# Air Quality and its Environmental Consequences: Evidence from Salem District, Tamil Nadu

**M. Poonkodi**

*Research Scholar, Department of Economics*
*Periyar University, Salem, Tamil Nadu, India*

**Dr. D. Janagam**

*Professor, Department of Economics*
*Periyar University, Salem, Tamil Nadu, India*

***Editorial history***

**Received:** 15.06.2025
**Accepted:** 28.07.2025
**Published Online:** 10.08.2025

***Cite this article***

Poonkodi, M and D Janagam (2025). Air Quality and its. *Journal of Advanced Research and Innovation, 1*(4), 19-32.

https://doi.org/10.5281/zenodo.19679800

**Abstract**

Air pollution poses a significant threat to public health, making it crucial to assess air quality comprehensively and understand its implications for communities. This study focuses on Salem district, where the assessment of air quality becomes essential to gauge the extent of pollution and its potential impact on residents' well-being. The first objective of this study is to measure the concentration levels of diverse air pollutants, encompassing Particulate Matter ($PM_{10}$ and $PM_{2.5}$), Sulfur Dioxide ($SO_2$), Nitrogen Dioxide ($NO_2$), and others, across different areas within the Salem district. By collecting and analyzing data on air quality, this research aims to provide a current and comprehensive evaluation of the district's air quality. Furthermore, it seeks to identify temporal trends and spatial variations in air pollution concentrations, shedding light on the dynamic nature of environmental factors affecting the region. The second objective of this study addresses the paramount concern for the health of Salem district's residents. Through an in-depth investigation, we aim to determine the prevalence of respiratory and cardiovascular diseases among the population. This investigation relies on the analysis of health data drawn from local hospitals and medical records. Additionally, this study endeavors to assess the potential correlation between the occurrence of respiratory and cardiovascular conditions and residents' exposure to air pollutants. By understanding the intricate relationship between air quality and public health, we can formulate effective public policies and interventions aimed at mitigating the adverse impact of air pollution on the well-being of the community.

***Keywords: Air Quality Assessment, Salem District, Air Pollutants, Environmental Issue Particulate Matter ($PM_{10}$, $PM_{2.5}$) Sulfur Dioxide ($SO_2$)***

## Introduction

Air pollution remains one of the most important environmental issue concerns across the globe, contributing to substantial premature mortality with a greater impact in developing nations (Mannucci and Franchini, 2017; Barzeghar et al., 2020). As per the World Health Organization (WHO), it has been estimated that 4.2 million premature deaths globally are linked to ambient air pollution. The pollutants with the strongest evidence for environmental issue concern include particulate matter ($PM_{2.5}$ and $PM_{10}$), nitrogen dioxide ($NO_2$), sulphur dioxide ($SO_2$) and ozone ($O_3$) (WHO, 2020).India being the second most populous country of the world, is severely burdened with the hazardous effects of air pollution. In a recent study, a mortality of 1.2 million and 38.7 million disability-adjusted life-years (DALYs) has been found to be associated with air pollution in India (Balakrishnan et al., 2019). As per the 'World Air Quality report-2019' on the basis of particulate matter (PM2.5), India ranks the fifth most polluted country in the world and dominated the list of the smoggiest urban areas, where 21 of the top 30 most polluted cities were from India (IQAir, 2019). Owing to increasing industrialization across the country, the progressive worsening of ambient air pollution remains a great challenge for sustainable development and public health reforms (Gordon et al., 2018).

In the dawn of 2020, the world was threatened by the pandemic of COVID-19, caused by a novel infectious virus of the coronavirus family, SARS-CoV-2. It started as a cluster of viral pneumonia cases in Wuhan, China and had an unprecedented spread all over the world. As on May 6th, 2020, the SARS-CoV-2 pandemic has resulted in 3,588,773 cases and 2,47,503 deaths globally, wherein, a total of 49,391 cases and 1,694 deaths were reported from India (WHO, 2020b). India, with a population of 1.3 billion, entered into a nationwide lockdown on 25th March, 2020, to break the chain of coronavirus transmission. The lockdown measures primarily focused on flattening the epidemic curve by restricting social contact which include closure of public transport including railways and roadways, the shutting down of international and domestic air travel, and the closing of industries and businesses, except for essential public services.

Global scientific reports are coming up on the effect of COVID-19-related lockdowns or reduced anthropogenic activities and changes in air quality parameters (Chen et al., 2020; Muhammad et al., 2020; Tobías et al., 2020; Xu et al., 2020). In India, the effect of lockdown on air quality has been majorly discussed in print media reports, however, scientific publication remains limited (Jain and Sharma, 2020; Mahato et al., 2020; Sharma et al., 2020). In this context, the present study aims to assess the changes in air quality parameters during the implementation of the lockdown measures in the four major metropolitan cities of India, viz., Delhi, Mumbai, Kolkata, and Chennai for a one-month period (15 days before lockdown and 15 days after the implementation of lockdown). The meteorological parameters were also assessed during this period to observe any significant natural climatic deviations, if any. 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 ($NO_2$), sulfur dioxide ($SO_2$), 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. Air pollution is a global concern with far-reaching implications for public health and environmental sustainability. In this context, the focus of this study is to measure the concentration levels of various air pollutants in different areas of Salem district, a region facing its own unique set of challenges related to air quality. Air pollution is a complex problem that affects both developed and developing nations. It has been linked to numerous health problems, including respiratory diseases, cardiovascular issues, and even premature mortality. Moreover, it has detrimental effects on the environment, contributing to climate change and the degradation of ecosystems. Salem district, situated in the southern Indian state of Tamil Nadu, is home to a diverse range of urban and rural areas, industries, and ecosystems. This diversity makes it an ideal location for a study on air pollution, as pollution levels can vary significantly across different regions and landscapes. The pollutants of primary concern in this study include particulate matter ($PM_{2.5}$ and $PM_{10}$), nitrogen dioxide ($NO_2$), sulfur dioxide ($SO_2$), and ozone ($O_3$). These pollutants are known to have adverse effects on human health and the environment, and their measurement is essential for understanding the extent of the air quality problem in Salem district. Several factors contribute to air pollution in this region, including industrial activities, vehicular emissions, agricultural practices, and natural sources. Therefore, a comprehensive assessment of air quality in Salem district is crucial for developing targeted strategies to mitigate pollution and protect the well-being of its residents. 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 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.

## Related Studies

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.

Tagris et al., (2009) potential health impact of ambient ozone and PM2.5 concentrations modulated by climate change over the United States is investigated using combined atmospheric and health modeling. Regional air quality modeling for 2001 and 2050 was conducted using the CMAQ Modeling System with meteorology from the GISS Global Climate Model, downscaled regionally using MM5, keeping boundary conditions of air pollutants, emission sources, population, activity levels, and pollution controls constant. Ben Map was employed to estimate the air pollution health outcomes at the county, state, and national level for 2050 caused by the effect of meteorology on future ozone and $PM_{2.5}$ concentrations. The changes in calculated annual mean $PM_{2.5}$ concentrations show a relatively modest change with positive and negative responses (increasing $PM_{2.5}$ levels across the northeastern U.S.) although average ozone levels slightly decrease across the northern sections of the U.S., and increase across the southern tier. Results suggest that climate change-driven air quality-related health effects will be adversely affected in more than 2/3 of the continental U.S. Changes in health effects induced by $PM_{2.5}$ dominate compared to those caused by ozone. $PM_{2.5}$-induced premature mortality is about 15 times higher than that due to ozone. Nationally the analysis suggests approximately 4000 additional annual premature deaths due to climate change impacts on PM2.5 vs 300 due to climate change-induced ozone changes. However, the impacts vary spatially. Increased premature mortality due to elevated ozone concentrations will be offset by lower mortality from reductions in PM2.5 in 11 states. Uncertainties related to different emissions projections used to simulate future climate, and the uncertainties forecasting the meteorology, are large although there are potentially important unaddressed uncertainties (e.g., downscaling, speciation, interaction, exposure, and concentration–response function of the human health studies). 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 (NOx), 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 (PM2.5) 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 PM2.5 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 PM2.5 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 PM2.5 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.

Orru et al (2017) studies that Air pollution significantly affects health causing up to 7 million premature deaths annually with an even larger number of hospitalizations and days of sick leave. Climate change could alter the dispersion of primary pollutants particularly particularte matter, and intensify the formation of secondary pollutants such ad near surface ozone. the purpose of the recent evidence on the impacts of climate change on air pollution and air pollution related health impact and future research. Modelled future ozone and particulate matter concentration and calculated the resulting health impacts under different climate scenarios. used and on projections of future air pollution emissions with relatively high uncertainty studies primary focused on mortality projections on the effects on morbidity. 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 ($SO_2$), Oxides of Nitrogen (NOx), Respirable Suspended Particulate Matter ($PM_{10}$), and Total Suspended Particulate Matter ($PM_{100}$), 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 (Srikanth, 2020) analyse that air pollution has been a visible concern that has increased significantly over the last decade across many part of India with severe consequences for human health. The Indian government as other many countries responded to the Covid 19 pandemic. Completed lockdowns that led to severe disruptions in economic activities. a beneficial short tern effect on the natural environment across cities was a redacting air pollution. This present a unique opportunity to integrate air pollution management into plans for economic recovery. This paper empirically examines the impact of imposing a 27-day lockdown on air pollution in India by comparing pollutant concentration data from 8 representative cities over matching periods of time during the lockdown with those of the previous year, and the National Ambient Air Quality Standards (NAAQS). This provides an opportunity to understand the maximum extent to which air pollution could potentially be reduced in these cities. Thereafter, these findings are analyzed in conjunction with city level socio-economic correlates and current air pollution management strategies, to gain policy insights on the scope for integrating improved air quality with economic recovery for a sustainable future. With city action plans having been recently prepared for improving air quality, this is indeed an appropriate time to conduct analyses to impact and bend the curve of air pollution substantially The current focus on public health provides an opportunity to concentrate on the management of air pollution as a critical component of public health management. Costabile et al. (2020) focus on the severe acute respiratory syndrome corona virus 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.

**Statement of the Problem**

Salem District, located in provides relevant geographical context is confronted with escalating concerns related to air quality and its consequential impact on the environment. Despite the evident signs of deteriorating air quality and the potential environmental repercussions, there is a distinct scarcity of in-depth research dedicated to comprehensively assessing these issues within this specific geographic region. This research problematizes the lack of localized investigation and analysis of the complex relationship between air quality and environmental effects in Salem District, highlighting the pressing need to address this gap in knowledge. Consequently, this study aims to elucidate the specific environmental challenges arising from air pollution in Salem District and contribute substantively to our understanding of the issue, ultimately guiding effective policy formulation and environmental management strategies. The evaluation of air quality in Salem District holds significant importance as it provides crucial insights into the extent of pollution and its consequential impact on the environment. It is imperative to meticulously measure the concentration levels of various air pollutants, including but not limited to Particulate Matter ($PM_{10}$ and $PM_{2.5}$), Sulfur Dioxide ($SO_2$), Nitrogen Dioxide ($NO_2$), among others. This comprehensive assessment aims to offer an up-to-date and thorough analysis of the region's air quality status. By doing so, the study intends to not only gauge current pollutant levels but also discern any discernible temporal trends or spatial disparities in air pollution concentrations within the Salem District.

**Objective of the Study**

To measure the concentration levels of various air pollutants in different areas of Salem district.

**Hypotheses**

Higher levels of air pollution in Salem district are associated with an increased incidence of environmental issues

**Materials and Method**

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.

**Study Area**

The study area covers five major locations in Salem, which is the steel city Tamil Nadu. Chennai is an area about 426 km2 which lies between geocoordinate 13.04°N to 80.17°Eon the southeast coast of India and in the northeast corner of Tamil Nadu. The data used in the model development was collected from the Tamil Nadu Pollution Control Board (Homepage: tnpcb.gov.in) from 2015 to 2021. Air Quality Index (AQI) is the value that measures the pollution level of the ambient air and it was measured based on four pollutants in air: Sulfur dioxide (SO2), Nitrogen dioxide (NO2), PM2.5 (particulate matter with a diameter less than 2.5 μm) and PM10 (particulate matter with diameter less than 10 μm)

**Research Gap**

The relationship between air quality and its environmental consequences within Salem District. While studies on air quality and its environmental impacts in broader contexts exist, there's a lack of comprehensive research that is geographically focused on Salem District. This research aims to bridge this gap by providing an in-depth analysis of the unique environmental challenges and effects of air pollution in this specific region, ultimately contributing valuable insights for localized environmental management and policy decisions.

**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.

**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

Table 1 shows the Air Quality Index (AQI) categorizes air quality into different ranges based on concentrations of various pollutants such as PM2.5, PM10, NO, O, CO, SO, NH, and PB. In the "Good" range (0-50 AQI), the air is excellent for daily activities, while the "Satisfactory" range (51-100 AQI) still poses minimal risks. The "Moderate" range (101-200 AQI) indicates increased pollutants, requiring caution, and the "Poor" range (201-300 AQI) suggests potential health concerns. "Very Poor" (301-400 AQI) and "Severe" (400-500 AQI) ranges pose significant and severe health risks, respectively, necessitating immediate protective measures like staying indoors and using air purification systems

**Table 2 Ambient Air Monitoring in Tamil Nadu**

| **Pollutant** | **$SO_2$** | **$NO_2$** | **$PM_{10}$** | **$PM_{2.5}$** |
|---|---|---|---|---|
| Average Time (Hours) | 24 | 24 | 24 | 24 |
| Standard | 80 | 80 | 60 | 100 |
| Moderately (101 -200) | 101 -250 | 61-90 | 81-180 | 101-168 |

Note: all units are in ug/m3 unless mentioned otherwise source: CPCB

The table 2 provides data on ambient air monitoring in Tamil Nadu, specifically measuring the concentration levels of four key pollutants: sulfur dioxide ($SO_2$), nitrogen dioxide ($NO_2$), particulate matter with a diameter of 10 micrometers or less ($PM_{10}$), and fine particulate matter with a diameter of 2.5 micrometers or less ($PM_{2.5}$). These measurements are reported over a 24-hour time frame. The table also includes the air quality standards set by regulatory authorities, which are expressed in micrograms per cubic meter (ug/m3) as follows: 80 $ug/m_3$ for both SO2 and NO2, 60 $ug/m_3$ for $PM_{10}$, and 100 $ug/m_3$ for $PM_{2.5}$. These standards, sourced from the Central Pollution Control Board (CPCB), serve as benchmarks for evaluating air quality.

In essence, the table's interpretation highlights that it presents crucial data on the levels of key air pollutants in Tamil Nadu, with a focus on $SO_2$, $NO_2$, $PM_{10}$, and $PM_{2.5}$, all measured over a 24-hour period. These measurements are compared against air quality standards established by the CPCB, with the aim of assessing whether the air quality in the region complies with the set standards or if it exceeds permissible limits. This information is vital for environmental monitoring and policy-making to ensure public health and environmental well-being.

**Table 3 Salem District Level Air Pollutant up to 2015 to 2020**

| Year | Pollutant | Level | Mixed (Sowdeswari ) | Commercial (Ram Nagar) | Industrial (SIDCO) |
|---|---|---|---|---|---|
| 2015 | $SO_2$ | Min | 6 | 5 | 6 |
| | | Max | 15 | 11 | 16 |
| | $NO_2$ | Min | 15 | 16 | 19 |
| | | Max | 36 | 45 | 49 |
| | $PM_{10}$ | Min | 41 | 17 | 19 |
| | | Max | 122 | 88 | 94 |
| | $PM_{2.5}$ | Min | 10 | 8 | 13 |
| | | Max | 29 | 37 | 46 |
| 2016 | $SO_2$ | Min | 5 | 5 | 6 |
| | | Max | 10 | 10 | 11 |
| | $NO_2$ | Min | 16 | 14 | 30 |
| | | Max | 36 | 16 | 41 |
| | $PM_{10}$ | Min | 38 | 19 | 21 |
| | | Max | 117 | 101 | 125 |
| | $PM_{2.5}$ | Min | 11 | ND | 13 |
| | | Max | 26 | ND | 58 |
| 2017 | $SO_2$ | Min | 6 | 5 | 5 |
| | | Max | 15 | 11 | 11 |
| | $NO_2$ | Min | 20 | 15 | 15 |
| | | Max | 43 | 33 | 58 |
| | $PM_{10}$ | Min | 41 | 18 | 20 |
| | | Max | 138 | 99 | 116 |
| | $PM_{2.5}$ | Min | ND | ND | ND |
| | | Max | ND | ND | ND |
| 2018 | $SO_2$ | Min | 5 | 6 | 6 |
| | | Max | 11 | 11 | 11 |
| | $NO_2$ | Min | 18 | 16 | 17 |
| | | Max | 43 | 32 | 36 |
| | $PM_{10}$ | Min | 27 | 19 | 20 |
| | | Max | 127 | 97 | 124 |
| | $PM_{2.5}$ | Min | 11 | 8 | 13 |
| | | Max | 54 | 56 | 58 |
| 2019 | $SO_2$ | Min | 4 | 5 | 5 |
| | | Max | 26 | 10 | 9 |
| | $NO_2$ | Min | 8 | 17 | 18 |
| | | Max | 42 | 33 | 36 |
| | $PM_{10}$ | Min | 21 | 18 | 17 |

| | | | | | |
|---|---|---|---|---|---|
| 2019 | $PM_{10}$ | Max | 183 | 74 | 244 |
| | $PM_{2.5}$ | Min | 13 | 15 | 15 |
| | | Max | 80 | 48 | 49 |
| 2020 | $SO_2$ | Min | 4 | 5 | 4 |
| | | Max | 23 | 10 | 13 |
| | $NO_2$ | Min | 9 | 16 | 11 |
| | | Max | 47 | 27 | 74 |
| | $PM_{10}$ | Min | 21 | 24 | 18 |
| | | Max | 128 | 75 | 60 |
| | $PM_{2.5}$ | Min | ND | ND | ND |
| | | Max | ND | ND | ND |

Table 3 presents air pollutant concentration levels in Salem District from 2015 to 2020, focusing on three distinct locations: Mixed (Sowdeswari), Commercial (Ram Nagar), and Industrial (SIDCO). The key pollutants measured include sulfur dioxide ($SO_2$), nitrogen dioxide ($NO_2$), particulate matter with diameters of 10 micrometers or less ($PM_{10}$), and particulate matter with diameters of 2.5 micrometers or less ($PM_{2.5}$). Notably, there are variations in pollutant levels both within and across years.

For sulfur dioxide ($SO_2$), the values fluctuated across the locations, with minimum levels ranging from 4 to 6 micrograms per cubic meter and maximum levels varying from 9 to 26 micrograms per cubic meter. Nitrogen dioxide ($NO_2$) concentrations also showed variations, with minimum levels ranging from 8 to 30 micrograms per cubic meter and maximum levels varying from 14 to 58 micrograms per cubic meter. Particulate matter levels ($PM_{10}$) demonstrated a similar trend, with minimum values ranging from 17 to 41 micrograms per cubic meter and maximum values varying from 17 to 244 micrograms per cubic meter, indicating significant differences between locations and years. However, for particulate matter with a diameter of 2.5 micrometers or less ($PM_{2.5}$), there are data gaps marked as "ND" (not determined), suggesting a need for more consistent monitoring in some years and locations. These data points underscore the importance of ongoing air quality monitoring efforts to assess environmental conditions, guide policy decisions, and protect public health in Salem District.

**Table 4 Variation in the Pollutants Before and After Lockdown in Salem District**

| Location | Period | $PM_{10}$ | $SO_2$ | $NO_2$ | $PM_{2.5}$ | AQI |
|---|---|---|---|---|---|---|
| Kondalampatti | Beforelockdown | 96 | 10 | 20 | 35 | 94.42 |
| | Afterlockdown | 56 | 9 | 19 | 25 | 56.67 |
| | Variation | -40 | -1 | -1 | -10 | -37.75 |
| | Variation(%) | -41.67 | -10.00 | -5.00 | -28.57 | -39.98 |
| Asthampatti | Beforelockdown | 95 | 11 | 21 | 35 | 97.49 |
| | Afterlockdown | 58 | 10 | 20 | 25 | 58.19 |
| | Variation | -37 | -1 | -1 | -10 | -39.3 |
| | Variation(%) | -38.95 | -9.09 | -4.76 | -28.57 | -40.31 |
| Suramangalam | Beforelockdown | 68 | 10 | 17 | 26 | 93.58 |
| | Afterlockdown | 43 | 9 | 16 | 19 | 46.43 |
| | Variation | -25 | -1 | -1 | -7 | -47.2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Suramangalam | Variation(%) | -36.76 | -10.00 | -5.88 | -26.92 | -50.38 |
| Ammapatai | Beforelockdown | 94 | 11 | 20 | 35 | 67.05 |
| | Afterlockdown | 46 | 9 | 18 | 22 | 46.44 |
| | Variation | -48 | -2 | -2 | -13 | -20.61 |
| | Variation(%) | -51.06 | -18.18 | -10 | -37.14 | -30.74 |

Table 4 presents a unique perspective on the impact of the COVID-19 lockdown on air quality in different locations within Salem District, as reflected in variations in pollutant levels before and after the lockdown period.

Remarkably, in Kondalampatti, there was a substantial reduction in PM10 levels by 41.67%, indicating significantly improved air quality post-lockdown. This improvement is also seen in other pollutants, with $SO_2$, $NO_2$, and $PM_{2.5}$ showing reductions of 10.00%, 5.00%, and 28.57%, respectively. The overall Air Quality Index (AQI) dropped by 39.98%, reflecting a substantial enhancement in air quality in this location during the lockdown.

In Asthampatti, a similar trend emerged, with PM10 levels declining by 38.95%, reflecting cleaner air. The reductions in $SO_2$, $NO_2$, and $PM_{2.5}$ by 9.09%, 4.76%, and 28.57% respectively, further underscore the positive impact of the lockdown on air quality. The AQI, representing overall air quality, decreased by 40.31%, signifying a notable improvement in Asthampatti's air quality during the lockdown.

Suramangalam witnessed a remarkable 36.76% decrease in PM10 levels, indicative of significantly improved air quality. The reductions in $SO_2$, $NO_2$, and $PM_{2.5}$ by 10.00%, 5.88%, and 26.92% respectively, complemented this positive trend. The AQI plummeted by 50.38%, suggesting a substantial and impressive enhancement in Suramangalam's air quality during the lockdown.

Finally, Ammapatai experienced a notable 51.06% decrease in $PM_{10}$ levels, representing a significant improvement in air quality. $SO_2$ and $NO_2$ reductions of 18.18% and 10.00%, respectively, further underscore this improvement. Despite a slightly lower decrease in $PM_{2.5}$ at 37.14%, the AQI decreased by 30.74%, signifying a considerable overall enhancement in air quality in Ammapatai during the lockdown.

In summary, these findings illustrate how the lockdown measures in response to the COVID-19 pandemic had a remarkable positive impact on air quality in different areas of Salem District, with substantial reductions in various pollutants and improved overall air quality during this unique period of restricted human activity.

**Findings and Conclusion**

The study found that on the Air Quality Index (AQI) categories and their associated pollutant concentration ranges. It reveals that as the AQI category advances from "Good" to "Severe," there is a gradual escalation in pollutant levels, including $PM_{2.5}$, $PM_{10}$, NO, CO, SO, NH, and PB. In the "Good" category, air quality is excellent with minimal health risks, while "Satisfactory" maintains acceptability. "Moderately" indicates moderate air quality with heightened pollutants, "Poor" signifies significant deterioration and health concerns, "Very Poor" represents severe health risks, and "Severe" indicates extremely hazardous air quality, demanding immediate protective measures. These findings emphasize the importance of monitoring and responding to AQI levels to safeguard public health.

The found the information on the average time frames (24 hours) for monitoring four key air pollutants ($SO_2$, $NO_2$, $PM_{10}$, and $PM_{2.5}$) in Tamil Nadu, alongside the air quality standards set by the CPCB (80 $ug/m_3$ for $SO_2$ and $NO_2$, 60 $ug/m_3$ for $PM_{10}$, and 100 $ug/m_3$ for $PM_{2.5}$). However, specific concentration data for these pollutants is absent, making it challenging to ascertain compliance with air quality standards. To draw concrete findings, additional data or context regarding pollutant levels in Tamil Nadu would be required to assess the region's actual air quality status.

In summary, table 2 offers information on the average time frames and air quality standards for $SO_2$, $NO_2$, $PM_{10}$, and $PM_{2.5}$ in Tamil Nadu. However, it lacks specific concentration data for these pollutants, making it difficult to draw definitive conclusions regarding compliance with air quality standards. Additional data or context would be necessary to assess the actual air quality conditions in the region The data table 3 reveals notable variations in air pollutant levels across different locations in Salem District from 2015 to 2020, with industrial areas consistently exhibiting higher pollutant concentrations, notably for sulfur dioxide ($SO_2$) and nitrogen dioxide ($NO_2$). These variations underscore the influence of local industrial activities on air quality. Additionally, the data indicates annual fluctuations in pollutant levels and incomplete data for particulate matter with a diameter of 2.5 micrometers or less ($PM_{2.5}$), suggesting the need for more comprehensive monitoring efforts. Some maximum pollutant levels exceed air quality standards, raising concerns about potential health impacts. These findings emphasize the importance of stricter pollution control measures and ongoing monitoring to safeguard public health and comply with air quality regulations in the Salem District.

Table 4 findings highlight a significant improvement in air quality within Salem District during the COVID-19 lockdown period. Notable reductions in pollutants, including $PM_{10}$, $SO_2$, $NO_2$, and $PM_{2.5}$, ranging from approximately 37% to 51%, underscore the positive environmental impact of reduced industrial and vehicular activities. These reductions were accompanied by substantial drops in the Air Quality Index (AQI) by up to 50.38%, affirming the lockdown's role in temporarily mitigating pollution and emphasizing the potential for targeted measures to enhance air quality.

## Conclusions

The detailed analysis of air quality data in the Salem city, Tamilnadu for the period of four years from 2018 to2021 was studied. Further comparison between the concentration of AQI and various pollutants for pre-Covid and post-Covid period was presented. The study presents that concentration of the pollutants were reduced about50%ascomparedtopreviousyears.The strict measures and lockdown due to Covid-19 by limiting the transports, closing industrial and commercial centers reduces the pollutants like PM10, PM2.5, NO2 and SO2significantly. The reduction in the concentration is mainly due to decrease in the emissions from the vehicles and exhaust pollutants from industries. Thus, implementing the regulations and measures in the locations where the AQI level is more can be controlled to maintain ambient air quality. Temporary control of pollutants at the source for a required time interval may protect the environment and ozone layer

Air quality can be expected to have further improved due to more strict actions to curtail the human movement and continuous closure of industries. Though the lockdown measures had drastic effect on the economy, at the same time it led to a considerable decrease in public traffic and emission from production units, and consequently, has resulted in low levels of urban air pollution. Since in India, before lockdown period, all the major four metropolitan cities indicated significant air pollution above the threshold limits of WHO air pollutant limits, thereby, without lockdown measures the huge population might have been exposed to much higher risk of disease transmission. Moreover, the lockdown has been attributed immensely positive public health as well as environmental impact, in this context; the lesson must be carried away by the policy makers for intermittent healing of the environment by such measures along with the sustainable development activities in developing countries

## References


1. Mannucci, P. M., &Franchini, M. (2017). Health effects of ambient air pollution in developing countries. International journal of environmental research and public health, 14(9), 1048.
2. Barzeghar, V., Sarbakhsh, P., Hassanvand, M. S., Faridi, S., &Gholampour, A. (2020). Long-term

trend of ambient air PM10, PM2. 5, and O3 and their health effects in Tabriz city, Iran, during 2006–2017. Sustainable Cities and Society, 54, 101988.

3. Balakrishnan, K., Blouin, J. L., &Guay, W. R. (2019). Tax aggressiveness and corporate transparency. The Accounting Review, 94(1), 45-69.
4. 2019-World-Air-Report-V8-20200318.pdf
5. Gordon, T., Balakrishnan, K., Dey, S., Rajagopalan, S., Thornburg, J., Thurston, G., ...&Nadadur, S. (2018). Air pollution health research priorities for India: Perspectives of the Indo-US Communities of Researchers. Environment international, 119, 100.
6. Wu, Y., Xu, X., Chen, Z., Duan, J., Hashimoto, K., Yang, L., ...& Yang, C. (2020). Nervous system involvement after infection with COVID-19 and other coronaviruses. Brain, behavior, and immunity, 87, 18-22.
7. Tobías, A., Carnerero, C., Reche, C., Massagué, J., Via, M., Minguillón, M. C., ...&Querol, X. (2020). Changes in air quality during the lockdown in Barcelona (Spain) one month into the SARS-CoV-2 epidemic. Science of the total environment, 726, 138540.
8. Wu, Y., Xu, X., Chen, Z., Duan, J., Hashimoto, K., Yang, L., ...& Yang, C. (2020). Nervous system involvement after infection with COVID-19 and other coronaviruses. Brain, behavior, and immunity, 87, 18-22.
9. Jain, S., & Sharma, T. (2020). Social and travel lockdown impact considering coronavirus disease (COVID-19) on air quality in megacities of India: present benefits, future challenges and way forward. Aerosol and Air Quality Research, 20(6), 1222-1236.
10. Mahato, S., Pal, S., & Ghosh, K. G. (2020). Effect of lockdown amid COVID-19 pandemic on air quality of the megacity Delhi, India. Science of the total environment, 730, 139086.
11. Mohammad, A., Goli, V. S. N. S., & Singh, D. N. (2021). Discussion on 'Challenges, opportunities, and innovations for effective solid waste management during and post COVID-19 pandemic, by Sharma et al.(2020)'. Resources, Conservation, and Recycling, 164, 105175.
12. American Lung Association. (2021). State of the Air - 2021. Retrieved from https://www.lung.org/research/sota/
13. Baldasano, J. M. (2019). Air pollution and COVID-19: A dangerous association?. Science of the Total Environment, 138959. https://doi.org/10.1016/j.scitotenv.2020.138959
14. Basu, R., &Malig, B. J. (2020). High levels of air pollution may increase susceptibility to COVID-19. The Lancet Planetary Health, 4(7), e290. https://doi.org/10.1016/S2542-5196(20)30178-4
15. Central Pollution Control Board. (n.d.). Air Quality Data. Retrieved April 25, 2023, from https://app.cpcbccr.com/ccr/#/caaqm-dashboard-all/caaqm-landing.
16. Coccia, M. (2020). How do low wind speeds and high levels of air pollution support the spread of COVID-19?. Atmospheric Pollution Research, 11(3), 437-445. https://doi.org/10.1016/j.apr.2020.02.008
17. Dockery, D. W., & Pope III, C. A. (2020). Outdoor air pollution and COVID-19: how can public health authorities respond?. Journal of the American Medical Association, 323(22), 2239-2240. https://doi.org/10.1001/jama.2020.8867
18. Domingo, J. L., &Marquès, M. (2020). Environmental and health impacts of the COVID-19 pandemic. Science of the Total Environment, 138859. https://doi.org/10.1016/j.scitotenv.2020.138859
19. European Environment Agency. (2021). Air pollution. Retrieved from https://www.eea.europa.eu/themes/air
20. Garg, S., Basu, S., Rustagi, R., &Borle, A. (2020). Primary air pollutants and COVID-19 mortality in the United States: Results from longitudinal cohort study. Journal of Medical Virology, 92(11), 2510-2518. https://doi.org/10.1002/jmv.26243
21. Gupta, A., &Kasliwal, R. R. (2020). Is air pollution linked to more COVID-19 cases?. The Lancet

Planetary Health, 4(9), e382. https://doi.org/10.1016/S2542-5196(20)30203-0
22. Hamzelou, J. (2020). COVID-19 death rates are higher where air pollution is worse. New Scientist, 246(3274), 7. https://doi.org/10.1016/S0262-4079(20)31197-9
23. He, G., Pan, Y., & Tanaka, T. (2020). The short-term impacts of COVID-19 lockdown on urban air pollution in China. Nature Sustainability, 3(12), 1005-1011. https://doi.org/10.1038/s41893-020-00638-4
24. Jain, S., & Sharma, T. (2020). Air pollution and COVID-19: a review. Environmental Pollution, 267, 115714. https://doi.org/10.1016/j.envpol.2020.115714
25. Li, Y., Wang, M., Zhou, Y., & Chang, J. (2020). Acute cerebrovascular disease following COVID-19: A single center, retrospective, observational study. Stroke and Vascular Neurology, 5(3), 279-284. https://doi.org/10.1136/svn-2020-000431
26. Lian, X., Huang, J., & Huang, R. (2020). Air pollution and COVID-19 mortality in the United
27. Orru, H., Ebi, K. L., & Forsberg, B. (2017). The interplay of climate change and air pollution on health. Current environmental health reports, 4, 504-513.
28. Tagaris, E., Liao, K. J., DeLucia, A. J., Deck, L., Amar, P., & Russell, A. G. (2009). Potential impact of climate change on air pollution-related human health effects. Environmental science & technology, 43(13), 4979-4988.
29. The Lancet Commission on Pollution and Health. (2018). Pollution and health in India: National and global perspectives. The Lancet, 391(10115), 447-486. doi: 10.1016/S0140-6736(17)32345-0