

Assessing Environmental and Health Impacts in an Industrial Cluster in Thoothukudi District

A Comparative Analysis using a Comprehensive Perception Survey



Citizen consumer and civic Action Group (CAG), Chennai

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Survey partner - Vidiyal Trust, Thoothukudi

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Introduction

Thoothukudi is an industrial district on the east coast of southern Tamil Nadu, with the port city of Thoothukudi as a major industrial hub. Due to the advantages offered by Thoothukudi port, the industrial cluster has spread to the neighbouring taluks as well. At the time of the survey, Thoothukudi district had five operational thermal power plants with nine more in the works. The area was also home to many chemical industries, including a copper smelting factory¹. In a thermal power plant, stack emissions, coal dust from the coal storage facility and ash pond are the major causes of air pollution while ash pond and coal washing water are the major causes of water pollution. For a smelting factory, the primary sources of pollution are the emissions of noxious gases and particulate matter from the smelting process². The concentration of chemical industries and thermal power plants in the industrial taluks of Thoothukudi district leads to a mixture of several contaminating sources. This makes it difficult to specifically measure and relate the impact of the thermal power plants and industrial activities on air, water, health and the surrounding environment. Thus, it is of interest to study the impact of these industries on the people of this district.

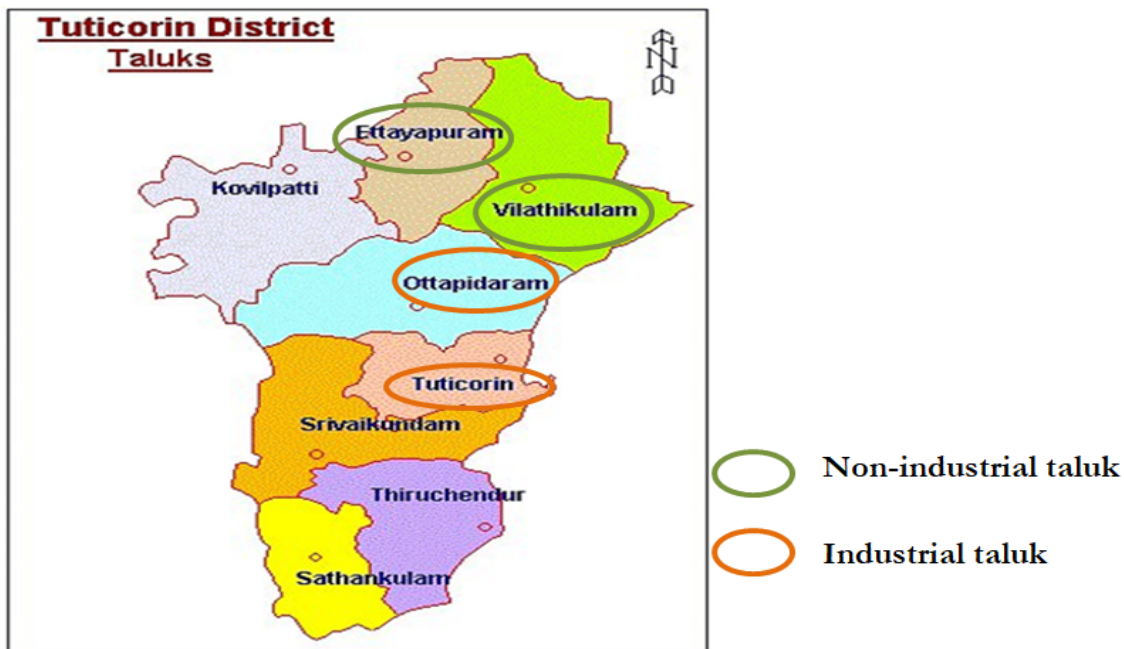


Figure 1 - Map showing the taluks selected for the study

Methodology

At CAG, we chose to undertake a public perception survey in October-December 2016 to assess the difference in the quality of life and environmental impacts, if any, as a result of industrialisation in Thoothukudi district. The survey was carried out in four taluks of the district. Out of the four taluks, two are industrial areas - Thoothukudi and Ottapidaram, with thermal power plants and chemical industries in-situ, while Vilathikulam and Ettayapuram are non-industrial areas with the populace primarily engaged in agriculture and inland fisheries. A stratified random sampling technique was used wherein survey participants from the four taluks (the four strata) were selected via a random sampling technique. The survey analysed the impact on resources such as agriculture, water, and well-being of those living in the sample areas.

¹ dcmsme.gov.in/dips/IPS%20Tuticorin%20Revised.pdf

² <http://www.miga.org/sites/default/files/archive/Documents/CopperSmelting.pdf>

In total, the sample included 2,002 respondents from four taluks of Thoothukudi district.

Taluk		No. of Respondents
Industrialized area	Thoothukudi	520
	Ottapidaram	490
Non Industrialized area	Vilathikulam	580
	Ettayapuram	412
Grand total		2,002

Table 1 - Number of respondents from each taluk

Further, out of the 2,002 samples, 1,624 (81.12%) were male and 378 (18.88%) female. However, due to cultural and educational barriers, a sizeable percentage of women who were interviewed were unable to respond adequately.

Respondents were also chosen across age categories as detailed below.

Age	Total number of respondents
21-30	407
31-40	312
41-50	702
51-60	370
Above 60	211
Total	2,002

Table 2 - Respondents grouped by age

Perception survey gives us the opportunity to understand the experience of the individuals living in the study area, their understanding of their locality and health. Perception survey captures the understanding of the survey respondents on the chosen topic which then could form the basis for further scientific studies in related areas. Responses were collected by volunteers trained in using [Kobo toolbox](#), a free, open-source tool for mobile data collection. The advantage of Kobo toolbox is that it is a dynamic method of data collection and provides an interface for immediate analysis, including basic data visualisation techniques. It is a scalable and easy method to collect data digitally or on paper in the field. The volunteers were the local youth - graduates and diploma holders.

This perception survey aims to ascertain:

- (a) Linkages between industrial development and changes in the local environment, including air and water quality
- (b) Changes to agriculture and fishing due to industrial pollution; and
- (c) Impact of industrial pollution on the health of people living in these clusters

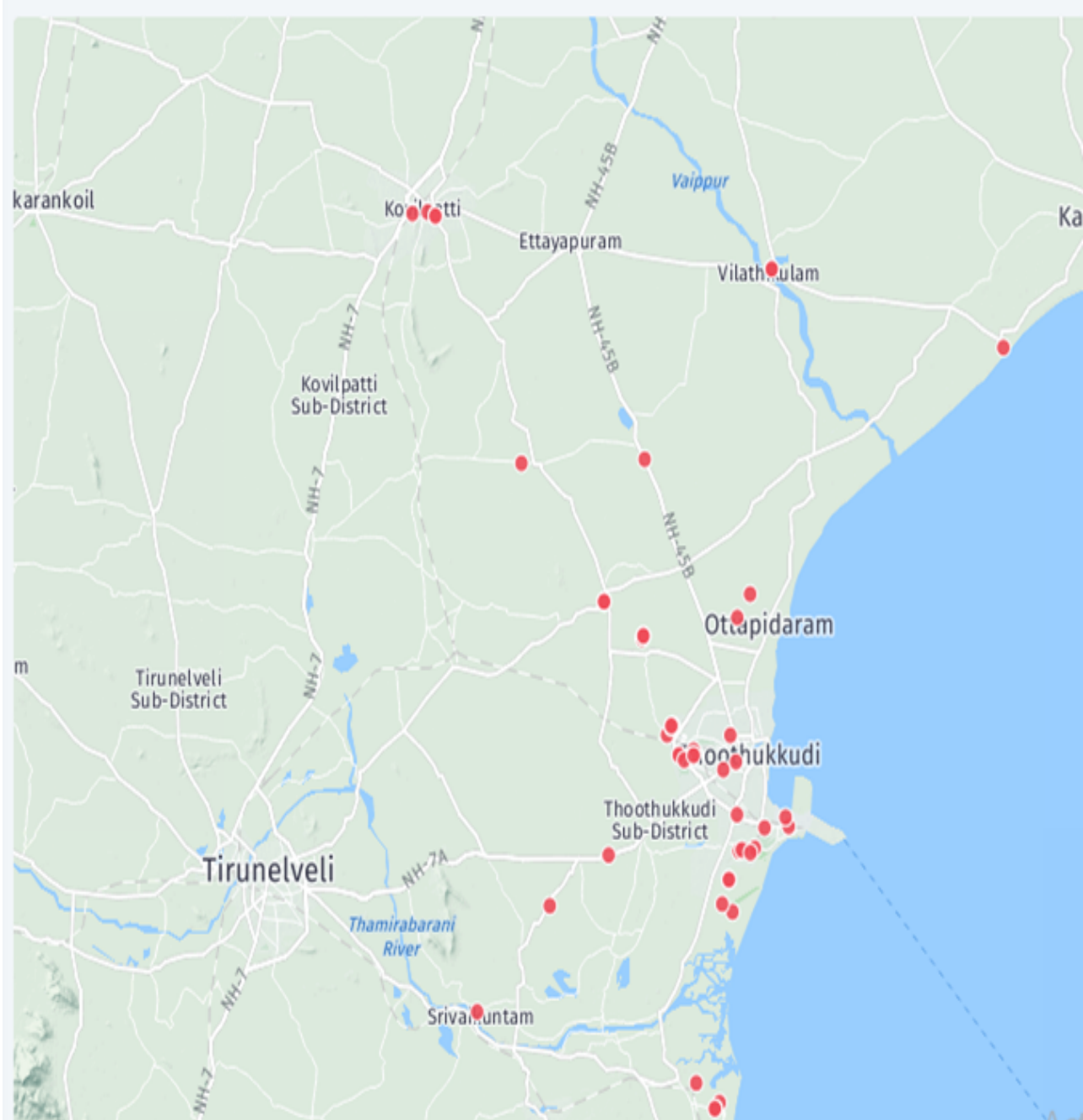


Figure 2 - Map showing the location of industries in four taluks

The findings of the survey are discussed below.

Survey findings

Education and Income

With the advent of industries in a location, the incentives for formal education increase, which is reflected in the significantly higher number of graduates in the industrial taluks (15%). The number of graduates in these taluks is 13% points higher than in the non-industrial taluks (2%).

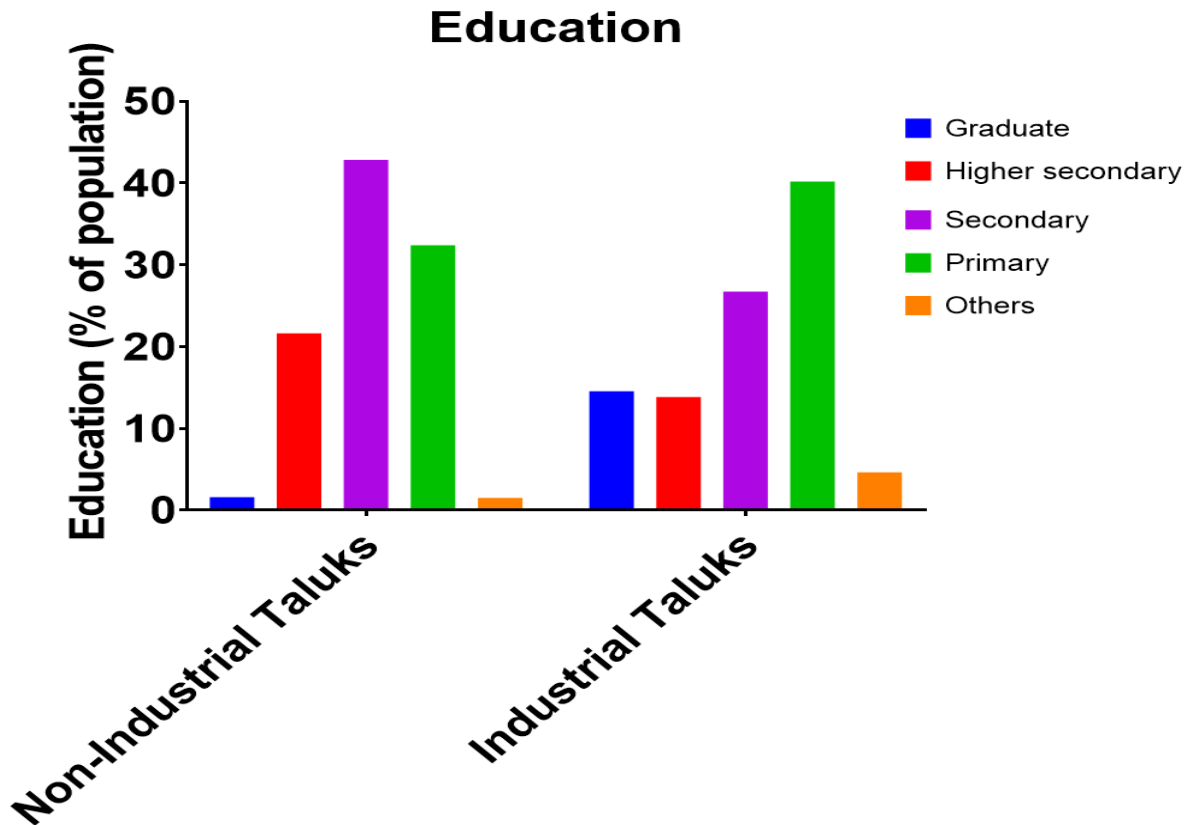


Figure 3 - Education levels in the four taluks

While 40% of respondents in the non-industrial taluks reported a family income of more than ₹1,00,000 per annum, only 4% of respondents in the industrial taluks earn in this range. 76% of respondents in the non-industrial taluks earn more than ₹75,000 per annum, whereas less than 20% of respondents from industrial taluks earn in this range. There are twice as many respondents in the industrial taluks whose families earn less than ₹25,000 per annum as compared to respondents in non-industrial taluks.

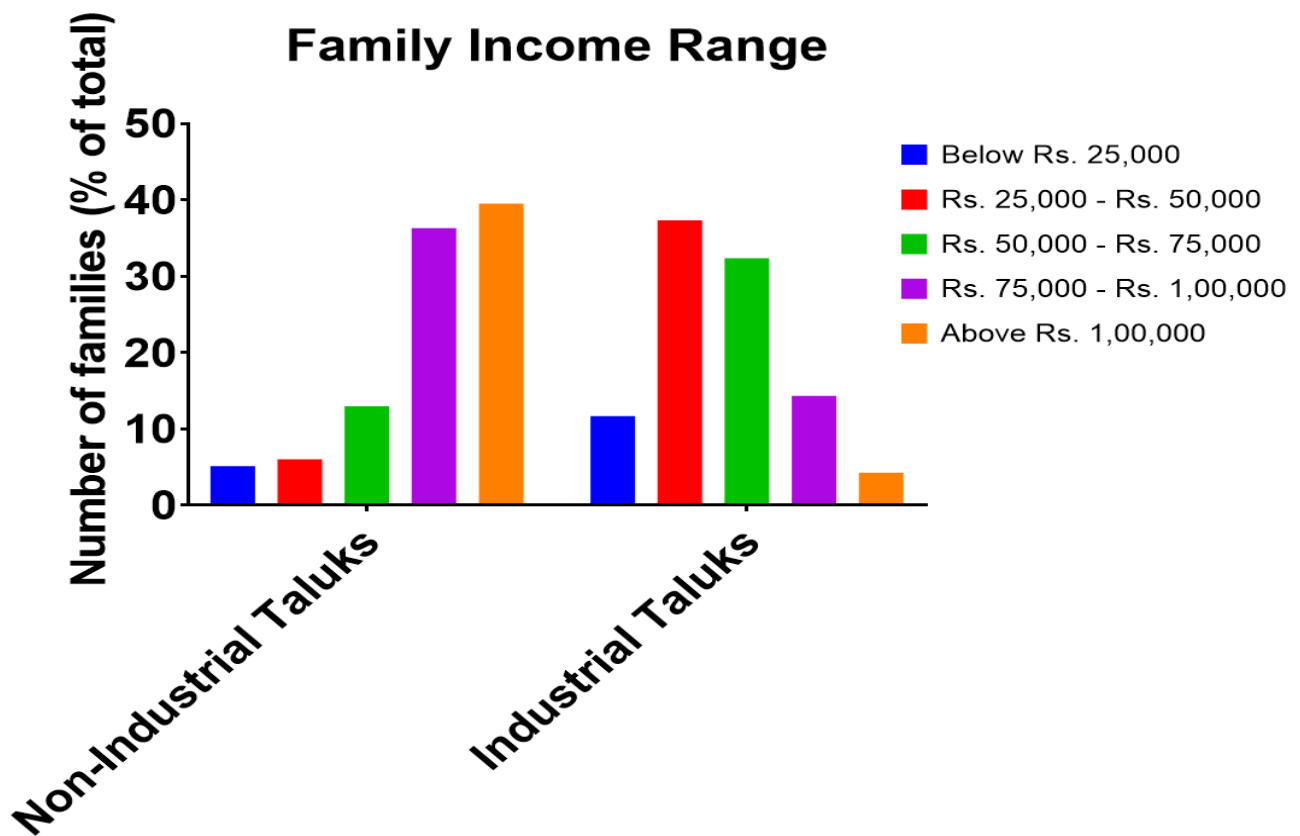


Figure 4 - Annual income range of families

Agriculture

Agriculture is defined by the soil characteristics, water availability, and climatic conditions of the particular area. The physical characteristics of soil are influenced by many factors including nutrient change and change in chemical composition. These factors are influenced by pollutants such as heavy metals, coal dust and fly ash released from industries. To assess perceived effects of pollutants on agriculture, respondents were asked about the major crops grown in the area, whether there is an effect on productivity in the past decade (positive or negative), change in soil colour and texture, change in production in the last decade, crop changes post irrigation and presence of any heavy metals in soil.

Even with a cluster of industries in the vicinity, 42% of the respondents from the industrial taluks are involved in agriculture either as farm owners (26%) or as farm labourers (16%). In the non-industrial taluks, 26% of the respondents are involved in agriculture, as farm owners (21%) or farm labourers (5%). Of those involved in farming, we see a stark difference in the annual income between the industrialised and non-industrialised taluks with the latter having better income levels. 89% of the respondents involved in farming in the industrialised taluks earn less than ₹75,000 per annum as compared to 52% of the respondents involved in farming in the non-industrial taluks. 48% of the respondents involved in farming in the non-industrial taluks earn more than ₹75,000 per annum as compared to only 11% of the respondents involved in farming in the industrial taluks. Major crops cultivated by the respondents were groundnut and chilli in the non-industrial taluks, and pulses, rice, corn and coconut in the industrial taluks

In the 10-year data (2005 to 2015), for the total agriculture produce (kg/acre/annum), we see a rise in the median annual produce for the non-industrial taluks from 2005, when it was 1,500 kg/acre/annum to 2,000 kg/acre/annum in 2013. In 2015, however, the median for the total annual produce fell to 1,500 kg/acre/annum. In the same period, the median for the total agriculture produce of industrial taluks fell from 1,500 kg/acre/year to 1,200kg/acre/year (figure 1). The data could imply that the industrialisation may have had

an impact on yield. However, weather patterns, crop patterns etc may play additional roles. Higher dependency on agriculture coupled with lower yields could be the reason for lower-income levels of the respondents in the industrial taluks.

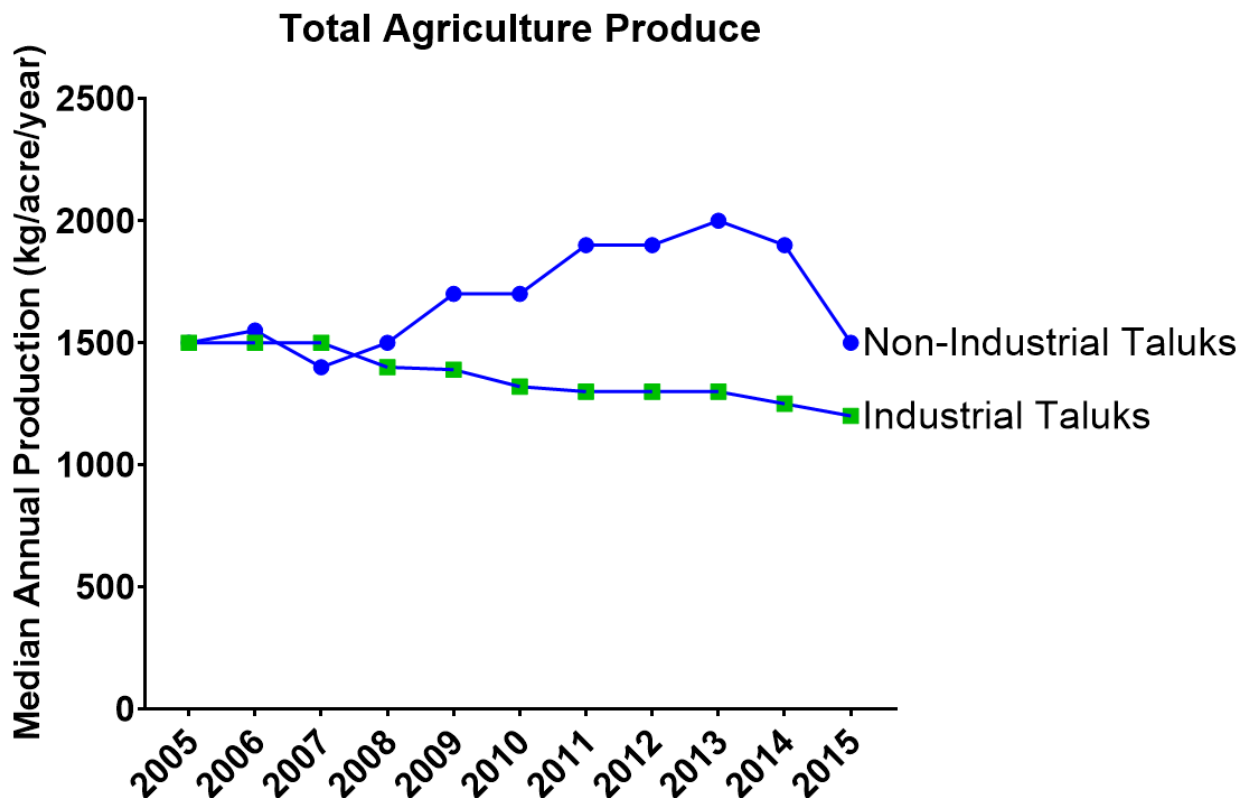


Figure 5 - Change in total agriculture produce between 2005 to 2015

Water for irrigation

It is interesting to note that the farmers in both these groups vary greatly in their source of water for irrigation, with farmers in industrial taluks dependent on more than two sources (borewells, panchayat connection and lakes/ponds) as compared to the farmers in non-industrial taluks, who use only one water source of which lakes/ponds are used by 36% of the respondents. Piped connection in industrial areas indicates the benefits of industrialisation flowing to the farmers. In the industrial taluks, 11% of the respondents involved in farming reported wilting, while 43% of the respondents involved in farming reported drying of their crop after irrigation. This indicates the possibility of harmful chemicals in the water for irrigation.

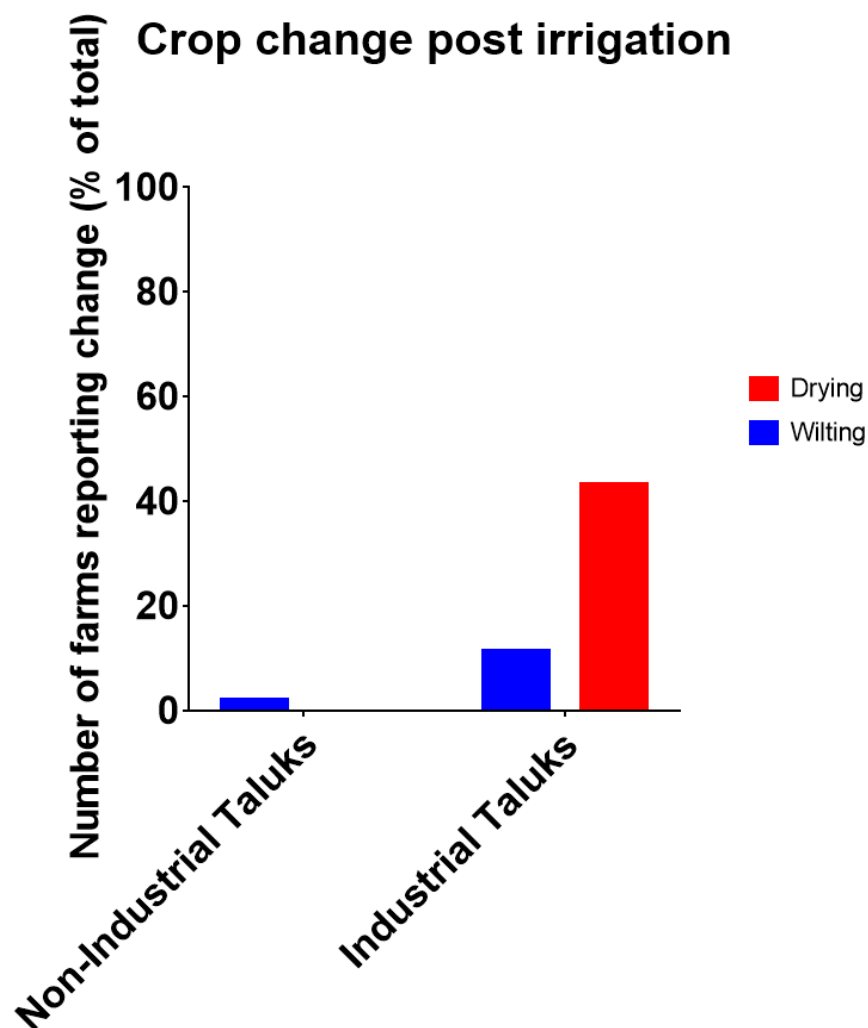


Figure 6 - Crop change post irrigation

Fishing

The questionnaire contained items relevant to identifying the impact of industrial waste on the fishing industry. Inland fishing is carried out in open sources like ponds and tanks. 30% of respondents from the industrialised taluks are involved in fishing as compared to less than 1% in non-industrial taluks³. Most of the respondents in both the groups are involved in fishing in tanks and ponds (64% of the sample surveyed) as compared to the ones fishing in the sea (25% of the sample surveyed) or in the river (10% of the sample surveyed). 55% of respondents involved in fishing from the industrial taluks have reported changes in their fish catch in the last five years (2010 to 2015). These changes are either reduction in quantity only (24%), change in the fish species only (23%), or both (53%). 41% of the respondents reported changes in the breeding season of fish which in turn can impact the size and sex of the catch. For those respondents whose main source of income is fishing (24% of respondents from industrial taluks), these changes would reflect in their reduced earnings. 61% of the respondents involved in fishing in industrialised taluks earn less than ₹50,000 per annum which is 15% of the total respondents from this group. In comparison, only 26% of the respondents involved in fishing in non-industrialised taluks earn less than ₹50,000 per annum which is just 1% of the total respondents from this group. Thus, we can see fishing too, is one of the reasons for lower-income of respondents in the industrial taluks.

³ No respondents from Vilathikulam, one of the two non-industrial taluks, are involved in fishing.

→ No. of people reporting change in	Pattern	Quantity	Species	Species & Quantity	Breeding season	Respondents involved in fishing
↓ Taluk						
Ettayapuram	18	7	12	1	13	41
Ottapidaram	47	14	20	28	63	130
Thoothukudi	46	18	11	44	37	116
Grand Total	111	39	43	73	113	287

Table 3 - Respondents view on changes in fishing pattern, quantity, species, breeding season

Health

According to the WHO's Global Burden of Disease (GBD) 2010 report published in December 2012⁴, outdoor air pollution has become the fifth largest killer in India after high blood pressure, indoor air pollution, tobacco smoking, and poor nutrition. Industrial pollutants affecting air and water quality causes major environmental health problems, a universal problem affecting both the developed and the developing world.

While only 45 (5%) respondents from the non-industrialised taluks reported health ailments like high blood pressure, tiredness and headache, 340 (34%) respondents from the industrial taluks have reported ailments like asthma, shortness of breath, kidney ailments, tiredness/lethargy, joint pain, headaches, high blood pressure and cough. Industrial pollution is a well-known trigger for various health ailments by virtue of pollutants creeping into the air we breathe, the water we consume, the food we eat and the level of noise we are exposed to. Thus, the survey next set out to record the participants' perception of air quality, domestic water quality and noise.

⁴<https://www.cseindia.org/latest-finding-listing-air-pollution-as-one-of-top-10-killers-in-the-world-shocking-says-cse-4730>

Perception of Air Quality

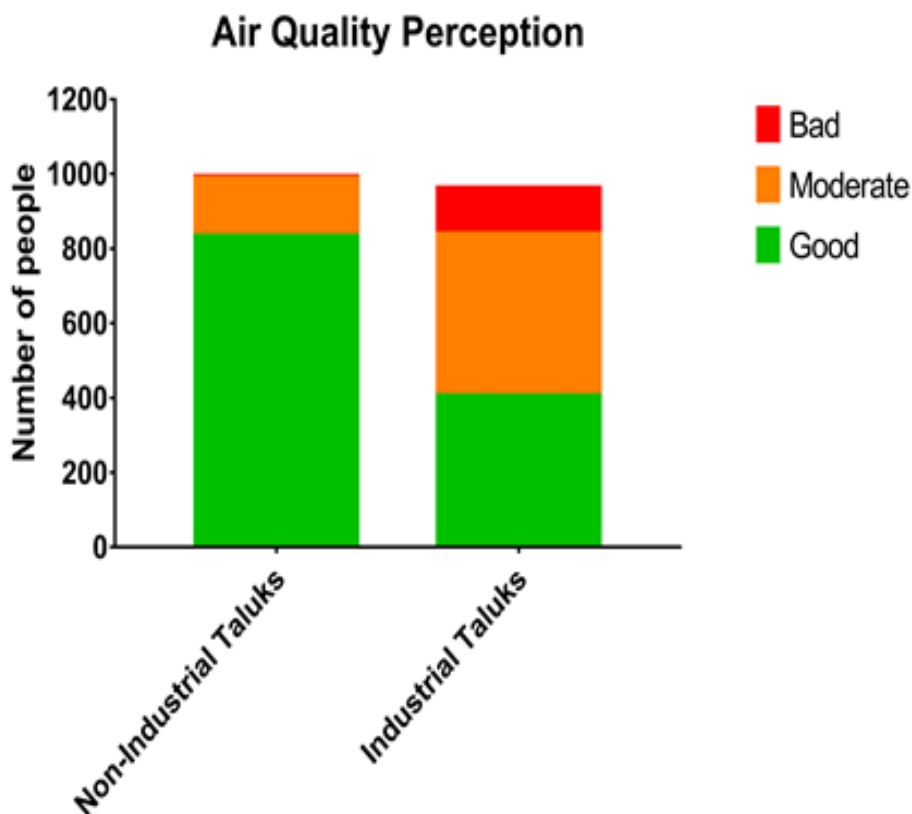


Figure 7 - Air Quality Perception

60% respondents from industrialized taluks do not have a good perception of ambient air quality. They rate it as bad or moderately poor in quality. In absence of air quality monitoring stations in these taluks, it is difficult to ascertain at this stage if there is a direct link between people's perception of ambient air quality and higher incidence of ailments like asthma and shortness of breath. Eight of ten respondents from the non-industrialized taluks have reported they perceive their air quality to be good.

Perception of changes due to air pollution

20% of the respondents from industrialized taluks reported foul smell and 40% of them reported breathing difficulty. Corrosion of metal surfaces, colour change and drying of plant leaves was reported by more than half the respondents. Respondents in the non-industrial taluks did not experience these problems.

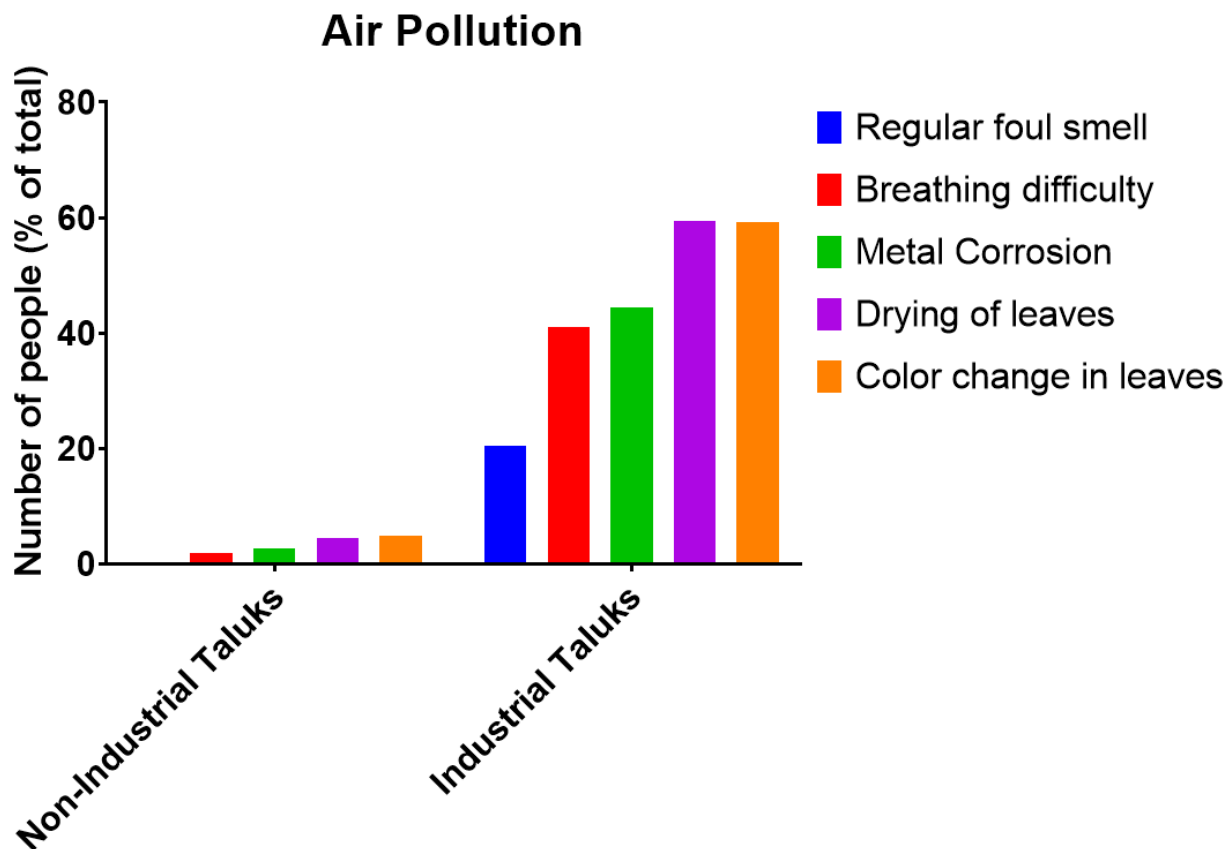


Figure 8 - Perception of changes due to air pollution

Domestic Water

There is a marked difference in the respondents' preferences with respect to source of water for domestic consumption, with 50% of the respondents in the industrial taluks dependent on municipal/panchayat connections, whereas almost 40% of the respondents in non-industrial taluks relied on lakes/ponds. This could be either due to drying up of the lakes/ponds or due to pollution in the industrialised taluks.

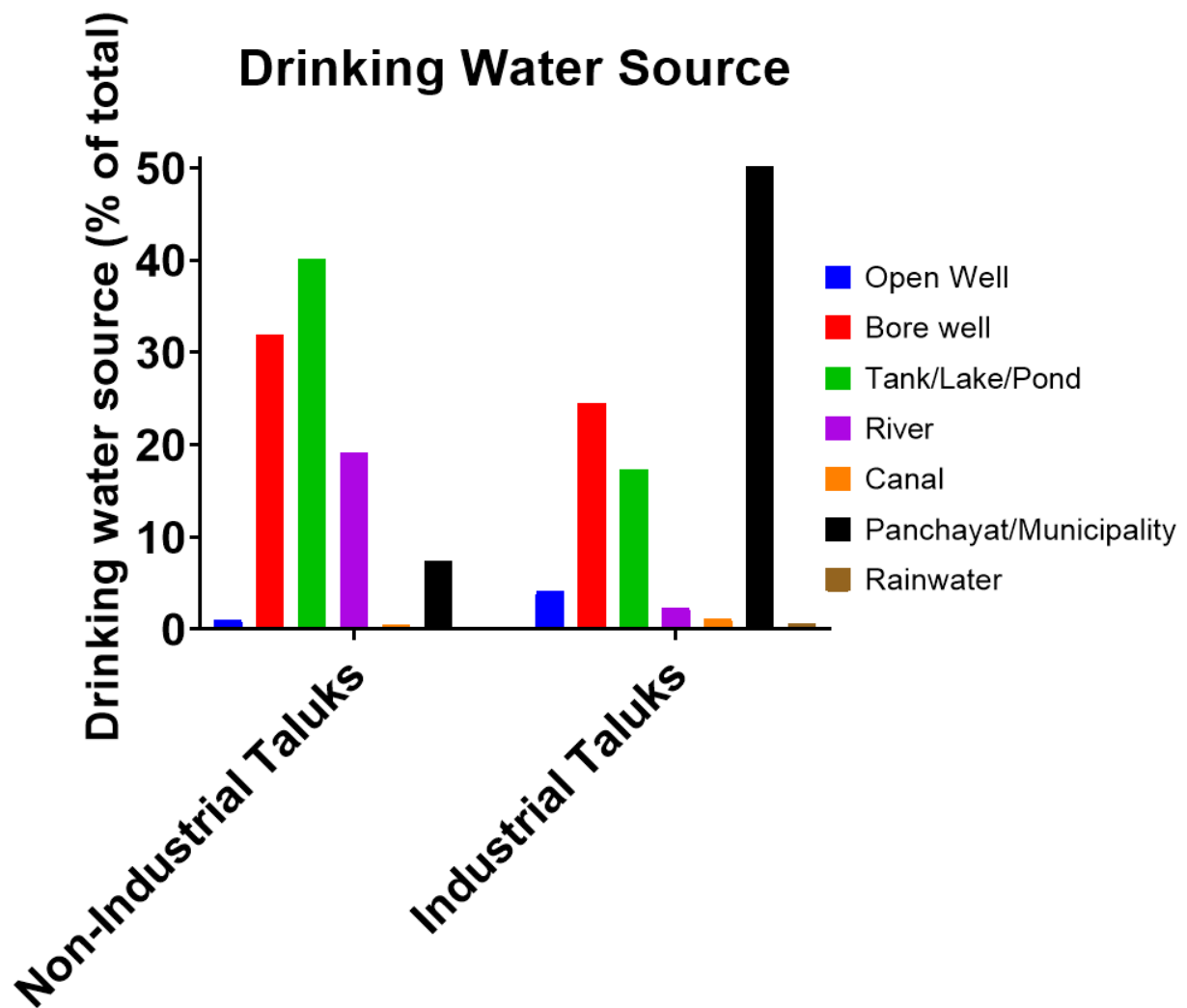


Figure 9 - Source of drinking water

Almost all respondents in industrialised taluks have reported increased salinity, and change in taste and colour of water. Concomitantly, 50% of the respondents reported vomiting, fever, nausea, and kidney ailments post water consumption. None of the respondents from non-industrial taluks reported any change in taste, salinity or colour of water, and very few reported vomiting, fever and nausea.

Health Issues related to water consumption

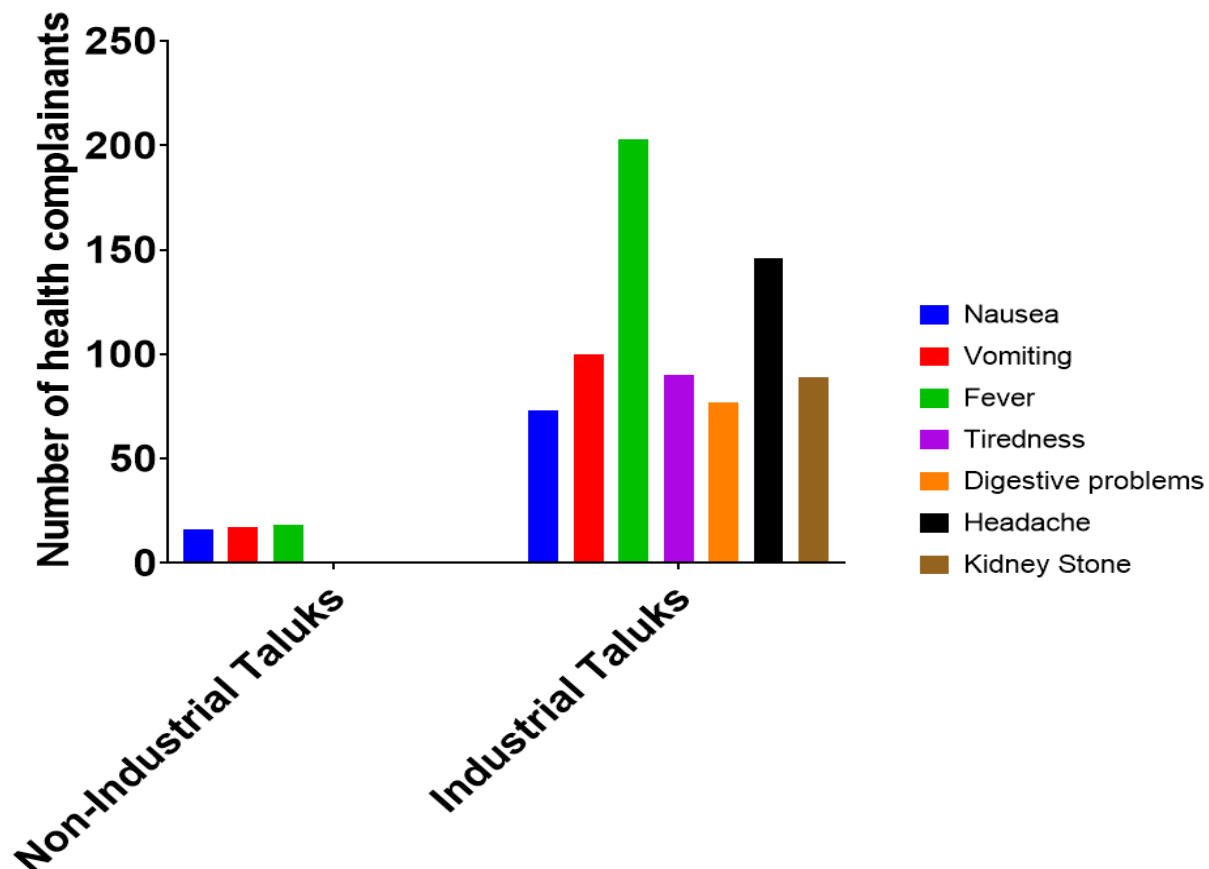


Figure 10 - Perception of health issues related to water consumption

Noise Pollution

There are 191 complaints of loud noises, sleep disruption and changes in the behaviour of domestic animals from industrialized taluks as compared to zero in non-industrialized taluks. Noise-led sleep disruption can lead to ill effects like increased blood pressure, increased heart rate and increased feeling of fatigue.

Summary

Environmental degradation due to pollutants in air, water and soil poses a significant threat to human health worldwide. Harmful consequences of this degradation of human health are already being felt globally. The results of this survey validate the statement above.

The industrialised taluks have more graduates, lower family income and lower agricultural yield, when compared to the non-industrialised taluks. Their water has undergone significant perceived changes in colour, odour, salinity and taste, compared to the other group.

Sleep interruption appears to be the most common outcome of noise pollution in industrialised areas. There is a marked difference in health-related issues between industrialised and non-industrialised areas. More respondents reported asthma and respiratory tract infections from Ottapidaram and Thoothukudi, than Ettayapuram and Vilathikulam. Air quality in industrial areas is perceived to be poor with residents rating it from moderate to bad.

Lack of awareness and relevant knowledge amongst the respondents has severely restricted the information gathered on parameters such as soil degradation and presence of heavy metals in soil. However, there appears to be a direct link between the incidence of asthma and living in an industrialised zone.

Taken together, **all these findings from the perception study indicate that industrialisation has been perceived to have an unwelcome effect on the quality of life** in the industrialised taluks.

Therefore, remedial measures and effective mitigation plans are needed to ensure that the environmental and health impacts of the industries are minimized. Appropriate steps would need to be taken to achieve the minimisation of impacts posed by industries.

Recommendations

This perception survey reveals what people living in the vicinity of industries experience, and perceive as the changes brought about in their lives by industrial development. Some recommendations are given below for consideration:

- It is evident that the perceived effects of industrial pollution in the industrial taluks have not spread to the non-industrial taluks. Keeping this in mind, any plans for industrialisation of previously non-industrialised areas have to be undertaken with adequate mitigation measures in place.
- Possible spillover pollution in non-industrial areas must be monitored continuously. For this purpose, an in-depth regional cumulative impact assessment needs to be conducted in case any new industry is to be set up or existing industry expanded. Rather than a piecemeal approach to a project and its environment impact assessment, such an exercise will help ascertain the impact of existing projects and the incremental impact of the project proposed. At the local level, installation of air and water quality monitors in the industrial taluks should be undertaken for continuous monitoring of the air and water quality.
- Efforts should be made to ensure that all farmers have been provided with soil health cards, and regular soil analysis is undertaken.
- The effectiveness of the existing environmental mitigation plans adopted by industries needs to be analysed, and possible course-correction strategies implemented. For industries which have been in operation for a long time, an assessment of the technologies in place has to be conducted.

- Efforts should be undertaken to promote greater awareness among the local communities on the effect of industrialisation on the ambient air quality. This can help them make informed choices regarding the development of their village/town/city when new projects are proposed.
- Undertake periodic testing of water used for irrigation for presence of heavy metals, so as to enable implementation of appropriate measures to overcome the harmful effects of heavy metal contamination.
- Ensure proper implementation of the prescribed standards for effluent discharge by industries.

Scope for future research

This study has focused on overall indicators leaving scope for further research on the impact of industrialisation on the health of children, pregnant or lactating women, and the elderly in these taluks. As these groups are the most vulnerable to the ill effects of air, water or soil pollution, periodic monitoring of the health of these groups is desirable.

Responses received in the survey could spur research exploring the links between specific pollutants and the health issues reported by respondents from the industrial taluks. Their research could establish, with scientific evidence, what the respondents have perceived and reported in this survey.

Annexure

List of Industries and its location in Thoothukudi District (Through RTI)

Industry name	Place	Coordinates (latitude)	Coordinates (longitude)
BPCL	Madurai Bypass road, Thoothukudi		
SHV LPG India private limited	Thoothukudi new harbour, Mullakadu	8.7204° N	78.1279° E
IOC Ltd	Harbour Estate, Mullakadu, Thoothukudi	8.7204° N	78.1279° E
Kalpaka Chemicals private Ltd	Ninnarpuram post, Thoothukudi	8.8177° N	78.1292° E
Adsorbent Carbons P ltd	Meelavittan, Thoothukudi	8.80444 ° N	78.0855 ° E
Indian Gas limited	Madavan kurichi, Trichendur taluk	8.1471° N	77.3023° E
Vedanta Limited	SIPCOT Industrial complex, Madurai Bypass Road, TV puram post, Thoothukudi	8.8233 °N	78.0786°E
DCW Ltd CPP division	Sahupuram, Thoothukudi	8.7641661° N	78.1348361° E
DCW Ltd Co-Gen power plant	Sahupuram, Thoothukudi	8.5833° N	78.1° E
Rajkumar Impex P Ltd	Thanoothu village, Srivaikuntam Taluk	8.7027° N	77.9746° E
V.V. Titanium Pigments Private Ltd	SIPCOT Industrial complex, South Veerapandiapuram post, Thoothukudi	8.8179° N	78.0749° E
DCW Limited	North kayalpattanam, Tiruchendur taluk, Thoothukudi	8.57°N	78.12°E
Premier Building Materials Pvt Ltd	South Ilanthakulam, Kovilpatti	9.1674° N	77.8767° E
Zirconium Complex	Pazhaya kayal village, Srivaikundam taluk	8.6986°N	78.131°E.
Bala Murugan Chemicals Pvt Ltd	South Sillukkanpatti, Thoothukudi		
Amba Fluoro Chem Global Limited	Ottapidaram taluk, Thoothukudi	8.9077° N	78.0210° E
Green star Fertilisers Pvt Ltd Ammonia Production	Mullakadu village, Thoothukudi Taluk	8.7204° N	78.1279° E
Nellai Cements Ltd	Nagampatti, Ottapidaram Taluk, Thoothukudi	9.0009° N	77.9503° E
My Home industries P Ltd	Melmaruthur village, ottapidaram taluk, Thoothukudi	8.8970° N	78.135075° E
NC John Sons pvt Ltd	Madathur Village. Thoothukudi	8.8075° N	78.0977° E
Indian Rare Earths Ltd	Mullakadu village, Thoothukudi Taluk	8.7040° N	78.1222° E
Heavy water plant,	Muthiahpuram, Thoothukudi	8.7416° N	78.15°E.
Coco Tufters Private Ltd	SIPCOT industrial estate, Thoothukudi	8.80415° N	78.097° E

DCW Limited Caustic Soda division	North Kayalpattinam Village, Tiruchendur tk, Thoothukudi Dt	8.566° N	78.1163°E
Transstory Shallow Draught Berth Port	VOC port, Thoothukudi	8.7563° N	78.1791° E
Thoothukudi Coal terminal Pvt Ltd	Muthiahpuram, Thoothukudi	8.7396° N	78.1365° E
DCW Limited	North Kayalpatnam, Thoothukudi District	8.566°N	78.116°E
IND Barath Energies	Eppodumvendran, Ottapidaram Tk, Thoothukudi	8.8827449 ° N	78.0535832° E
Sujana Power Thoothukudi ltd	Keela Arasaradi, Ottapidaram taluk, Thoothukudi	8.9077° N	78.0210° E
Sujana Power Gangaikondan Ltd	Keela Arasaradi, Ottapidaram taluk, Thoothukudi	8.9077° N	78.0210° E
Indian power projects ltd	Vembar village, Vilathikulam Village, Thoothukudi	9.0788° N	78.3629° E
Udangudi Super Critical Thermal Power	Udangudi, Tiruchendur taluk, Thoothukudi	8.434722° N	78.061111° E
Ind Barath Power Gencom Ltd	East Velayuthapuram, Ottapidaram taluk, Thoothukudi	8.8848° N	78.0547° E
Vedanta Limited thermal power division	SIPCOT, milavittan, Thoothukudi	8.8243° N	78.0795° E
Thoothukudi Thermal power station	Thermal nagar, Thoothukudi	8.7625° N	78.1764° E
NLC Tamilnadu Power Ltd	Mullakadu village, Thoothukudi Taluk	8° 4538.09° N	78° 1015.85° E
SPIC Electric power corporation Ltd	Thermal nagar, Thoothukudi	8.7553302° N	78.1584334° E
Coastal Energen p Ltd	Melamarudhu Village, ottapidaram taluk, Thoothukudi	8.9128° N	78.1461° E
Ind Barath Thermal power Ltd	Saminathan and ottapidaram, Thoothukudi	8.8848° N	78.0547° E
Ind-barath Thermal Madras Ltd	Sasthavinallur, pallakkurichi, Sathankulam taluk, Thoothukudi	10.667076 °N	79.772229°E
Vedanta Limited, Copper Smelter Project	Meelavittan, Thoothukudi	8.8233°N	78.0786°E
Vedanta Ltd-Copper smelter plant-2	SEZ, SIPCOT, south veerapandiya puram, Ottapidaram Taluk	8.8044°N	78.085°E
SPIC ltd	SPIC nagar, Thoothukudi	8.7405° N	78.1391°E
TAC Ltd	SPIC nagar, Thoothukudi	8.7385° N	78.1463° E
Vedanta Ltd, Copper Rod project	SIPCOT, Meelavittan, Thoothukudi	8.8243° N	78.0795° E
KTV-KOG Food products India Pvt Ltd	SIPCOT, Meelavittan, Thoothukudi	8.8243° N	78.0795° E
Sewerage Treatment plant	Alagiya Mamallapuram, Tiruchendur Tk, Thoothukudi Dt		
Sewage treatment plant Thoothukudi corp	Thoothukudi	8.824 °N	78.0786°E

OEG Renew Waters Thoothukudi pvt ltd	Keela Arasaradi, Ottapidaram taluk, Thoothukudi	8.9077° N	78.0210° E
VVD and sons Pvt Ltd	Sinthalakattai Village, Ottapidaram taluk, Thoothukudi	8.7998° N	78.1339° E
maris Associates PVT ltd	SIPCOT, Meelavittan, Thoothukudi	8.8009° N	78.0896° E
Loyal Textile Mills Ltd	Mill street, Kovilpatti	9.17°N	77.87°E
The lakshmi mills company Ltd	Lakshimipuram, Kovilpatti	9.169°N	77.857°E
Arsan Syntex Ltd	Eppodumvendran, Ottapidaram Tk, Thoothukudi	9.0035° N	78.0559° E
SSD Spinning mills	Thoothukudi	9.1674° N	77.8767° E
Kayaar Exports Pvt Ltd	KR nagar, Kovilpatti	9.1674° N	77.8767° E
Aruppukottai shri vijayalakshmi textile mills ltd	Sankaralingapuram village, vilathikulam Tk, Thoothukudi	9.5096° N	77.8925° E
jai jagadhabika textile mills Pvt Ltd	Sankaralingapuram village, vilathikulam Tk, Thoothukudi	9.5096° N	77.8925° E
Jayavelu spinning mills Pvt Ltd	Mettipatti Village, Vilathikulam Tk, Thoothukudi dt	9.1316° N	78.1646° E
Thoothukudi spinning mills	Palayamkottai road, Thoothukudi	8.7944° N	78.1232° E
Madura Coats Ltd	beach road, Thoothukudi		
Mountain Spinning Mills	Kottudankadu village, Thoothukudi Tk, Thoothukudi Dt	8.7369° N	78.0250° E
Sahayamatha Salt Refinery Ltd	Thoothukudi		
DCW Salt works Division	Arumuganeri, Tiruchendur Tk, Thoothukudi Dt		
Zirconium Complex Desalination plant	pazhaya kayal village, Srivaikundam taluk	8.6312° N	77.9125° E
South Ganga Water Technologies P ltd	Keelaarasaradi Village, Ottapidaram taluk	8.9077° N	78.0210° E
St John CFS Park	SIPCOT, Harbour express road, Thoothukudi	8.8041°N	78.0977° E
Universal Mine Developer and Service Pro Ltd	kattarangulam Village, kovilpatti Taluk, Thoothukudi Dt		
TN Solar Power Energy private limited	Cithivinayakanpatti, Vilathikulam, Thoothukudi Dt	9.1316° N	78.1646° E