

Air Pollution and Public Health: An Analytical Study in Salem District, Tamil Nadu

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Abstract—Air pollution has become one of the most critical environmental and public health challenges in India, and Salem District in Tamil Nadu is no exception. Rapid urbanization, industrial growth, and the increasing number of vehicles have significantly contributed to the deterioration of air quality in the region. This study, aims to examine the major sources of air pollution, assess its impact on human health, and analyze the level of public awareness regarding air quality issues in the district. The research adopts a mixed-method analytical approach, combining both primary and secondary data. Primary data were collected from 300 respondents across urban and rural areas through structured questionnaires, while secondary data were obtained from government reports and environmental monitoring records. Statistical tools such as correlation and regression analysis were used to examine the relationship between air pollution levels and the incidence of respiratory and cardiovascular diseases. Qualitative interviews with healthcare professionals provided additional insights into the prevalence of pollution-related illnesses and local mitigation measures. The findings reveal that vehicular emissions, industrial discharges, and construction dust are the major sources of air pollution in Salem. The concentration of particulate matter (PM_{2.5} and PM₁₀) in several urban areas exceeded permissible limits, posing serious health risks. The study observed a higher incidence of asthma, bronchitis, and other respiratory problems among residents living near industrial and high-traffic zones. Furthermore, rural populations displayed lower awareness and fewer protective measures compared to urban residents, reflecting a need for targeted health education and environmental awareness programs. The study concludes that air pollution poses a significant threat to public health and calls for coordinated actions, including stricter emission control, promotion of clean energy, improved public transport, and continuous air quality monitoring. The research emphasizes that protecting air quality is essential not only for environmental sustainability but also for improving the overall quality of life and public health in Salem District.

Index Terms—Air pollution, Human Health issue, Environmental issue

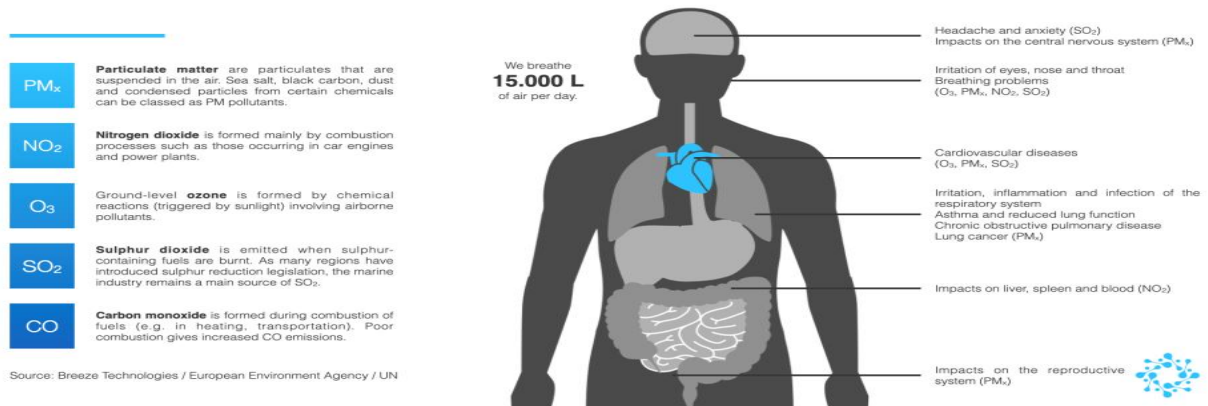
I. INTRODUCTION

In recent years, air pollution has become a significant concern in society due to its detrimental effects on the health impacts of air pollution on the Population. Air pollution is a pressing environmental concern that has significant implications for human health. The quality of the air we breathe plays a crucial role in determining our overall well-being. Unfortunately, the levels of air pollution have been on the rise in many regions around the world, posing serious health risks to populations exposed to contaminated air. Pollution consists of a complex mixture of harmful substances, including particulate matter (PM), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), ozone (O₃), and volatile organic compounds (VOCs). These pollutants are primarily emitted from industrial activities, vehicular emissions, power generation, and residential sources such as cooking and heating. When released into the atmosphere, they can have both short-term and long-term impacts on human health. The health effects of air pollution are diverse and can affect various organ systems within the body. Short-term exposure to high levels of air pollutants can lead to respiratory problems, such as asthma exacerbation, increased coughing, and irritation of the respiratory tract. Individuals with pre-existing respiratory conditions are particularly vulnerable to these acute effects. Moreover, long-term exposure to air pollution has been linked to chronic health conditions. Scientific studies have established associations between prolonged exposure to polluted air and increased risks of cardiovascular diseases, such as heart attacks, strokes, and hypertension. Air pollution has also been implicated in the development of respiratory diseases, including chronic obstructive pulmonary disease

(COPD) and lung cancer. Additionally, emerging research suggests that air pollution can have detrimental effects on other organ systems and health outcomes. Studies have shown links between air pollution and adverse pregnancy outcomes, such as low birth weight, preterm birth, and developmental issues in children. Furthermore, air pollution has been associated with impaired cognitive function and an increased risk of neurodegenerative diseases,

including Alzheimer's and Parkinson's diseases. The magnitude of the health impact of air pollution is significant and has prompted the attention of policymakers, public health agencies, and researchers worldwide. Efforts are being made to monitor and regulate air quality, implement emission control measures, and develop public health interventions to mitigate the health risks associated with air pollution exposure.

Main air pollutants and their health impacts



Human Health Effect

Numerous studies have been conducted to investigate the effects of air pollution on human health. 1. Respiratory Health Effects: Research consistently demonstrates that exposure to air pollution, particularly fine particulate matter (PM_{2.5}) and nitrogen dioxide (NO₂), is associated with an increased risk of respiratory problems. These include exacerbation of asthma, chronic obstructive pulmonary disease (COPD), respiratory infections, and decreased lung function. 2. Cardiovascular Health Effects: Air pollution has been linked to an increased risk of cardiovascular diseases, such as heart attacks, strokes, and hypertension. Long-term exposure to particulate matter and gaseous pollutants like ozone (O₃) and nitrogen oxides (NO_x) has been shown to contribute to the development and progression of cardiovascular conditions. 3. Adverse Pregnancy Outcomes: Pregnant women exposed to air pollution are at a higher risk of adverse outcomes, including preterm birth, low birth weight, and developmental issues in children. Maternal exposure to pollutants like PM_{2.5} and polycyclic aromatic hydrocarbons (PAHs) has been associated with these negative pregnancy outcomes. 4. Neurological and Cognitive Effects:

Emerging evidence suggests that air pollution may have detrimental effects on the central nervous system. Long-term exposure to fine particulate matter has been linked to cognitive decline, neuroinflammation, and an increased risk of neurodegenerative disorders like Alzheimer's and Parkinson's diseases. 5. Cancer Risk: Certain air pollutants, such as benzene, formaldehyde, and polycyclic aromatic hydrocarbons (PAHs), are classified as carcinogens. Prolonged exposure to these pollutants, primarily from industrial emissions and vehicle exhaust, has been associated with an increased risk of lung cancer and other respiratory tract cancers. 6. Children's Health: Children are particularly vulnerable to the effects of air pollution due to their developing respiratory and immune systems. Studies have shown that exposure to pollutants like PM_{2.5} and NO₂ can lead to respiratory symptoms, impaired lung function, increased asthma prevalence, and long-term impacts on cognitive development. 7. Mitigation Strategies: The literature also explores various strategies to mitigate the health impacts of air pollution. These include implementing stricter emission standards for vehicles and industries, promoting the use of clean energy sources, improving urban planning to reduce exposure, and raising public

awareness about the health risks of air pollution. It is important to note that this summary only scratches the surface of the vast body of literature on air pollution and its health effects. Researchers continue to

investigate the complex interactions between different pollutants, the underlying mechanisms of harm, and the effectiveness of mitigation measures to protect public health.

Short- term effect and long-term effect image



II. AIR QUALITY INDEX

The Air Quality Index (AQI) is a measure of how polluted the air is in a particular location. It is a standardized system used by governments and environmental agencies around the world to provide information about the quality of the air we breathe. The AQI provides a numerical value that represents the level of air pollution and the corresponding health effects. The AQI takes into account several pollutants that are commonly found in the air, including ground-level ozone, particulate matter, sulfur dioxide, nitrogen dioxide, and carbon monoxide. These pollutants can have varying levels of health effects, depending on their concentration and duration of exposure. The AQI ranges from 0 to 500, with higher

values indicating more severe air pollution and increased health risks. AQI values between 0 and 50 are considered good, while values between 51 and 100 are moderate. AQI values between 101 and 150 are unhealthy for sensitive groups, and values between 151 and 200 are considered unhealthy for everyone. Values between 201 and 300 are very unhealthy, and values over 300 are considered hazardous. The AQI is an essential tool for individuals and public health officials to monitor air quality and make decisions about outdoor activities and health precautions. It can also help identify areas of high pollution and guide policies and regulations to reduce emissions and protect public health.

Table:1.1-Air Quality Index Range

AQI Category Range	PM(2.5) 24- Hr	PM(10) 24- Hr	NO 24-Hr	O 8-Hr	CO 8 -Hr	SO 24- Hr	NH 24-Hr	PB 24-Hr
Good(0-50)	0-50	0-30	0-40	0-50	0-1.0	-	-	0-0.5
Satisfactory 51-100	51-100	31-60	41-80	51-100	1.1-2.0	-	-	0.5-1.0
Moderately 101-200	101-250	61-90	81-180	101-168	2.1-10	-	-	1.1-2.0
Poor 201-300	251-350	91-120	181-280	169-208	10-17	-	-	2.1-3.0

very poor 301-400	351-430	121-250	281-400	209-748	17-34	-	-	3.1-3.5
Severe 400-500	430+	250+	400+	748+	34+	1600+	1800+	3.5+

Source: EPA

The interpretation of the Air Quality Index (AQI) categories and their corresponding ranges for different pollutants is as follows: Good (0-50): This category indicates that the air quality is excellent and poses little to no risk to human health. The concentrations of PM_{2.5}, PM₁₀, NO, Ozone (O₃), Carbon Monoxide (CO), Sulfur Dioxide (SO₂), Nitrogen Dioxide (NO₂), and Lead (Pb) are all within safe limits. Satisfactory (51-100): The air quality is acceptable in this category, although some pollutants may be slightly elevated. It poses a minimal risk to human health. The concentrations of pollutants are slightly higher than in the Good category but still within acceptable limits. Moderately Polluted (101-200): The air quality in this category may start to have adverse effects on sensitive individuals. It is recommended to limit prolonged exposure. The concentrations of pollutants are noticeably higher than in the satisfactory category and may pose health risks to vulnerable populations. Poor (201-300): The air quality in this category is considered unhealthy for sensitive groups. It may cause respiratory discomfort and can have more significant health impacts on individuals with pre-existing conditions. The concentrations of pollutants are significantly elevated and can pose health risks to the general population. Very poor (301-400): The air quality in this category is considered very unhealthy, and it poses a high risk to human health. It can cause respiratory difficulties and may lead to more severe health issues. The concentrations of pollutants are substantially higher than in the Poor category. Severe (400-500): The air quality in this category is extremely hazardous and can have severe health effects on the entire population. It is recommended to avoid outdoor activities and stay indoors. The concentrations of pollutants are exceptionally high and pose significant risks to human health. The interpretation of the AQI helps individuals and authorities assess the quality of the air and take necessary precautions to protect public health. It provides guidance on when to limit outdoor

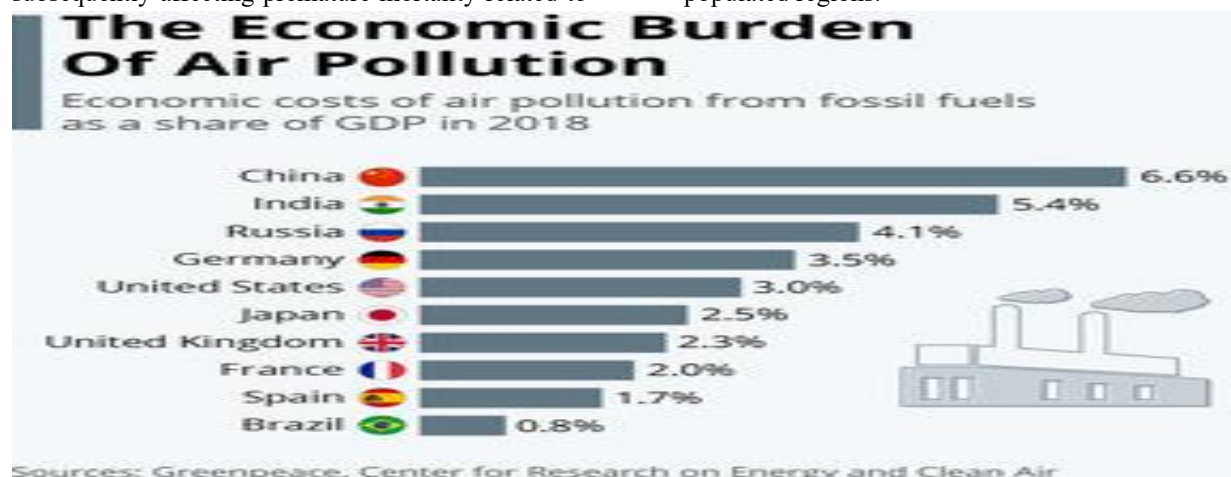
activities, wear protective masks, and implement measures to reduce pollution levels.

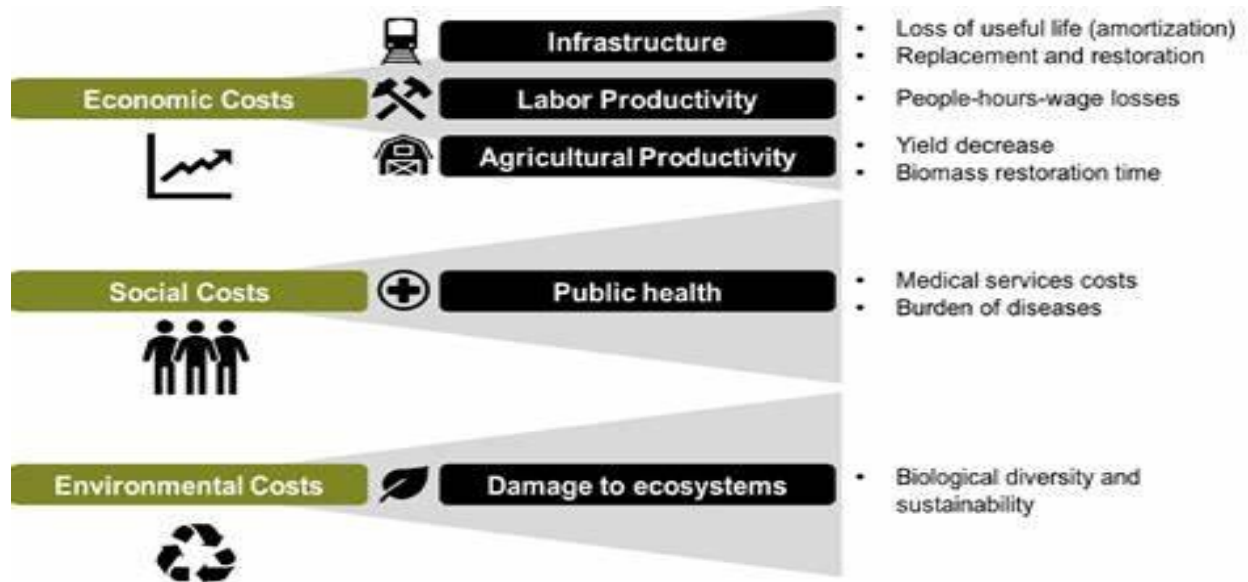
III. RELATED STUDY

Badami (2005) directed their attention towards the rapid growth of motor vehicle activity in India and other low-income countries experiencing rapid industrialization, which is leading to high levels of urban air pollution and various negative impacts on socioeconomic factors, environment, health, and welfare. This paper begins by examining the local, regional, and global consequences associated with air pollutant emissions resulting from motor vehicle activity in India. It explores the technological, behavioral, and institutional factors that have contributed to these emissions. Subsequently, the paper discusses the challenges associated with implementing various policy measures undertaken to address the issue, considering the policy context. Finally, the paper offers insights and lessons learned from the recent Indian experience, aiming to enhance understanding and more effectively tackle the problem of transport air pollution in India and similar countries while being considerate of their specific needs, capabilities, and limitations. Costabile et al. (2020) focuses on the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus responsible for COVID-19. The disease was first reported in December 2019 in Wuhan, China, and subsequently spread globally, leading the World Health Organization (WHO) to declare it a Public Health Emergency of International Concern. By April 2020, it became evident that the rate of spread and mortality varied significantly across different countries and regions, prompting questions about the role of atmospheric factors, particularly atmospheric pollution, in influencing the transmission and mortality rates of COVID-19. The complexity of this topic remains unresolved, and numerous urgent aspects require further investigation. Therefore, these

questions serve as ongoing challenges for current research endeavors. In this study, we specifically aim to address two aspects to shed light on critical gaps that are relevant for future research. **Gunasekaran et al. (2012)** - Air Pollution Monitoring in Salem Sowdeswari College Premises" Air pollution is a prevalent environmental issue in both developed and developing cities worldwide. Various studies have observed numerous pollutants in the environment, particularly focusing on gaseous and particulate pollutants. This paper aims to investigate the status and trends of key pollutants, namely Sulphur dioxide (SO₂), Oxides of Nitrogen (NO_x), Respirable Suspended Particulate Matter (PM₁₀), and Total Suspended Particulate Matter (PM₁₀₀), at Salem Sowdeswari College premises. The college has established an air quality monitoring station as part of the National Air Quality Monitoring Programme led by the Central Pollution Control Board in New Delhi. The monitoring activities encompassed a 24-hour sampling period, with 4-hour sampling intervals for gaseous pollutants and 8-hour intervals for particulate matter. The measurements were conducted three times a week, specifically on Mondays, Wednesdays, and Fridays, resulting in a total of 156 observations over the course of a year. This comprehensive approach aimed to gather robust data on the concentration levels of the monitored pollutants in the study area. Due to the lack of specific information beyond the monitoring methodology, the rewriting assumes a general summary of the research focus and monitoring approach. Fang et al. (2013) aimed to investigate how climate change influences surface concentrations of fine particulate matter (PM_{2.5}) and ozone (O₃), subsequently affecting premature mortality related to

air pollution. The researchers quantified the global changes in premature mortality and years of life lost (YLL) associated with variations in surface O₃ and PM_{2.5} throughout the 21st century due to climate change. To achieve this, they employed a global coupled chemistry-climate model to simulate both present and future climate conditions and examined the impact of evolving climate on air quality. Epidemiological concentration-response relationships were utilized to estimate the resulting alterations in premature mortality and YLL. To isolate the effect of climate change on air quality, emissions of air pollutants were held constant while allowing climate to evolve based on a moderate projection of greenhouse gas emissions (A1B scenario) for the 21st century. The findings revealed that changes in climate alone led to an increase in simulated PM_{2.5} concentrations worldwide, as well as higher or lower O₃ concentrations depending on whether the regions were populated or remote. The global annual premature mortality associated with chronic PM_{2.5} exposure exhibited an increase of approximately 100 thousand deaths (with a 95% confidence interval ranging from 66 to 130 thousand), while the corresponding YLL increased by nearly 900 thousand years (95% CI: 576 to 1,128 thousand). Furthermore, annual premature mortality linked to respiratory disease resulting from chronic O₃ exposure increased by 6,300 deaths (95% CI: 1,600 to 10,400). These findings highlight the climate penalty, indicating that more stringent emission controls will be necessary for the future to meet existing air quality standards and mitigate the heightened health risks associated with climate change-induced deterioration of air quality in populated regions.





IV. OBJECTIVE

- To measure the concentration levels of various air pollutants in different areas of Salem district.
- To investigate the prevalence of respiratory and cardiovascular diseases among residents of Salem district and assess their association with exposure to air pollution.

HYPOTHESES

- Higher levels of air pollution in Salem district are associated with an increased incidence of respiratory and cardiovascular diseases.

V. METHODOLOGY

This research will adopt a mixed-methods approach, combining quantitative and qualitative data. Air quality data will be collected from the Tamil Nadu Pollution Control Board and other relevant sources to determine the level of air pollution in Salem district. A survey will be conducted to assess the health outcomes of individuals living in areas with varying levels of air pollution. Additionally, in-depth interviews will be conducted with key stakeholders, including government officials, health professionals, and representatives from industry and civil society organizations, to gain insights into existing measures to mitigate air pollution and potential solutions to address the problem.

VI. RESEARCH GAP

Although several studies have examined the impact of air pollution on human health in India, few studies have focused specifically on the Salem district. This research aims to fill this gap and provide a comprehensive understanding of the effects of air pollution on human health in this region. Additionally, this research will identify potential solutions to mitigate air pollution and its effects on human health, which can inform policy decisions and interventions to improve the air quality in the Salem district.

VII. LIMITATION

Firstly, the study is limited by the availability and quality of data. While there are a number of sources of data on air pollution in Salem district, including monitoring stations and satellite imagery, there may be gaps or inconsistencies in the data that could impact the accuracy of the analysis. Secondly, the study is limited by the scope of the analysis. While this study focuses on air pollution in Salem district, there are many other factors that could impact human health in the region, including access to healthcare, diet, and lifestyle factors. Thirdly, the study is limited by the complexity of the relationship between air pollution and human health. Fourthly, the study is limited by the potential for bias. While efforts have been made to control for confounding variables and other sources of bias, there may be factors that are not fully accounted

for in the analysis fifthly, the study is limited by the generalizability of the findings. While the results of this study provide valuable insights into the impact of air pollution on human health in the Salem district, they may not be directly applicable to other regions or populations. Finally, the study is limited by the scope of the recommendations. While the results of this study can inform policy decisions and public health interventions aimed at reducing air pollution and improving public health, there may be additional factors that need to be considered in developing effective solutions. For example, political, economic, and social factors could impact the feasibility of implementing certain policies or interventions

VIII. CONCLUSION

In summary, has provided an overview of air pollution, including its definition, causes, impacts, and significance. It has highlighted the need for further research and action to address this global environmental challenge. The subsequent chapters will delve deeper into specific aspects of air pollution, providing a more detailed understanding and proposing potential solutions to mitigate its adverse effects.

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