ASSESSMENT OF AIR POLLUTION AND AMBIENT AIR QUALITY IN TAMIL NADU

Abstract

Air pollution refers to the contamination of the indoor or outdoor environment by chemical, physical, or biological agents that alter the natural characteristics of the atmosphere. The depletion of stratospheric ozone caused by air pollution poses significant threats to human health and the Earth's ecosystems.

The quality of air is intricately connected to global climate and ecosystems. Many activities that contribute to air pollution, such as the burning of fossil fuels, also result in greenhouse gas emissions. Consequently, policies aimed at reducing air pollution offer a dual benefit by addressing climate change and improving public health. These policies not only reduce the burden of disease associated with air pollution but also contribute to mitigating climate change in the short and long term.

Efforts should be focused on reducing the sources and impacts of climate change, including the reduction of toxic chemical use and improved management of toxic waste. Active participation from all segments of society through environmental education, awareness campaigns, and capacity building is crucial for nature conservation and environmental protection. It is vital to integrate environmental principles into development planning, policies, and practices to ensure sustainable outcomes. Moreover, promoting environmental governance through legislation, policy implementation, and advocacy is essential.

Therefore, it is imperative to identify gaps in the current management of resource bases. The present study aims to assess the air quality and

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air pollution situation in Tamil Nadu, providing valuable insights into the state's environmental conditions and supporting the development of effective strategies for sustainable resource management.

Keywords: Air Pollution, Ambient Air Quality

I. INTRODUCTION

The Tamil Nadu Pollution Control Board (TNPCB) is actively monitoring air quality to assess the concentration of air pollutants originating from industrial emissions and the growing number of vehicles. In Chennai, multiple monitoring programs such as the National Air Quality Monitoring Programme (NAMP) and the Chennai Ambient Air Quality Monitoring Programme (CAAQM) track ambient air quality at various locations. Other cities like Thoothukudi, Coimbatore, Madurai, Salem, and Tiruchirapalli also have air quality monitoring in place. Continuous monitoring stations have been established in Cuddalore, Tuticorin, Ranipet, Manali-Chennai, Royapuram-Chennai, Kottivakkam-Chennai, and Tamil Nadu Scenario to evaluate pollution levels.

The rapid increase in the number of vehicles, driven by urbanization, economic growth, and easy access to finance, has exacerbated the issue of vehicular pollution. Not only are there new vehicles, but also older vehicles with outdated technology and non-compliance with emission norms. Additionally, the quality of fuel supplied further contributes to the problem of vehicular pollution. The TNPCB has been monitoring vehicular emissions since 1992, with three dedicated monitoring stations in Chennai at Alandur, Ambattur, and Vyasarpadi, continuously monitoring emissions from goods and transport vehicles. Vehicular emission monitoring is also conducted in other locations such as Dindigul, Palani, Ooty, Chengalpattu, and Katteri.

To effectively tackle environmental challenges, establishing a robust Pollution Database for Tamil Nadu through data collection from various sources is proposed. Striving for harmonious coexistence with nature is crucial to safeguard ecological security. This necessitates achieving objectives such as conserving biodiversity, promoting sustainable resource usage, and engaging rural communities in conservation efforts. By prioritizing these objectives, a sustainable future that benefits both humans and the environment can be achieved.

II. METHODOLOGY

This study relies on secondary data from diverse sources, including the Tamil Nadu Pollution Control Board (TNPCB), National Air Quality Monitoring Program (NAMP), reviews journals, books, and periodicals. These sources have played a pivotal role in providing valuable data and insights for the study's objectives. It is crucial to highlight that the information presented in this study is derived from diligently collected and analyzed secondary data, enabling meaningful and reliable conclusions to be drawn.

III. OBJECTIVE

1. Assess the current status of air quality in Tamil Nadu by monitoring and evaluating air pollutant concentrations.
2. Examine the number of vehicles in Tamil Nadu, including both new and old vehicles, to understand their contribution to vehicular pollution.
3. Develop long-term strategies for emission control through effective measures and policies to improve air quality and promote a healthier environment in Tamil Nadu.

IV. LITERATURE REVIEW

The ambient air contains a wide range of potentially harmful pollutants, originating from both natural sources and human activities (1). Surprisingly, natural sources also contribute significantly to global air pollution alongside anthropogenic activities (2). Motor vehicles and industrial processes remain the primary contributors to air pollution, overshadowing other sources (3). India's rapid industrialization, urbanization, and transportation development have brought economic growth but also caused significant environmental degradation (4). Developing countries' unplanned urbanization and rapid industrialization have led to environmental deterioration and a decline in quality of life (5). Emissions from industries and vehicle exhausts, including particulate matter and gaseous pollutants, have adverse effects on respiratory health and urban environments (6). Urban air pollution is now a major concern for public health and regulatory bodies due to its detrimental impact (7).

Air pollution can be defined as the contamination of the atmosphere by gaseous, liquid, or solid waste products that pose a threat to human, plant, and animal health (Meenakshi and Elangovan, 2000). While natural sources release some pollutants, emissions from industrial activities and combustion engines contribute significantly more (Avnish and Mayank, 2010). Fuel combustion from stationary and mobile sources is the primary cause of human-induced air pollutant emissions (Avnish and Mayank, 2010). Outdoor air pollution includes various harmful substances like sulfur dioxide, carbon monoxide, nitrogen oxides, ozone, lead, and toxic particles (Barman et al., 2008). Alarming levels of air pollution in India have reduced the average life expectancy of 660 million Indians by 3.2 years (Meenakshi and Saseetharan, 2003).

The deterioration of air quality in Indian cities is primarily attributed to burning fossil fuels for industrial processes, transportation, and improper waste disposal (Meenakshi and Saseetharan, 2003). In many Indian cities with over one million populations, air pollution exceeds the recommended standards of the World Health Organization (Meenakshi and Saseetharan, 2003). The worsening air quality is amplified by factors like rapid industrialization, increasing vehicles, energy consumption, and improper waste management in urban areas.

V. AIR POLLUTION

Air pollution refers to the contamination of the Earth's atmosphere by the introduction of particulates, biological molecules, or other harmful substances. These pollutants have the potential to cause diseases, human fatalities, harm to food crops, and damage to both the natural and built environment. The depletion of the stratospheric ozone layer, resulting from air pollution, has been widely acknowledged as a significant threat to human health and the Earth's ecosystems. Indoor air pollution and urban air quality are recognized as two of the most severe toxic pollution problems faced globally.

Sources: There are various activities or factors which are responsible for releasing pollutants into the atmosphere. These sources can be classified into two major categories.

1. **Anthropogenic (man-made) Sources:** Anthropogenic sources of air pollution primarily stem from the combustion of various types of fuel. These sources can be categorized into stationary and mobile sources. Stationary sources encompass power plants, manufacturing factories, waste incinerators, furnaces, and other fuel-burning devices commonly found in industrial settings. In less developed countries, traditional biomass burning, including wood, crop waste, and cow-dung, represents a major contributor to air pollutants.

   Mobile sources of air pollution include vehicles, marine vessels, and aircraft. Emissions from these sources are produced by the combustion of fuel, as well as the release of fumes from substances such as paint, hair spray, varnish, aerosol sprays, and solvents. Additionally, waste deposition in landfills generates methane during the decomposition process. Methane is highly flammable, capable of forming explosive mixtures with air, and can displace oxygen in enclosed spaces. It is worth noting that military resources, such as nuclear weapons and toxic gases, also play a significant role in contributing to air pollution.

2. **Natural Sources:** Air pollution can also originate from natural sources such as dust, particularly from large areas of land with limited vegetation. Another natural source of air pollution is radon gas, which is formed through the radioactive decay of radium in the Earth's crust. Radon is known to be a health hazard and can accumulate in buildings, especially in confined spaces, posing a significant risk for lung cancer.

   Smoke and carbon monoxide emitted during wildfires and volcanic activity contribute to air pollution by releasing sulfur, chlorine, and ash particulates. It is important to note that pollutants can have either natural or man-made origins. They are classified as primary or secondary pollutants.

   Primary pollutants are directly produced from specific processes, such as ash from a volcanic eruption or carbon monoxide gas from motor vehicle exhaust. Examples of primary pollutants also include sulfur dioxide emitted by factories.

   On the other hand, ***secondary pollutants*** are not emitted directly but form in the atmosphere when primary pollutants react or interact with other substances. Ground-level ozone is a prominent example of a secondary pollutant. It is formed when primary pollutants like nitrogen oxides and volatile organic compounds react with sunlight. Some pollutants can exhibit characteristics of both primary and secondary pollutants, as they are emitted directly but can also form from the transformation of other primary pollutants.

   In India, a major source of air pollution is the burning of fuel wood and biomass in both rural and urban areas. A significant portion of the population relies on fuel wood and biomass cakes for cooking and heating purposes. Biomass cook stoves are prevalent in over 100 million Indian households and are used multiple times a day. Traditional fuels such as dried cow dung, agricultural waste, and firewood are still widely used for cooking fuel in India.

- **Major Primary Pollutants produced by Human Activity include:**

  - **Sulphur Oxides (SOx*),*** particularly sulfur dioxide (SO2), are produced by volcanoes and various industrial processes. Coal and petroleum contain sulfur compounds, and when combusted, they release sulfur dioxide. The further oxidation of SO2, usually in the presence of a catalyst like NO2, leads to the formation of sulfuric acid (H2SO4) and contributes to the occurrence of acid rain.

  - **Nitrogen Oxides (NOx),** especially nitrogen dioxide (NO2), are emitted during high-temperature combustion processes and can also be produced by electric discharge during thunderstorms. Nitrogen dioxide (NO2) is a prominent air pollutant and a chemical compound with the formula NO2.

  - **Carbon Monoxide (CO)** is a toxic gas that results from the incomplete combustion of fuels such as natural gas, coal, or wood. Vehicular exhaust is a major source of carbon monoxide emissions.

  - **Volatile Organic compounds (VOCs)** are well-known outdoor air pollutants. They can be categorized as either methane (CH4) or non-methane volatile organic compounds (NMVOCs). Methane is a greenhouse gas that contributes to the enhancement of global warming. Aromatic NMVOCs, such as benzene, toluene, and xylene, are suspected carcinogens and may lead to leukemia with prolonged exposure.

- **Another compound often associated with industrial use is *1,3-butadiene***

  - **Particulate Matter:** *Particulate Matter (PM)* refers to solid or liquid particles suspended in a gas, commonly found in the atmosphere. These particles can vary in size and composition and are often referred to as fine particles. They can originate from various sources, both natural and human-made.

  - **Aerosols:** *Aerosols,* on the other hand, are a combination of particles and gas. They can occur naturally from events such as volcanic eruptions, dust storms, forest fires, and sea spray. Human activities, including the burning of fossil fuels in vehicles, power plants, and industrial processes, also contribute significantly to the production of aerosols.

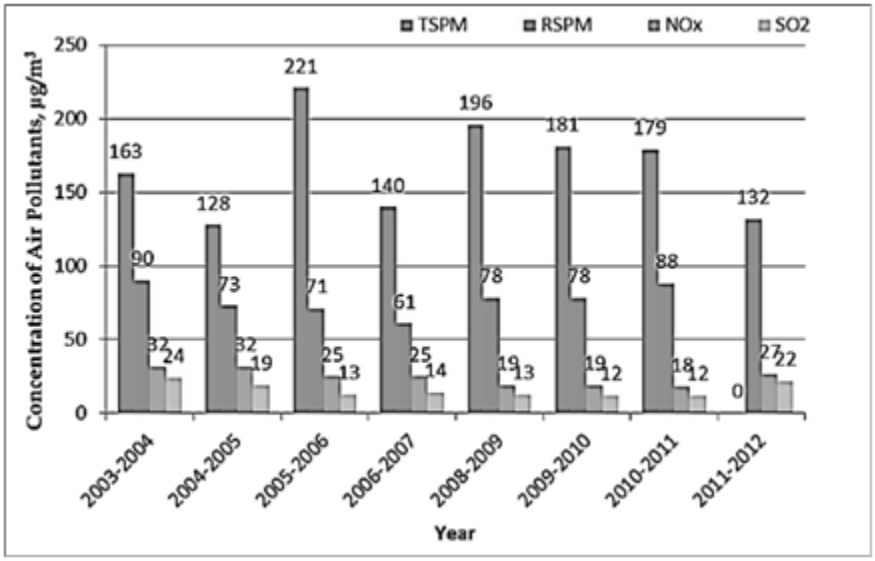
  - **Chlorofluorocarbons (CFCs):** Chlorofluorocarbons (CFCs) are gases that are harmful to the ozone layer. They are commonly used in air conditioners and refrigerators. When released into the air, CFCs rise to the stratosphere where they interact with other gases and contribute to the depletion of the ozone layer. This depletion allows harmful ultraviolet rays from the sun to reach the Earth's surface, leading to skin cancer and other related health issues.

- **Secondary Pollutants Include:** *Particulates* that are formed from the chemical reactions of gaseous primary pollutants are known as secondary pollutants. One example of secondary air pollution is smog, which occurs as a result of extensive coal burning in an area. The combination of smoke and sulfur dioxide leads to the formation of smog. Additionally, smog is also produced by emissions from vehicles and industries, which undergo reactions in the atmosphere with sunlight to create secondary pollutants, contributing to the formation of photochemical smog.

Ground-level ozone (O3) is another secondary pollutant formed from the interaction of nitrogen oxides (NOx) and volatile organic compounds (VOCs). Ozone is a significant component of the troposphere, the lower part of the Earth's atmosphere. It also plays a crucial role in specific regions of the stratosphere, known as the Ozone layer.

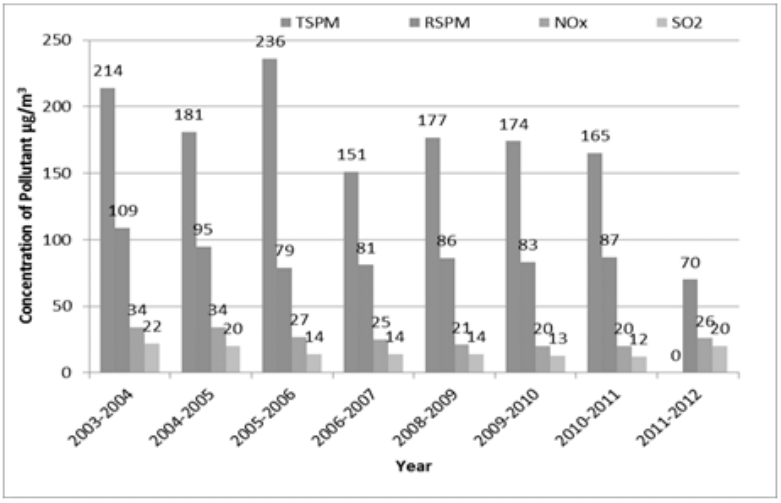
Peroxyacetyl nitrate (PAN) is yet another secondary pollutant that forms from the reaction of nitrogen oxides (NOx) and volatile organic compounds (VOCs). It is a compound that contributes to air pollution and is generated through the atmospheric reactions of NOx and VOCs.

Ambient Air Quality Monitoring Results of Chennai between 2003 &2012				
A. Location: Municipal Kalyanamandapam, Kathivakkam, Chennai				
Category -Industrial Area				
Year	Annual Average Concentration of Air pollutants, µg/m^3			
	TSPM	RSPM	NOx	SO_2
2003-2004	163	90	32	24
2004-2005	128	73	32	19
2005-2006	221	71	25	13
2006-2007	140	61	25	14
2008-2009	196	78	19	13
2009-2010	181	78	19	12
2010-2011	179	88	18	12
2011-2012	NA	132	27	22
Prescribed Standard				
Industrial	360	120	80	80
Residential, Rural & Other Areas (Mixed)	140	60	60	60
NAAQS-2009	NA	60	40	50



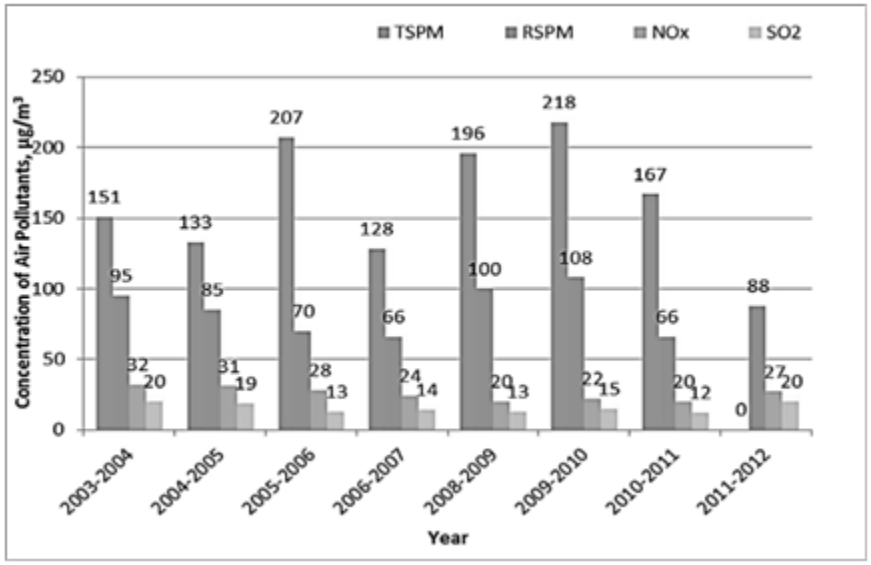
Graph Showing Ambient Air Quality in Kathivakkam Chennai between 2003-2012

Ambient Air Quality Monitoring Results of Chennai between 2003 &2012				
B. Govt. Hr. Sec, School, Manali, Chennai				
Category -Industrial Area				
Year	Annual Average Concentration of Air pollutants, µg/m^3			
	TSPM	RSPM	NOx	SO_2
2003-2004	214	109	34	22
2004-2005	181	95	34	20
2005-2006	236	79	27	14
2006-2007	151	81	25	14
2008-2009	177	86	21	14
2009-2010	174	83	20	13
2010-2011	165	87	20	12
2011-2012	NA	70	26	20
Prescribed Standard				
Industrial	360	120	80	80
Residential, Rural & Other Areas (Mixed)	140	60	60	60
NAAQS-2009	NA	60	40	50



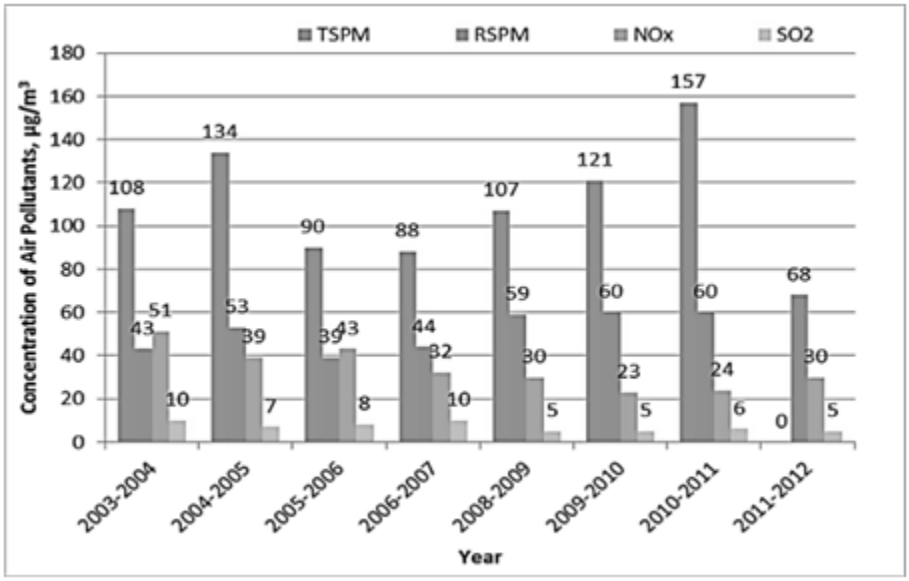
Graph Showing Ambient Air Quality inManali Chennai between 2003-2012

Ambient Air Quality Monitoring Results of Chennai between 2003 &2012 C. Municipal Office , Thiruvottiyur, Chennai				
Category - Mixed Area				
Year	Annual Average Concentation of Air pollutants, µg/m^3			
	TSPM	RSPM	NOx	SO_2
2003-2004	151	95	32	20
2004-2005	133	85	31	19
2005-2006	207	70	28	13
2006-2007	128	66	24	14
2008-2009	196	100	20	13
2009-2010	218	108	22	15
2010-2011	167	66	20	12
2011-2012	NA	88	27	20
Prescribed Standard				
Industrial	360	120	80	80
Residential, Rural & Other Areas (Mixed)	140	60	60	60
NAAQS-2009	NA	60	40	50



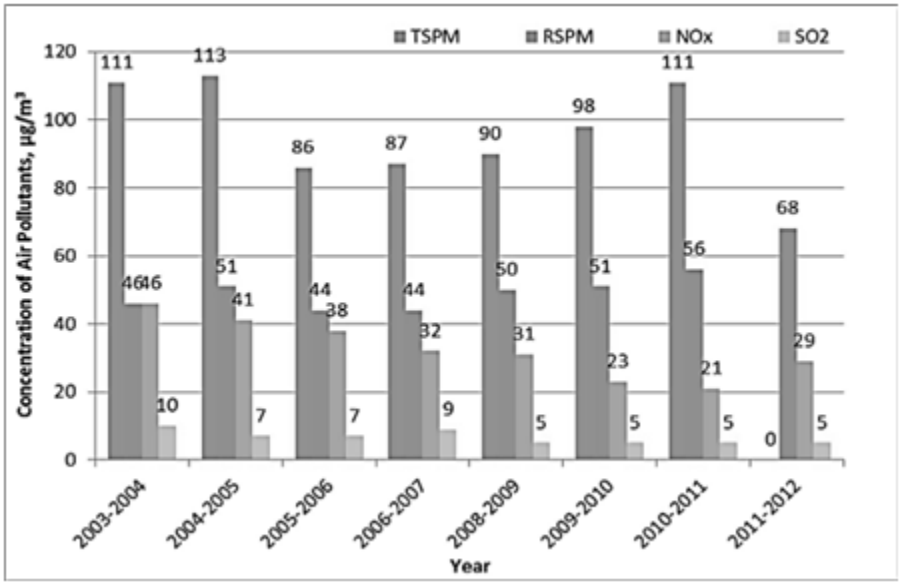
Graph Showing Ambient Air Quality in Thiruvottiyur Chennai between 2003-2012

Ambient Air Quality Monitoring Results of Coimbatore between 2003&2012				
A. Location: Collectorate Office Building/GD Matric School, Coimbatore				
Category -Mixed Area				
Year	Annual Average Concentration of Air pollutants, µg/m^3			
	TSPM	RSPM	NOx	SO_2
2003-2004	108	43	51	10
2004-2005	134	53	39	7
2005-2006	90	39	43	8
2006-2007	88	44	32	10
2008-2009	107	59	30	5
2009-2010	121	60	23	5
2010-2011	157	60	24	6
2011-2012	NA	68	30	5
Prescribed Standard				
Industrial	360	120	80	80
Residential, Rural & Other Areas (Mixed)	140	60	60	60
NAAQS-2009	NA	60	40	50



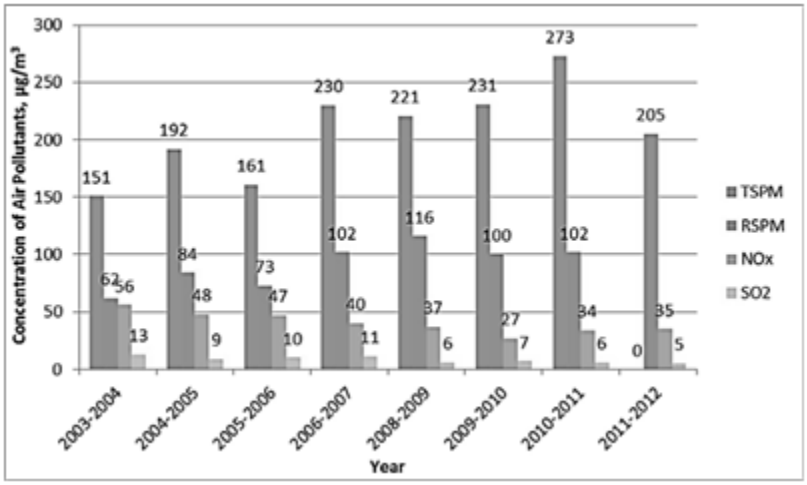
Graph Showing Ambient Air Quality in GD, School Coimbatore between 2003-2012

Ambient Air Quality Monitoring Results of Coimbatore between 2003 &2012				
B. Location: Ponniyarajapuram, Coimbatore				
Category -Residential Area				
Year	Annual Average Concentration of Air pollutants, µg/m^3			
	TSPM	RSPM	NOx	SO_2
2003-2004	111	46	46	10
2004-2005	113	51	41	7
2005-2006	86	44	38	7
2006-2007	87	44	32	9
2008-2009	90	50	31	5
2009-2010	98	51	23	5
2010-2011	111	56	21	5
2011-2012	NA	68	29	5
Prescribed Standard				
Industrial	360	120	80	80
Residential, Rural & Other Areas (Mixed)	140	60	60	60
NAAQS-2009	NA	60	40	50



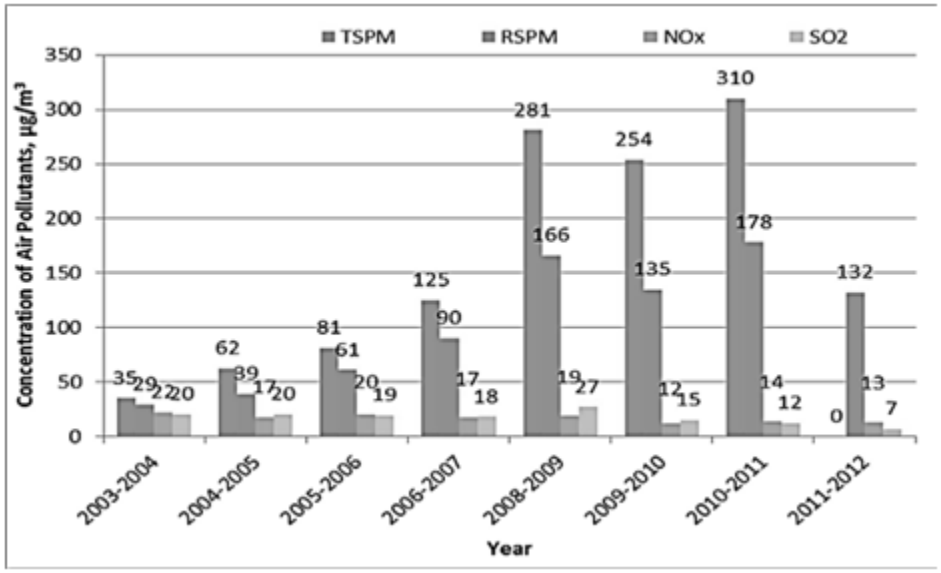
Graph Showing Ambient Air Quality in Ponniyarajapuram Coimbatore between 2003-2012

Ambient Air Quality Monitoring Results of Coimbatore between 2003 &2012				
C. Location: SIDCO, Coimbatore				
Category -Industrial Area				
Year	Annual Average Concentration of Air pollutants, µg/m^3			
	TSPM	RSPM	NOx	SO_2
2003-2004	151	62	56	13
2004-2005	192	84	48	9
2005-2006	161	73	47	10
2006-2007	230	102	40	11
2008-2009	221	116	37	6
2009-2010	231	100	27	7
2010-2011	273	102	34	6
2011-2012	NA	205	35	5
Prescribed Standard				
Industrial	360	120	80	80
Residential, Rural & Other Areas (Mixed)	140	60	60	60
NAAQS-2009	NA	60	40	50



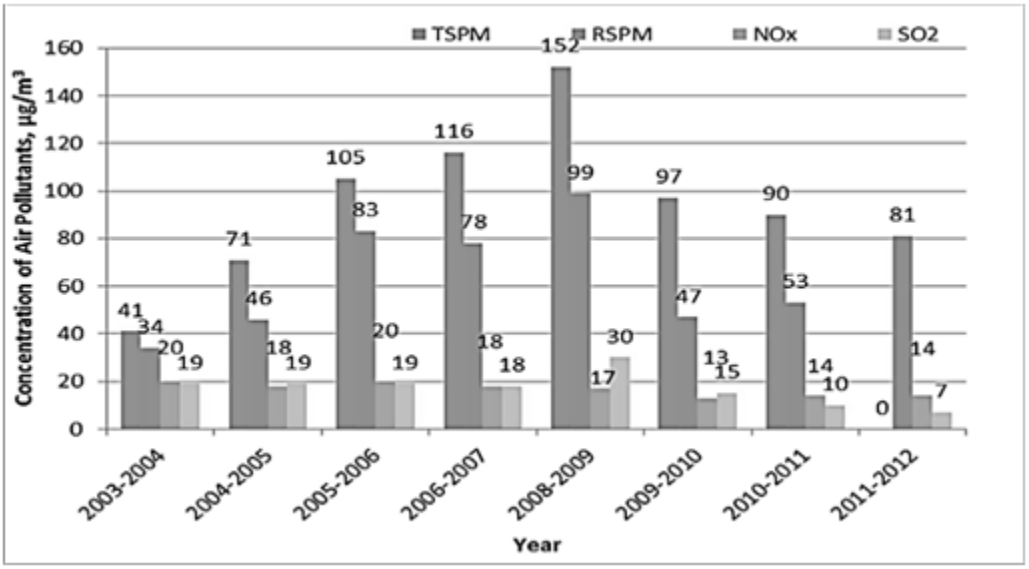
Graph Showing Ambient Air Quality in SIDCO Coimbatore between 2003-2012

Ambient Air Quality Monitoring Results of Thoothukudi between 2003&2012				
A. Location: Raja Agencies, Thoothukudi				
Category -Industrial Area				
Year	Annual Average Concentration of Air pollutants, µg/m^3			
	TSPM	RSPM	NOx	SO_2
2003-2004	35	29	22	20
2004-2005	62	39	17	20
2005-2006	81	61	20	19
2006-2007	125	90	17	18
2008-2009	281	166	19	27
2009-2010	254	135	12	15
2010-2011	310	178	14	12
2011-2012	NA	132	13	7
Prescribed Standard				
Industrial	360	120	80	80
Residential, Rural & Other Areas (Mixed)	140	60	60	60
NAAQS-2009	NA	60	40	50



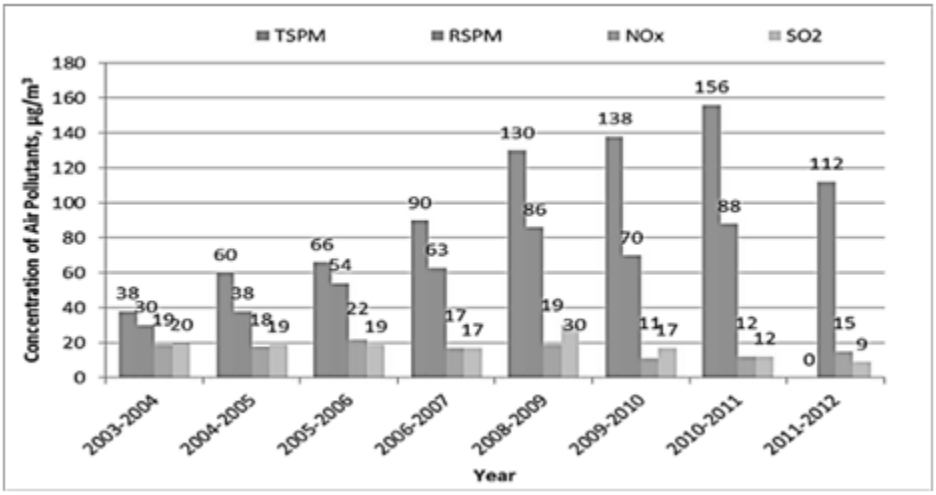
Graph Showing Ambient Air Quality in Thoothukudi between 2003-2012

Ambient Air Quality Monitoring Results of Thoothukudi between 2003&2012				
B. Location: AVM Building, Thoothukudi				
ory -Mixed Area				
Year	Annual Average Concentration of Air pollutants, µg/m^3			
	TSPM	RSPM	NOx	SO_2
2003-2004	41	34	20	19
2004-2005	71	46	18	19
2005-2006	105	83	20	19
2006-2007	116	78	18	18
2008-2009	152	99	17	30
2009-2010	97	47	13	15
2010-2011	90	53	14	10
2011-2012	NA	81	14	7
Prescribed Standard				
Industrial	360	120	80	80
Residential, Rural & Other Areas (Mixed)	140	60	60	60
NAAQS-2009	NA	60	40	50



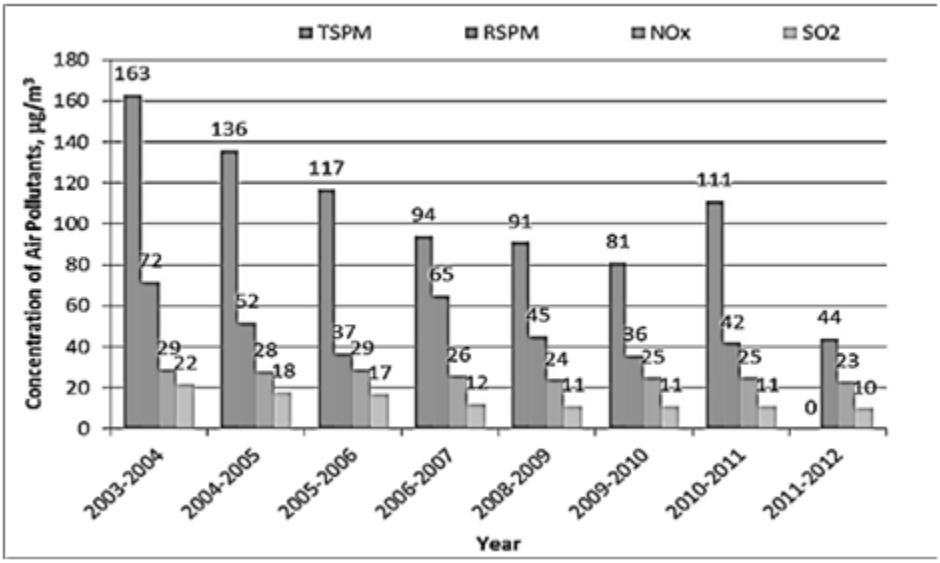
Graph Showing Ambient Air Quality in Thoothukudi between 2003-201

Ambient Air Quality Monitoring Results of Thoothukudi between 2003&2012				
C. Location: Fisheries College/ SIPCOT, Thuthookudi				
Category -Industrial Area				
Year	Annual Average Concentration of Air pollutants, µg/m^3			
	TSPM	RSPM	NOx	SO_2
2003-2004	38	30	19	20
2004-2005	60	38	18	19
2005-2006	66	54	22	19
2006-2007	90	63	17	17
2008-2009	130	86	19	30
2009-2010	138	70	11	17
2010-2011	156	88	12	12
2011-2012	NA	112	15	9
Prescribed Standard				
Industrial	360	120	80	80
Residential, Rural & Other Areas (Mixed)	140	60	60	60
NAAQS-2009	NA	60	40	50



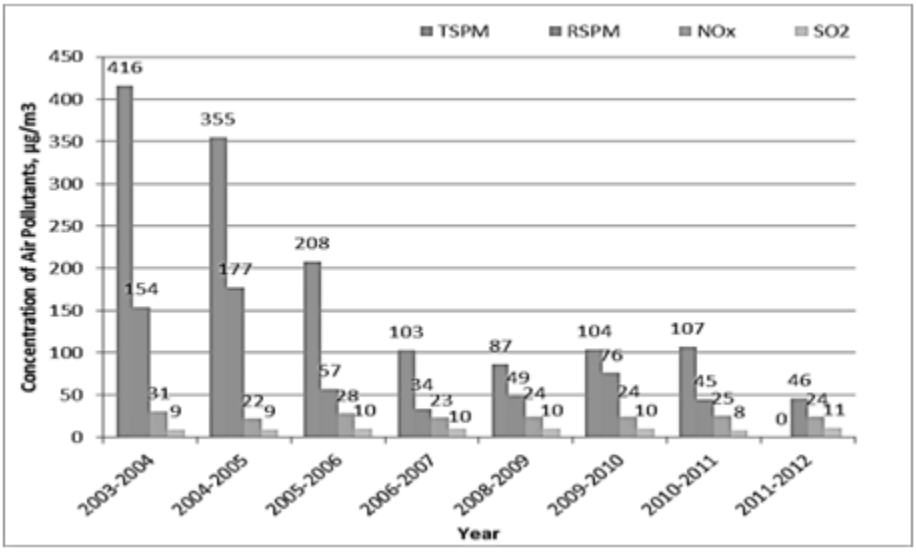
Graph Showing Ambient Air Quality in SIPCOT Thoothukudi between 2003-2012

Ambient Air Quality Monitoring Results of Madurai between 2003&2012				
A. Location: Fennar Ltd, M/s. Susee cars & Trucks (p)Ltd., Madurai				
Category -Industrial Area				
Year	Annual Average Concentration of Air pollutants, µg/m^3			
	TSPM	RSPM	NOx	SO_2
2003-2004	163	72	29	22
2004-2005	136	52	28	18
2005-2006	117	37	29	17
2006-2007	94	65	26	12
2008-2009	91	45	24	11
2009-2010	81	36	25	11
2010-2011	111	42	25	11
2011-2012	NA	44	23	10
Prescribed Standard				
Industrial	360	120	80	80
Residential, Rural & Other Areas (Mixed)	140	60	60	60
NAAQS-2009	NA	60	40	50



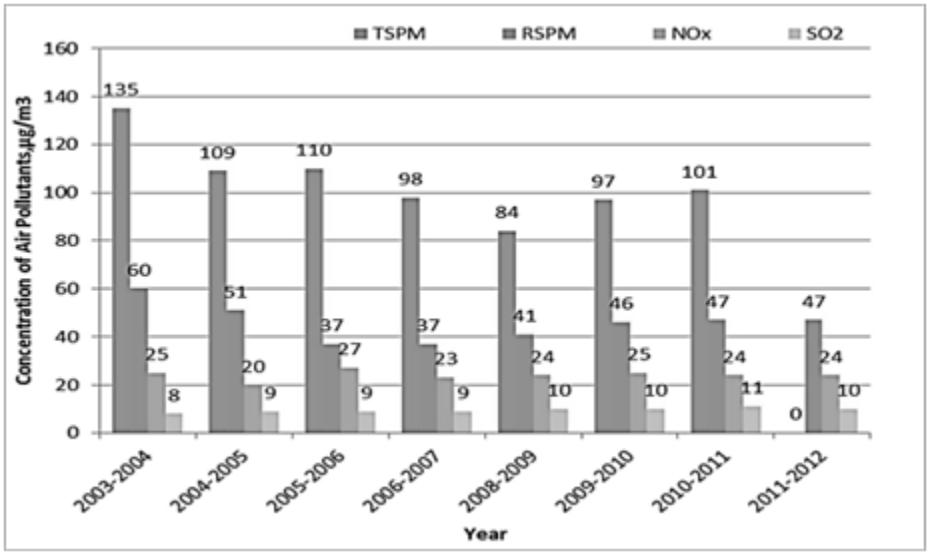
Graph Showing Ambient Air Quality in Madurai between 2003-2012

Ambient Air Quality Monitoring Results of Madurai between 2003&2012				
B. Location: Kunnathur Chatram/Avvai Girls Hr.Sec.school Madurai				
Category -Mixed Area				
Year	Annual Average Concentration of Air pollutants, µg/m^3			
	TSPM	RSPM	NOx	SO_2
2003-2004	416	154	31	9
2004-2005	355	177	22	9
2005-2006	208	57	28	10
2006-2007	103	34	23	10
2008-2009	87	49	24	10
2009-2010	104	76	24	10
2010-2011	107	45	25	8
2011-2012	NA	46	24	11
Prescribed Standard				
Industrial	360	120	80	80
Residential, Rural & Other Areas (Mixed)	140	60	60	60
NAAQS-2009	NA	60	40	50



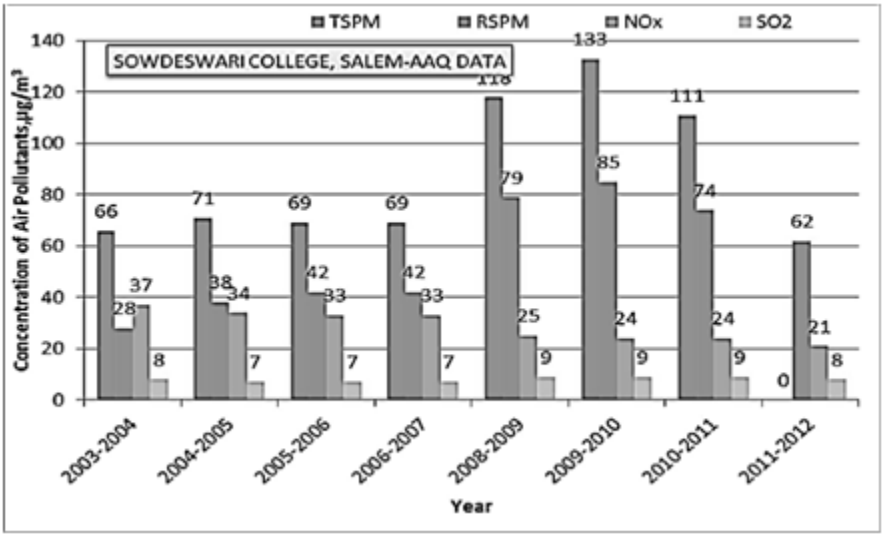
Graph Showing Ambient Air Quality in Kunnathur Chatram Madurai between 2003-2012

Ambient Air Quality Monitoring Results of Madurai between 2003&2012				
C. Location: Highway Project Building, Madurai				
Category -Residential Area				
Year	Annual Average Concentration of Air pollutants, µg/m^3			
	TSPM	RSPM	NOx	SO_2
2003-2004	135	60	25	8
2004-2005	109	51	20	9
2005-2006	110	37	27	9
2006-2007	98	37	23	9
2008-2009	84	41	24	10
2009-2010	97	46	25	10
2010-2011	101	47	24	11
2011-2012	NA	47	24	10
Prescribed Standard				
Industrial	360	120	80	80
Residential, Rural & Other Areas (Mixed)	140	60	60	60
NAAQS-2009	NA	60	40	50



Graph Showing Ambient Air Quality in Highway Project Building Maduraibetween 2003-2012

Ambient Air Quality Monitoring Results of Salem between 2003&2012				
A. Location: Sowdeswari College Building , Salem				
Category -Mixed Area				
Year	Annual Average Concentration of Air pollutants, µg/m^3			
	TSPM	RSPM	NOx	SO_2
2003-2004	66	28	37	8
2004-2005	71	38	34	7
2005-2006	69	42	33	7
2006-2007	69	42	33	7
2008-2009	118	79	25	9
2009-2010	133	85	24	9
2010-2011	111	74	24	9
2011-2012	NA	62	21	8
Prescribed Standard				
Industrial	360	120	80	80
Residential, Rural & Other Areas (Mixed)	140	60	60	60
NAAQS-2009	NA	60	40	50



Graph Showing Ambient Air Quality in Salem between 2003-2012

Data collected from various organizations and departments in Tamil Nadu indicate high levels of respirable suspended particulate matter (RSPM) and total suspended particulate matter (TSPM) in industrial and urban areas. Addressing these elevated pollution levels requires comprehensive measures such as improved control equipment, effluent and sewage treatment, resource recovery, cleaner technological processes, and stricter regulations to reduce harmful emissions.

VI. STATUS OF NUMBER OF VEHICLES IN TAMIL NADU

District wise Number of Commercial Vehicles As On 01.4.2013

Sl.No.	Name Of The District	Stage Carriages		Mini Buses	Autorick-Shaws	Ordi-Nary Taxi	Motor Cabs		Maxi Cabs		Omni Buses		Psv
		Public	Private				Sp	Aip	Sp	Aip	Sp	Aip	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Chennai	6546	6	0	70675	531	21560	7550	16023	3484	189	57	3474
2	Kancheepuram	659	177	112	3741	0	2189	148	4670	38	66	0	2950
3	Tiruvallore	182	108	62	5927	0	2872	832	2958	752	11	0	569
4	Vellore	599	615	98	14095	132	862	539	1337	126	0	2	478
5	Tiruvannamalai	271	331	157	2581	2	1309	372	661	65	0	5	66
6	Cuddalore	401	345	122	4011	8	2876	113	1802	10	0	0	54
7	Villupuram	755	303	172	8030	23	3428	124	1473	68	5	0	27
8	Salem	855	501	215	5955	5	2281	161	1894	16	88	9	162
9	Namakkal	266	518	203	821	0	1948	45	930	8	42	0	329
10	Dharmapuri	394	314	55	1767	0	557	63	434	18	1	0	18
11	Krishnagiri	494	143	48	3084	0	290	488	414	55	3	0	157
12	Trichy	769	465	204	9791	1895	4180	186	2288	83	63	9	178
13	Karur	116	167	117	1216	0	537	12	442	6	4	0	156
14	Perambalur	67	72	98	522	0	604	10	353	1	0	0	16
15	Ariyalur	125	31	34	209	0	520	4	323	0	0	0	11
16	Thanjavur	601	226	167	5677	12	2651	157	1484	131	52	21	22
17	Nagapattinam	170	162	189	4185	0	1983	22	1023	146	16	0	15
18	Tiruvarur	180	96	84	1525	0	1490	14	629	13	0	0	2
19	Pudukkottai	357	189	49	1483	61	1245	0	869	0	0	5	31
20	Erode	463	512	155	2780	0	3164	127	1366	15	4	4	341
21	Coimbatore	1203	448	161	10782	69	11629	155	3746	9	43	41	658
22	Udhagamandalam	423	0	118	2967	838	1781	462	710	37	0	2	54
23	Tiruppur	513	306	87	1733	15	1956	18	1285	5	17	0	779
24	Madurai	1184	240	274	13252	0	4117	142	3133	65	27	2	271
25	Dindigul	519	376	102	4848	32	2438	21	1457	16	18	0	181
26	Theni	258	103	109	5750	0	1193	65	1391	30	34	0	160
27	Virudhunagar	339	268	149	3345	0	1690	15	1413	8	11	0	1165
28	Sivagangai	285	170	58	2373	2	1647	4	784	0	5	0	52
29	Ramanathapuram	337	106	60	5134	8	1090	13	1578	2	0	0	14
30	Tuticorin	330	189	166	3904	68	2357	6	1517	1	44	6	307
31	Tirunelveli	556	292	267	10072	25	4556	13	3333	0	7	0	391
32	Kanniyakumari	684	78	233	6094	25	1887	0	1963	0	0	0	130
	State Total	22053	8060	4125	218329	3751	92887	11881	63683	5208	750	163	13218
	Chennai -City	6546	6	0	70675	531	21560	7550	16023	3484	189	57	3474

Source : Transport Department, Govt. of Tamil Nadu

The above data provides information on the number of commercial vehicles in different districts of Tamil Nadu as of April 1, 2013. The categories of vehicles include stage carriages, mini buses, auto rickshaws, ordinary taxis, motor cabs, maxi cabs, and Omni buses. The vehicles are further classified as public or private, and whether they are operated by self-owners or associations.

In Chennai, the capital city, there were 6,546 stage carriages, 6 mini buses, and no auto rickshaws. Additionally, there were 70,675 public ordinary taxis, 531 self-owned ordinary taxis, 21,560 public motor cabs, 7,550 self-owned motor cabs, 16,023 public maxi cabs, and 3,484 self-owned maxi cabs. Chennai also had 189 self-owned Omni buses.

Other districts also had varying numbers of commercial vehicles, with different proportions of public and self-owned vehicles. For example, Kancheepuram district had 659 stage carriages, 177 mini buses, 112 auto rickshaws, 3,741 public ordinary taxis, and so on. The total number of commercial vehicles in the state was 220,053.

The data provides a comprehensive overview of the distribution of commercial vehicles across the districts of Tamil Nadu. It highlights the presence of a significant number of vehicles in Chennai, which is expected due to its status as the capital and a major urban center. The information can be useful for transportation planning, infrastructure development, and policy-making related to the management of commercial vehicles in the state.

Number of vehicles in Tamil Nadu - 2003

Number of vehicles in Tamil Nadu - 2003

DISTRICTWISE NUMBER OF COMMERCIAL VEHICLES AS ON 01.04.2003

SL. NO.	Name of the District	Stage Carriages		Mini Buses	Auto Rick-Saws	Ordi Nary Taxi	Motor Cabs		Maxi cabs		Omni Buses		Private Service Vehicle	Sch-Ool Bus	Ambu-Lance	Fire Figh-Ter	Light Commercial Vehicle	Lorri-Ies	Arti-Culated Vehicle	National Permit		Trac-Tors & Trai-Lers	Total Trans-Port Vehicles
		Pub-Lic	Pri-Vate				Sp	Aip	Sp	Aip	Sp	Aip								Lorri-Ies	Articulated Vehicle		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Chennai	3673	0	0	39782	222	5162	2400	3828	191	138	66	690	740	645	64	7156	16334	988	2939	649	660	86327
2	Kancheepuram	765	157	84	8145	41	1622	659	1272	32	5	3	232	387	85	30	2076	3912	73	329	7	1761	21677
3	Tiruvallore	80	108	59	2961	0	496	80	1154	47	0	0	36	118	35	4	935	4292	68	490	12	385	11360
4	Vellore	554	413	87	5943	27	230	78	585	14	3	4	176	60	43	20	269	5810	124	1767	14	1230	17451
5	Tiruvannamalai	176	280	150	1744	0	44	62	294	16	1	2	33	17	42	10	491	1979	98	385	0	344	6168
6	Cuddalore	336	291	115	3027	32	1787	37	1186	23	4	1	52	37	67	25	146	2816	488	614	3	1572	12659
7	Villupuram	586	293	156	1650	14	906	25	738	14	8	0	137	50	49	66	297	2903	334	638	2	1426	10292
8	Salem	470	416	166	3606	2	1252	41	834	40	19	16	109	213	68	33	4269	4622	298	2401	33	1523	20431
9	Namakkal	248	252	209	401	1	585	41	405	9	6	2	82	108	47	8	1836	5735	2479	6082	573	2042	21151
10	Dharmapuri	662	212	131	3169	0	213	39	312	10	1	0	120	275	58	19	1364	3438	94	573	50	870	11610
11	Trichy	507	362	192	4739	17	2570	28	1126	24	30	20	65	131	91	30	2775	4777	479	826	124	1353	20266
12	Karur	111	263	130	807	0	272	25	163	6	8	2	24	15	48	7	1211	2045	169	599	53	863	6821
13	Perambalur	170	97	147	363	0	441	5	300	8	3	0	34	49	17	1	119	920	17	161	10	1000	3862
14	Thanjavur	387	243	203	2900	6	1371	67	982	15	2	2	61	19	37	16	958	2499	117	102	0	1452	11439
15	Nagapattinam	195	88	150	1597	4	1795	66	774	25	5	0	24	42	21	10	281	1196	121	169	12	1466	8041
16	Tiruvarur	170	82	103	1165	0	1293	2	452	7	0	0	3	7	4	1	389	812	6	25	26	344	4891
17	Pudukkottai	309	159	49	1155	2	999	38	822	3	11	0	28	46	65	19	458	2362	100	128	2	545	7300
18	Erode	530	423	168	2642	7	1283	86	823	9	5	5	126	169	86	46	3280	7637	1252	1613	3	2376	22569
19	Coimbatore	1255	580	215	8407	41	2872	314	1672	84	15	8	518	785	207	93	7155	12663	1014	2071	7	2814	42790
20	Udhagamandalam	359	0	98	1837	88	564	82	393	36	2	1	45	85	88	12	428	653	160	236	0	427	5594
21	Madurai	817	196	238	6190	0	1448	115	1411	29	33	6	111	320	114	63	2253	3906	160	459	0	1523	19392
22	Dindigul	321	301	132	2459	24	1019	52	668	3	5	1	73	228	45	12	510	3184	107	384	0	1363	10891
23	Theni	242	73	90	961	0	257	56	665	14	8	2	94	87	44	10	303	1487	290	432	0	875	5990
24	Virudhunagar	348	179	134	1206	3	637	38	1032	11	4	2	195	205	107	23	1748	2277	106	482	0	874	9611
25	Sivagangai	258	130	59	1089	17	696	39	528	6	3	0	34	140	42	6	673	1301	430	34	0	498	5983
26	Ramanathapuram	295	65	46	2002	0	647	21	401	3	0	0	32	30	49	6	537	563	101	70	0	669	5537
27	Tuticorin	316	171	172	1835	66	1244	59	1146	17	3	0	204	103	104	28	1219	2774	95	329	290	764	10939
28	Tirunelveli	445	308	184	4341	179	2111	110	2778	43	7	4	89	262	156	39	3175	5076	193	205	11	2099	21815
29	Kanniyakumari	677	0	236	3596	121	1547	48	1266	65	0	0	53	195	92	34	1928	2171	77	196	6	928	13236
	State -total	16414	6345	3903	119719	914	35363	4713	28010	804	329	147	3480	4923	2556	735	48239	110144	10038	24739	1887	34046	457448
	Chennai city	3673	0	0	39782	222	5162	2400	3828	191	138	66	690	740	645	64	7156	16334	988	2939	649	660	86327

Source : Transport Department , Govt. of Tamil Nadu

The above data provides information on the number of commercial vehicles in various districts of Tamil Nadu as of April 1, 2003. The categories of vehicles include stage carriages, mini buses, auto rickshaws, ordinary taxis, motor cabs, maxi cabs, Omni buses, private service vehicles, school vehicles, ambulances, fire-fighting vehicles, light commercial vehicles, Lorries, articulated vehicles, national permit vehicles, and tractors. The vehicles are further classified as public or private, and whether they are operated by self-owners or associations.

In Chennai, the capital city, there were 3,673 stage carriages, 6 mini buses, and no auto rickshaws. Additionally, there were 39,782 public ordinary taxis, 222 self-owned ordinary taxis, 5,162 public motor cabs, 2,400 self-owned motor cabs, 3,828 public maxi cabs, and 191 self-owned maxi cabs. Chennai also had 138 self-owned Omni buses.

Other districts also had varying numbers of commercial vehicles, with different proportions of public and self-owned vehicles. For example, Kancheepuram district had 765 stage carriages, 157 mini buses, 84 auto rickshaws, 8,145 public ordinary taxis, and so on. The total number of commercial vehicles in the state was 457,448.

The data provides a comprehensive overview of the distribution of commercial vehicles across the districts of Tamil Nadu. It highlights the presence of a significant number of vehicles in Chennai, which is expected due to its status as the capital and a major urban center. The information can be useful for transportation planning, infrastructure development, and policy-making related to the management of commercial vehicles in the state.

Number of Vehicles in the State during 2003 and 2013

Year	Name Of The District	Stage Carriages		Mini Buses	Autorick-Shaws	Ordi-Nary Taxi	Motor Cabs		Maxi Cabs		Omni Buses		PSV
		Public	Private				SP	AIP	SP	AIP	SP	AIP	
2003	State - Total	16414	6345	3903	119719	914	35363	4713	28010	804	329	147	3480
2013		22053	8060	4125	218329	3751	92887	11881	63683	5208	750	163	13218

Source : Transport Department , Govt. of Tamil Nadu

Number of Vehicles in the Chennai during 2003 and 2013

Year	Name Of The District	Stage Carriages		Mini Buses	Autorick-Shaws	Ordi-Nary Taxi	Motor Cabs		Maxi Cabs		Omni Buses		PSV
		Public	Private				SP	AIP	SP	AIP	SP	AIP	
2003	State - Total	3673	0	0	39782	222	5162	2400	3828	191	138	66	690
2013		6546	6	0	70675	531	21560	7550	16023	3484	189	57	3474

Source: Transport Department, Govt. of Tamil Nadu

The significant number of vehicles directly contributes to air pollution in the state, with urban areas like Chennai City experiencing particularly high levels of pollutants such as CO and SO2. This can be attributed to the sheer volume of vehicles present. Moreover, inadequate fuel combustion and insufficient vehicle maintenance further exacerbate pollution levels. To address this issue, regular and thorough emissions checks are essential statewide to effectively monitor and control vehicle emissions.

Action Taken to Prevent Air Pollution in Tamil Nadu

1. **Industrial Pollution:** Several significant measures have been implemented to control industrial pollution in Tamil Nadu. Firstly, the city prohibits the establishment of new polluting units, aiming to prevent further pollution sources from emerging. Additionally, the city has also halted the construction of new incinerators, with a focus on phasing out existing ones. Instead, common facilities have been established outside the city to facilitate the safe incineration of bio-medical waste.

   Industries have been mandated to develop a green belt covering a minimum of 33% of their project area. Furthermore, industries are encouraged to contribute to the creation of green belts through avenue plantations along roadsides. Compliance with this condition is a prerequisite for the renewal of industrial consent.

   To ensure ongoing compliance and monitoring, industrial units are subjected to periodic inspections. These inspections involve the installation of online stack monitors, which are connected to the pollution control board's CARE Air center. This allows for real-time tracking and assessment of industrial emissions, enabling prompt corrective actions if necessary.

2. **Vehicular Pollution:** To address vehicular pollution in Tamil Nadu, several measures have been implemented to regulate vehicle emissions and promote sustainable transportation practices. Bharat Stage-II norms were introduced on July 1, 2011, mandating compliance for the registration of new passenger cars, which aim to control and reduce emissions from new vehicles.

   In Chennai city, emission norms for in-use vehicles have been established in consultation with the Ministry of Road Transport and Highways (MoRTH) and the Ministry of Environment, Forest and Climate Change (MoEF). These norms have been in effect since January 1, 1997, ensuring that all vehicles in the city adhere to specified emission standards.

   Since 1997, passenger cars fitted with catalytic converters have been registered, contributing to the reduction of harmful pollutants emitted by vehicles. To ensure ongoing compliance, regular inspections of in-use vehicles are conducted by officials from the Transport Department and Police Department in Chennai.

   The introduction of unleaded petrol since February 2000 has played a crucial role in reducing air pollution caused by vehicular emissions. Furthermore, in Chennai City, the

supply of low-sulfur diesel (0.05%) has been implemented since July 1, 2001, contributing to cleaner fuel consumption and reduced emissions.

Since April 1, 2002, the supply of pre-mixed 2T oil has been enforced, promoting the use of cleaner oils in two-stroke engines and reducing their emissions. Additionally, during peak hours, heavy vehicle entry in Chennai city is restricted on certain roads, minimizing congestion and associated pollution.

To improve overall transportation infrastructure and reduce traffic congestion, the construction of a Ring Road has been undertaken to divert intercity vehicles away from the city. The completion of the mass transport system, specifically the metro rail from Beach to Velachery, has provided an efficient and eco-friendly alternative for commuters.

Fiscal measures, such as the structuring of parking fees and road tolls, have been implemented to discourage private vehicle usage, encourage public transportation, and manage traffic flow effectively. These measures aim to mitigate vehicular pollution and promote sustainable mobility options in Tamil Nadu.

VII. CONCLUSION

Data collected from various organizations and departments of the Government of Tamil Nadu have revealed the presence of pollution in different districts of the state, highlighting the complex environmental pollution resulting from population growth, urbanization, and industrialization. While the establishment of control equipment, effluent treatment plants, and sewage treatment plants was believed to be sufficient for controlling emissions and ensuring safe effluent discharge, it is now recognized that the real solution lies in preventing pollution at its source through measures like resource recovery and cleaner technological processes.

The adoption of long-term preventive actions, such as process development to use less polluting raw materials, proves to be an effective approach in addressing environmental issues. An example of resource conservation is the recovery of chromium from tannery effluent. The compulsion to explore alternative energy sources has led industries producing hot waste gases to generate power, resulting in a reduction in coal usage and greenhouse gas emissions. Additionally, substituting hazardous substances with eco-friendly alternatives not only reduces pollution but also minimizes raw material consumption.

Environmental concerns arising from the generation of municipal solid waste, hazardous waste, e-waste, biomedical waste, and plastic waste from various sources including residential units, industries, healthcare facilities, and commercial establishments pose significant pollution challenges affecting land, water, air, and overall ecosystem health. In major cities and towns, issues related to sewage collection, treatment, and solid waste management remain unresolved. Transportation, particularly in urban areas, contributes significantly to air pollution, necessitating the development of effective traffic management plans.

Solving environmental problems requires a collective effort involving stakeholders from industries, waste processors, communities, NGOs, government bodies, and regulatory authorities. It is crucial for all stakeholders to have a comprehensive understanding of the latest legislations, technologies, standards, and related issues to facilitate the effective implementation of environmental protection programs.

To prevent air pollution, it is essential to reduce or eliminate the use of toxic substances that contribute to air pollution. This would involve discontinuing all fossil fuel-burning processes, ranging from industrial manufacturing to residential use of air conditioners. Regulations should be designed to further reduce harmful emissions into the Earth's atmosphere, ensuring a cleaner and healthier environment for future generations.

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