthropogenic activities like industrialisation, pesticide use, agricultural residues, urbanisation, forest fires, and poor waste management exacerbate environmental health risks and pollution, particularly in less developed nations.

India, a developing nation, ranks 3rd out of 100 most polluted cities globally, with 83 cities of the most contaminated air (World Air Quality Index (AQI) Ranking, 2023). Since 2015, low- and middle-income countries have accounted for over 90% of pollution-related fatalities worldwide (UNIDO, 2023). The government aims to achieve zero net carbon emissions by 2070, with the built environment playing a crucial role in achieving this goal (COP 26). Today's built environment could be more efficient, polluting, and resource-intensive. A seven-fold increase in emissions is predicted for India, making it necessary to implement climate-resilient designs and encourage material circularity, green buildings, and climate-proof buildings (Ness, 2023). The Indian economy, a developing nation, has experienced a 0.7°C increase in average temperature between 1901 and 2018, resulting in 2,267 fatalities and \$66,182 million in economic damages (WHO, 2019). To capture emerging risks associated with industrial hazardous production activities, it is necessary to identify or map hazards and risks at the local level. Rapid urbanisation and industrialisation create obstacles to sustainable development at the regional level, with adverse effects of climate change due to carbon emissions.

This study uses primary and secondary-level data to examine the local impacts of hazardous polluting activities in the textile city of Panipat, Haryana State. A town known as Indian Weaver City ranked 60th out of 690 most air-polluted districts globally in the WHO's Air Quality Life Index and 11th out of India's 100 most polluted industrial clusters in 2018 in the Comprehensive Environmental Pollution Index (CEPI) released by the Central Pollution Control Board (CPCB). The study uses primary and secondary-level data, including secondary air quality data from IQ Air for India and Panipat City from 1995 to 2021 and the CEPI score released by CPCB. Therefore, to capture the impacts, this study has four sections. The first section is related to the literature review, the second is related to pollution extent at the national (India) and sub-national (Haryana) levels, the third is associated with Air quality and CEPI score of Panipat (weaver) city and the fourth section is related to a case study in Panipat city to know the industry installation impact on neighbourhood villages. To capture the effect of air quality and environmental deterioration, a case study of the village Khukhrana (Panipat City) from the primary level of data collection has been discussed. At last, the study reveals that rapid urbanisation and industrialisation create obstacles to attaining sustainable development at the local level, with adverse effects of climate change due to carbon emissions in the air.

2. Literature Review

Airborne pollutants such as nitrogen oxide, ammonia, mercury, and carbon dioxide are released during industrial processes such as cement manufacturing, power, waste management, and raising cattle. These activities harm the environment, human health, water, air, and soil. There is literature that associates atmosphere particulate matter (PM) emissions with higher death rates, cancer of the lungs, and heart and respiratory illnesses (Curtis et al., 2006; Fontes et al., 2017) and impacts on health due to polluted air got attention worldwide. According to studies on epidemiology, in 2010, there were 223,000 cancer-related fatalities worldwide (Feng et al., 2018). Particulate matter with 2.5 µm or less aerodynamic dimensions is classified as PM_{2.5}. Sources of the contamination may be located, and health impacts (Nagy & Szabó, 2017) can be explained using the surrounding particulate matter chemical structures. The research emphasises how important it is to address particulate matter pollution on a localised scale to save the health of humanity (Bi et al., 2020).

Each year, hundreds of premature deaths are brought on by these emissions, which can cause diseases including asthma, bronchitis, cancer, and heart failure. In 2019 alone, India experienced an estimated 1.2 million air pollution-related premature deaths. At the same time, India's growing economy is driving CO₂ emissions, which increased by more than 55% in the last decade and are expected to rise by 50% by 2040. Today's energy choices matter for future development, as they have direct and far-reaching implications for the lives of a growing population. Energy-related air pollutants and CO₂ emissions often arise from the same sources. Therefore, adopting an integrated approach to tackle both can deliver essential co-benefits.

Although there have been decreases in the number of deaths brought on by severe poverty, the number of deaths brought on by toxic chemicals and ambient air pollution has climbed by over 66% since 2000 and by 7% since 2015. Low- and middle-income countries (LMICs) bear the brunt of the economic losses resulting from pollution, accounting for 92% of fatalities linked to pollution. In the 21st century, developing nations face challenges due to limited access to healthcare and

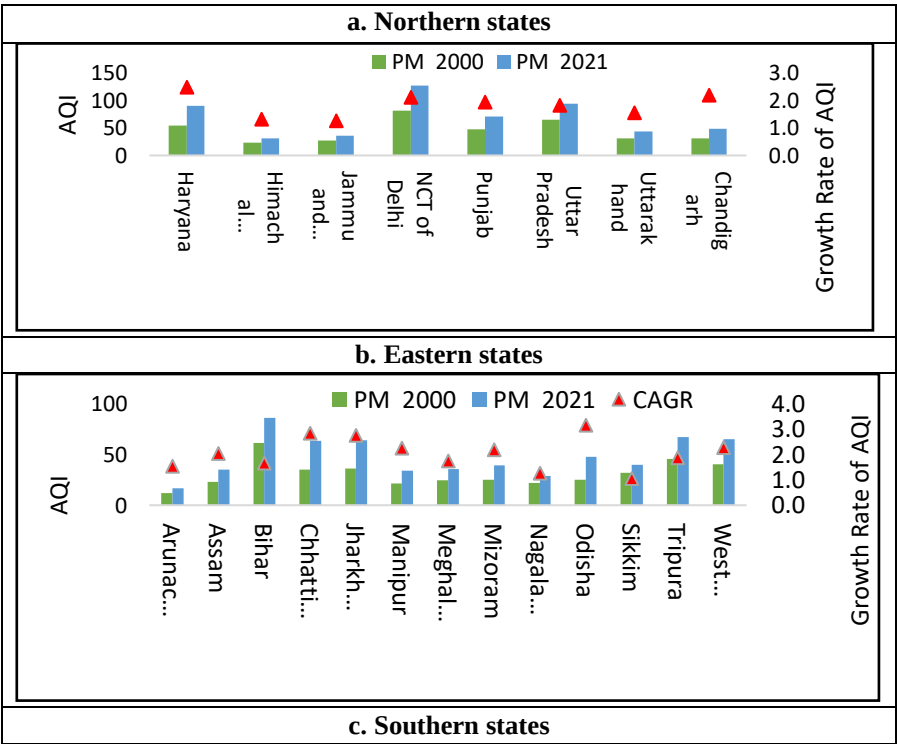
education (Curtin & Parker, 2014; Standish et al., 2014; Bundschuh et al., 2017; Smith, 2019). Air pollution has recently become one of India's most severe social and environmental issues. Simultaneously, the nation is witnessing indications of an increasingly hotter environment, which might have disastrous long-term consequences. Fundamental to both situations is fuel combustion connected to energy. This is the most significant contributor to India's carbon dioxide and its primary three airborne pollutants: nitrogen oxides (NO sulfur dioxide (SO₂) and PM_{2.5} levels). Public wellness has severe consequences when particulate matter emissions in numerous areas consistently above advised national and international levels (IEA, 2021).

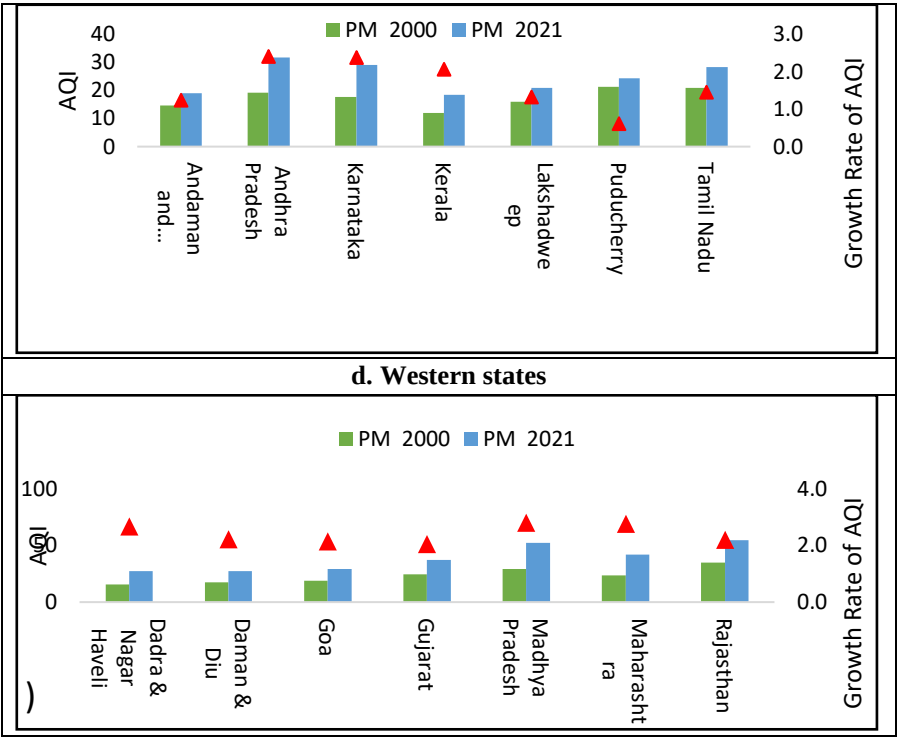
The significant contributor behind this is considered rapid urbanisation and industrialisation, which create obstacles to sustainable development at the national and local levels and have the adverse effects of climate change due to carbon emissions. As global temperatures continue to rise, the UN COP 26 conference suggested action to limit global temperatures to 1.5°C or below by the end of this century. The warming climate and hot weather are widely revealed to negatively impact human activities and well-being (Cisse et al., 2022). They can increase thermal discomfort, reduce labour capacity and increase mortality. High levels of poverty and inequality effectively address these challenges (World Bank, 2023). A competitive environment and unprecedented economic development pressures can lead to disregard for environmental regulations, leading to pollution and climate change.

3. Indian States Air Quality and Causes

In the context of the Indian economy, the effects of pollution are shown by the World Air Quality Report (2023), which reveals that India ranks 3rd out of 100 most polluted cities globally, with 83 having the most contaminated air, indicating a deteriorating air quality in the country, up from 8th place in 2022. The following figures show the air quality of all states by the existence of particulate matter (PM 2.5) in the local environment, and the intensity of this pollutant is measured by the Compound Annual Growth Rate (CAGR) from 2000 to 2021. To help in understanding the spatial distribution of contaminants in the atmosphere and to determine the cities with the most significant concentrations of pollutants, the data offers the level of PM_{2.5} for many towns in Haryana in addition to their total population in lakhs as of 2021, shown in figure 1.

Figure 1: Air Quality of Indian States by PM 2.5 from 2000 to 2021 Time Period



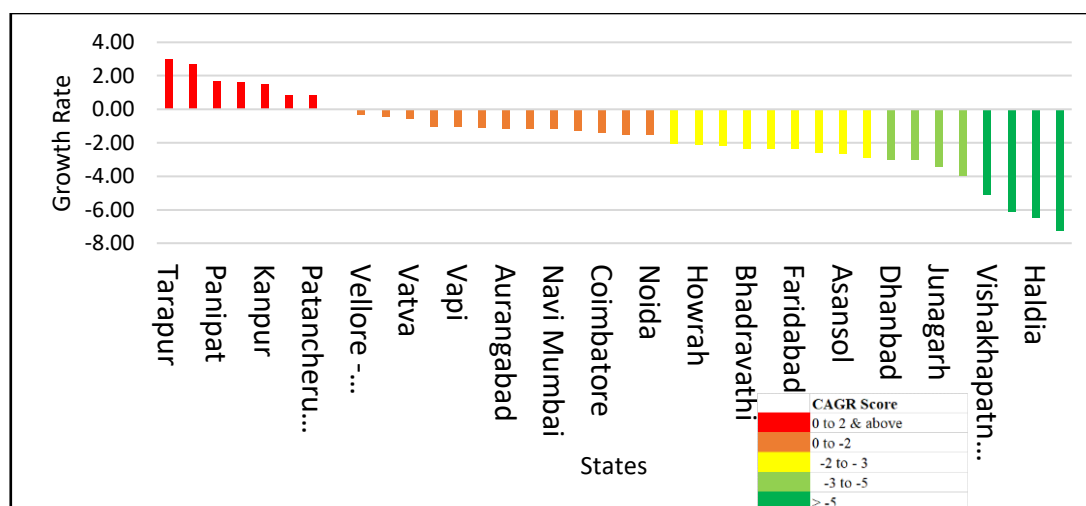


Source: Authors Calculation from Air Quality Index measure by Particulate Matter (PM2.5)

In the figure mentioned above, the Northern region of India, Haryana (2.5%), Chandigarh (2.2%) and Delhi (2.1%) have the highest CAGR scores for PM2.5 levels, indicating an alarming increase in the deterioration of air quality and no such effective measures were adopted to correct. Meanwhile, the states of Himachal Pradesh, Jammu & Kashmir, and Uttarakhand exhibit modest deterioration (around 1.3 % to 1.6 %).

Besides, the picture of other states also is shown through this data. In the Eastern states, the three states, namely Odisha (3.1), Chhattisgarh (2.8), and Jharkhand (2.7), had scored the fastest rates of CAGR, revealing that rise in PM2.5 level, indicating the adverse health and environment conditions prevail here. Further, when calculated for the Southern states, Andhra Pradesh (2.4) and Karnataka (2.4) had the highest CAGR scores. In the western state, Madhya Pradesh (2.8), Maharashtra (2.8), and Dadra & Nagar Haveli (2.7) have had the fastest growth rate in PM2.5 levels, which suggests considerable deterioration in the air quality. In cities where PM2.5 levels are high, immediate action is required to prevent various types of health issues, such as respiratory and cardiovascular illnesses. Enhancing green transportation, lowering industrial emissions, and enforcing stringent air quality standards can all help enhance the air quality. Raising community action and educating the public about the risks associated with elevated PM2.5 levels can also help improve air quality. But the picture needs to be clarified here as air quality deterioration can happen in various ways, such as in vehicles, households, etc., and the problems are generated as an outcome of the bad health of the public and the environment that has to be addressed immediately. Now, to go in-depth analysis, the study used the CEPI score, which is the Comprehensive Environmental Pollution Index (CEPI) released by the Central Pollution Control Board (CPCB), and it indicates the pollution extent in a particular city at land, air and water. It will help us to identify the reason behind the deterioration of quality not only of air but also of land and water and to know whether this industrial cluster has contributed.

Figure 2: CEPI Score of Growth Rates of States from 2009 to 2018



Source: CEPI Score from 2009 to 2018 released by CPCB

Figure 2 shows the cities with the highest CEPI scores from 2009 to 2018 and CAGR for knowing the growth rates, which reveals how much cities are concerned about working in a polluted environment. In the graph, green colour (both light and dark) indicates that the cities had adopted corrective measures for bettering environmental quality; thus -5 to -3 shows the reduction in hazardous pollutants and Jharsuguda (metallurgical industrial hubs), Haldia (agrochemicals, chemicals, petrochemicals and oil refineries industrial hub), Angul Talcher (Coal-rich industrial hubs), Vishakhapatnam (petrochemicals, fertiliser, sugar, and jute industrial hubs), Kobra, Junagarh (agriculture, fish processing, and cement industrial hubs), Ahmedabad and Dhanbad (coal capital of India) cities etc., comes under to this core. The performance of these industries shows that they are taking well-adoption measures for cleaner technologies. The same is adopted by the cities with scores from 0 to -3 and demonstrated by the yellow and brown colours. Besides, the towns in red suffer from a highly critically polluted environment, as demonstrated by the increasing CAGR score from 0 to 3 (approx.). The growth rate performance of these cities shows that pollution is continuously increasing at air, water, and land levels, and these are not taking sufficient measures to reduce the pollution level, such as Tarapur, Nazafgarh Drain Basin and Panipat etc., shown by the table 1.

Table 1: Majorly Critically Polluted Cities in India

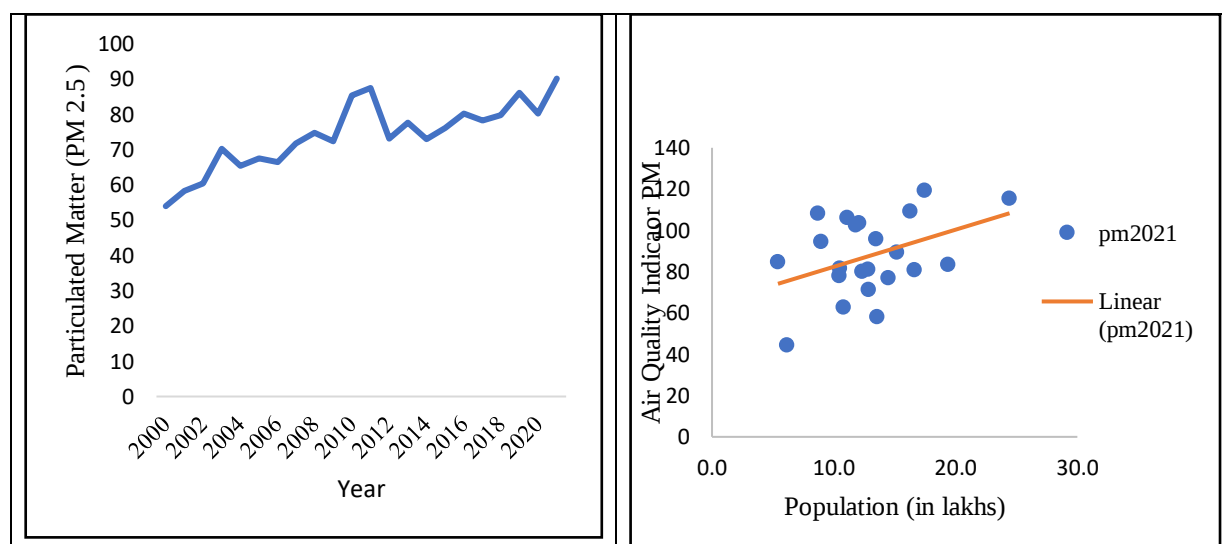
City	State	CEPI 2009	CEPI 2018	CAGR
Tarapur	Maharashtra	72.01	93.69	2.97
Nazafgarh Drain Basin	Delhi	73.09	92.65	2.67
Panipat	Haryana	71.91	83.54	1.68
Varanasi-Mirzapur	Uttar Pradesh	73.79	85.35	1.63
Kanpur	Uttar Pradesh	78.09	89.46	1.52
Jodhpur	Rajasthan	75.19	81.16	0.85
Patancheru Bollaram, (Telangana)	Andhra Pradesh	70.07	75.42	0.82

Source: Author's calculation

The data shows that the polluted environment exists majorly in the industrial clusters, but in the Northern region, Haryana is considered as the state of the agricultural base; instead, it performed a top position in air quality deterioration released by World AirIQ, 2023 and here also, performed under top 3rd position with the city, Panipat which is named as a weaver city and famous for as the handloom industries. To know the industrial background of Haryana state, the information given in the Haryana Statistical Yearbook 2023 shows that over the last few decades, urbanisation and industrialisation have increased in Haryana state. The state is the second-largest contributor of food grains to India's central pool and accounts for more than 60% of the export of Basmati rice in the country, the third-largest exporter of software and one of the preferred destinations for IT/ITeS facilities. Significant industries in Haryana are automotive, IT, agriculture and petrochemicals. Gurugram and Faridabad have the primary concentration of industries at around 43.6 %, and Yamuna Nagar, Panipat, and Sonapat come under a moderate concentration level, having around 26.2 %, with around 9 % or 1251 industrial units. Panipat City is one of the major industrial hubs in Haryana. The State Government has committed to creating a progressive business environment. With Haryana's structural transformation from an agrarian state to an industrial state and the services sector's recorded robust growth, the state has shown progressive development towards achieving sustainable development goals.

Besides, to know the pollution level in Haryana cities, the data was collected for air quality from 2000 to 2020, shown in Figure 3, which shows continuous air quality deterioration in the state. On the x-axis, the population size in lakhs, and on the y-axis, the Air Quality indicator PM 2.5 has been taken. Blue dots show the scatteredness (variability) of PM values with different population sizes. The orange line shows that in the population size and the environment quality of the state, there is a positive relationship, which suggests that as the population size increases, the indicator values of PM values also increase. A potential relationship can exist between population size and air quality, and other factors can also influence the PM level, such as transportation, households, etc. Therefore, the positive and linear relationship exists, as shown in the figure below. Most major industrial cities in the state, like Faridabad, Gurugram, Panipat, etc., have the highest population density in the towns with bad environmental weather conditions.

Figure 3: Trend of Particulate Matter in Haryana (2000-2021) and Population Growth and Air Quality (2021) in Haryana State



Source: Air Quality Index and Authors Calculation from Air Quality Index measure by Particulate Matter (PM2.5)

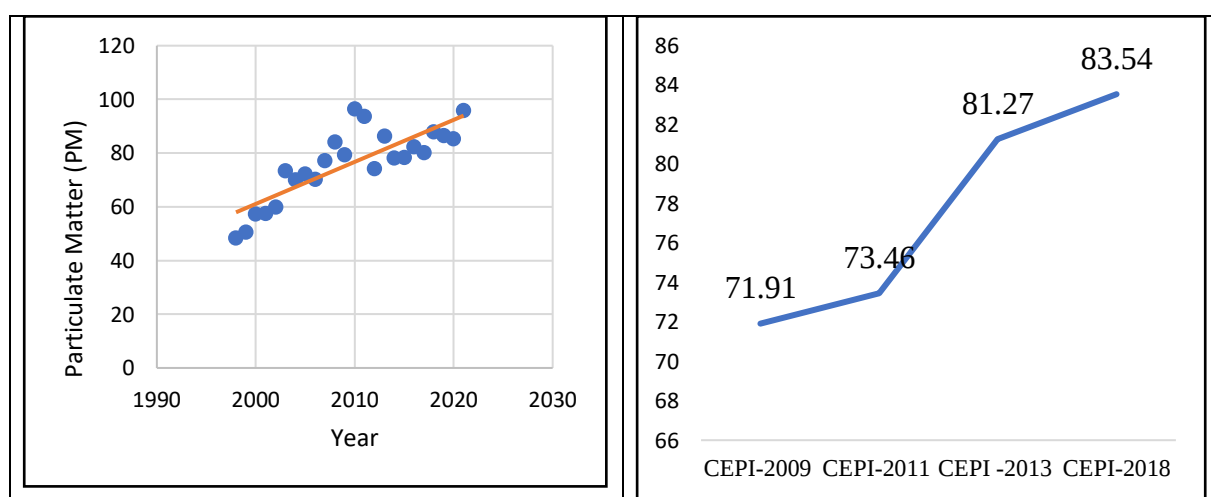
As a result, exposure to high levels of air pollution can harm the health of the citizens. It increases the risk of stroke, heart disease, chronic obstructive pulmonary disease, lung cancer and acute respiratory infections. The impact varies depending on the nature and concentration of pollutants, exposure, health, and age of the receptor. Air pollution also causes several mental health complications, such as impairment of cognitive abilities (Zhang et al., 2018), increased risk of Dementia and adverse effects on the development of an infant's brain (UNICEF, 2017). This upward tendency emphasises the necessity of efficient pollution control methods to alleviate these growing levels.

4. Air quality of Panipat City: Causes and Impacts

In this research study, Panipat district, a textile (weaver) city of Haryana State, has been chosen to analyse the impacts of hazardous polluting activities at the local level. The town has a textile looms base, and some central public sector units are also situated here. The Panipat Refinery (IOCL) is one of the largest refineries in South Asia. The industrial background of Panipat City has been taken from the Census (2011). It is famous for curtains, bed sheets, blankets, carpets, etc., and its handloom industries are well-known all over the world. . Statistically, the city has 3497 small and 39 large and medium-scale units, including 8 Major Hazardous units (MAH), three of which are large-scale public-sector projects, i.e. the Indian Oil Corporation oil refinery, the National Fertilizers Limited plant and the thermal power station. India's handloom district generates over Rs 4,000 crores and employs over two lakh people, accounting for over 50% of India's handloom exports and 75% of military barrack blankets (Panipat Gazetteer, 2015).

Besides, the socioeconomic environment has suffered greatly from over 8,000 industrial units. The trend of growing industries within the same population indicates the expansion of risks. The city scored 60th rank out of the most air-polluted 690 districts globally in the WHO Air Quality Life Index report (2021), which said the potential gain in life expectancy could be increased by up to 8.9 years for city residents if the pollution can be controlled up to the prescribed limit. At the national level, the city has scored 11th out of the 100 most polluted industrial clusters in India, as per the Comprehensive Environmental Pollution Index (CEPI) 2018, a nationwide assessment of industrial pollution levels based on air, water, and land quality for a particular region. The maximum allowable limit for a city's environmental carrying capacity is set at 70%, shown in Figure 4, and as per report conditionality, if any industrial clusters have a CEPI score higher than this limit, then it should be considered a critically polluted environment because an increasing value indicates an adverse environmental impact in an industrial region. It is also an indication of the irreversibility of the local environment. To capture the type of pollution and previous occurrences in Panipat city, the study is using secondary level data for environment quality from two sources, i.e., from the Central Pollution Control Board (CPCB), New Delhi, from 2009 to 2018 for the collection of the Comprehensive environment pollution index (CEPI) score shown in below figure, which provided a very insightful view for the critical level of Panipat city atmosphere and air quality. CEPI is a measure used to assess air, water, and land pollution in a region generated by industries. The city aggregates of CEPI scores recorded in the years 2009, 2011, 2013 and 2018 are 71.91, 73.46, 81.27, and 83.54, respectively, which is above the considerable limits in Panipat district, i.e., $CEPI > 70$, which is called the critical environment level as per the definition given by CPCB. The CAGR calculated, and its positive score, i.e., 1.68 (shown in Table 1), reveals that the city needs to adopt more measures to make a city pollution-free with its heavy industrial background.

Figure 4: Air Quality Index (1998 to 2021) and CEPI (2009-2018) in Panipat city



Source: Authors compilation IQAir for Particulate Matter (PM_{2.5}) in Air and CPCB reports for Panipat City reports released from 2009 to 2018 for CEPI score

The CPCB survey (2023) shows the picture of a hazardous environment, which inspected 924 gross polluting industries in Panipat City, with 413 sectors, or 45%, discharging untreated effluents into the Yamuna. About 181 polluting sectors were identified, with the Yamuna being the only river flowing through the district's eastern boundary. The District Disaster Management Plan highlights hazardous chemicals in chemical industries and oil refineries, potentially harming humans, plants, property, and the environment. This can be one of the results showing the city ranked 60th out of 690 air-polluted districts globally in the WHO's Air Quality Life Index due to heavy industrial concentration. Therefore, there is a need to study the causes behind these and the impacts on the population residing in Panipat. Before capturing the hazardous risks and effects, the study will try to understand the trend and pattern of the industrial sector growth rate in Panipat City. Further, the study will identify the emerging risks generated by this growth process. Also, we are taking the air quality capture from IQAir (1995-2021) release shown in Figure 4 that shows Panipat city is deteriorating due to a consistent increase in particle matter (PM), from 48.35 in 1998 to 95.8 in 2021, as shown. The highest PM level was recorded in 2010, reaching 96.37 degrees and peaks in 2010 (96.37) and 2021 (95.8), as per available data. This trend highlights the need for efficient pollution prevention policies; occasional brief drops are shown in the figures.

Now, we are taking both data, the CEPI score and air quality index data, to analyse the severity of environmental quality and determine the causes behind these. Over the years, Panipat has seen a steady rise in pollution, with PM levels almost tripling between 1998 and 2021 and a notable increase in CEPI scores between 2009 and 2018. This growth can be attributed to Panipat's industrial activity. A substantial contribution of PM levels to the total CEPI score is evident from the high PM levels observed in 2010 and 2011 (96.37 $\mu\text{g}/\text{m}^3$ and 93.63 $\mu\text{g}/\text{m}^3$, respectively), as indicated by the CEPI scores which shows in 2009 Panipat city score was 71.91 that increases 73.46 in 2011. This data gives us a comprehensive picture of the city's pollution level. Further, pollution intensity increases in years when PM (2.5) levels are high, as shown by CEPI 81.27 in 2013 and CEPI 83.54 in 2018. The severity of pollution can be seen in these periods; these are the critical pollution years. The above analysis of particulate matter (PM_{2.5}) and CEPI score indicates a persistent pollution problem in Panipat, as evidenced by the long-term pattern of rising PM levels and CEPI scores. The increasing scores point to increasing pollution, which may increase emissions, ineffective control mechanisms, and industrial activity. Excessive degradation of the environment with high CEPI assessments puts the environment, the sustainability of the environment, and human well-being at risk. The case study below reflects evidence related to these types of pollution.

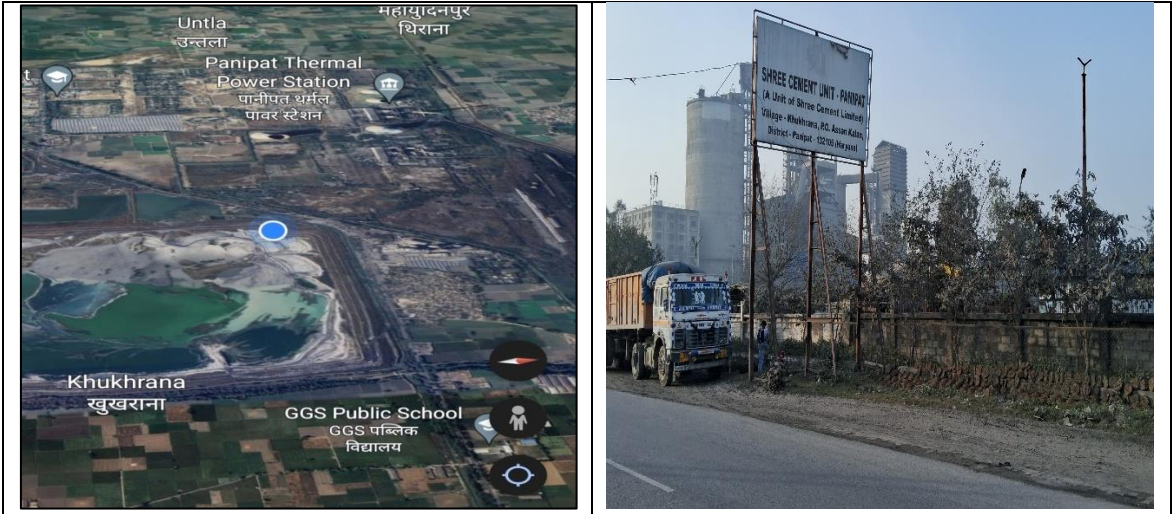
5. Industry and Neighborhood Village: A Case Study in Panipat City

The primary survey for the case study, Khukhrana village, was chosen near Panipat Thermal Power Station and the Shri Cement industry, as shown in Figure 9 and Figure 10. Based on our primary survey research, the study reveals that vulnerable groups, including women and elders, are most affected by health-related problems, with most elderly deaths due to heart-related diseases in the Khukhrana village of Panipat, as shown by the author in Figure 5. Non-communicable diseases like diabetes, high blood pressure, skin allergies, and breathing-related diseases like asthma and cough are common among people, especially women and old age people. According to an HPGCL survey (2010), a report evaluated the Ash Dyke Pond's effects on the air, groundwater, agriculture, and public health was the goal of this assessment for the Panipat Thermal Power Station that relies on coal as a fuel source also contribute to natural erosion, bottom ash, and fugitive dust emissions. Related to health, the results showed that chronic illness affects 36.12% of families in the villages of Khukhrana, Sutana, and Jatal.

The effects of air, water, and water pollution on land, livelihood, and health differ according to the direction of PTPS growth and the proximity to villages. In Assan Khurd and Khukhrana villages, 91.32% of homes use hand pumps to get their drinking water, and every household reports low water quality and inappropriate intake. Additionally, the survey found drinking water was unfit for consumption by 97.78% of the households in Khukhrana village, and 92.56% of the households in Untla village also stated the same. Just 22.18% of Assan Kalan families reported standard water colour, while 85.79% reported a salty taste. 66.66% of households blame cement or waste from power plants for the deterioration in water quality. Particularly in the villages of Khukhrana, Sutana, and Jatal, chronic ailments are common. 54.83% of families suffer from a chronic ailment, and 43.21% of Assan Kalan and 43.33% of Khukhrana report seeing a doctor three to four times a month. In all, more than four visits per month for different conditions were recorded by 65.60% of families. The survey revealed that the impacts of PTPS on land, livelihood, and health vary depending on the village's proximity and the direction of

expansion. The decline in water quality was attributed to residue from power plants or cement. It can be shown through the present status shown in Figure 5.

Figure 5: Khukhrana Village location



Source: Author visits to capture the site location close to Khukhrana village

The impact of industrial production activities that emit pollutants on the local environment is brought to light by our recent study in Panipat City, India's Khukhrana village. Our research shows that vulnerable populations like women and older people are most impacted, as shown in Figure 6. In addition, the study discovered during in-person interviews with the villagers that health-related issues have become more prevalent in daily life, with heart-related illnesses accounting for most deaths among the elderly. In the case study, the author interacted with residents and found that People frequently suffer from conditions like diabetes, high blood pressure, skin allergies, and breathing-related illnesses like asthma and cough. The elderly and women are more susceptible to coughs and asthma.

Figure 6: Industrial Project Affected Villagers in Panipat City



Source: Author’s interaction with villagers and Zee News (Haryana) covered news

Mainly, conditions like diabetes, hypertension, rashes, and respiratory disorders like asthma and cough are common in the general population. The elderly population are particularly susceptible to respiratory disorders like asthma and cough. As a result, the frequency of inhaler use has increased to two or three times daily. This has led to an asthmatic population and an increase in inhaler consumption, and the diabetic population has increased insulin consumption and more elderly deaths

than women and old age people. An older woman in a village shared her experience of polluted groundwater and ash dust, leading to high sugar levels and high blood pressure diseases, leading to the loss of her left eye. Despite seeking medical help, the woman questioned who was responsible for these issues, as they made land acquisitions for a better life rather than preserving dignity.

Figure 7: Pollution causes damages to Health and physical assets in the Village



Source: Author's visit to KhuKhraana village to capture the issues and damage conditions of physical assets in the village

An older woman (67 years old) living in a village shared her experience of the effect of polluted groundwater and ash dust in the air, which made their life hell in the town due to the closeness of industry. During our conversation, she disclosed that she had lost her left eye in the previous three to five years because of high blood pressure and sugar complications. Due to the lack of health-related facilities, as shown in Figure 7, outside the village, they make numerous attempts to see different physicians and hospitals, but all in vain. As they acquired land for a better life rather than the loss of our dignity, the woman questioned who was to blame for these problems. Therefore, identifying environmental risks is important because any natural or artificial disaster involves risks, hazards, and vulnerabilities that substantially negatively impact the economy, particularly for vulnerable populations like women and older people. They also result in significant losses of human and financial capital. This research study investigated and collected evidence from local levels of Panipat City and found that the local environment and residing population suffer in their daily activities. Without adequately assessing the social costs generated by industrial development projects, the output revenue should only be profit. This is earned at the expense of society's welfare.

6. Conclusion

If the development done for the betterment of the people just hinders their social well-being, then it should be considered a leakage in economic growth. This study examines India's air, water, and land environmental issues, focusing on Panipat City. The research reveals that pollution and hazardous waste from industrial sectors are causing living conditions to deteriorate, leading to land infertility and reduced property prices. In the last five years, 93% of families have reported health disorders, with 88% facing physical and 12% mental disabilities. Work-related illnesses have affected 84% of people, leading to 28% taking leave, 30% experiencing bed disability days, and 40% losing wages. Out of 46 deaths in household families, 28 were male, with the majority due to COVID-19 and fever. Premature deaths were around 33% in families. The research suggests that the government should prioritize the quality of life of the residing population, balancing environmental and human development activities. Enhancing green transportation, lowering industrial emissions, and enforcing stringent air quality standards can improve air quality and people's livelihood.

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