



Government of Puducherry



LiFE
Lifestyle for
Environment

**Department of Science, Technology & Environment
Puducherry Pollution Control Committee**

EIACP HUB NEWSLETTER

Status of Environment Related Issues in Puducherry

ASSESSMENT OF URBAN AIR QUALITY IN PUDUCHERRY DURING DIWALI CELEBRATIONS (2020-2023)

Volume XV-III

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About EIACP

 Environmental Information System (ENVIS) was renamed as EIACP (Environmental Information, Awareness, Capacity Building and Livelihood Programme).

 ENVIS came into existence as a plan programme in 1983.

 It is a project funded by the Ministry of Environment, Forests and Climate Change (MoEF&CC), to facilitate collection, analysis and dissemination of information on various facets of environment.

 The information is being disseminated through the quarterly newsletter and website.

About Puducherry - EIACP PC HUB

Puducherry EIACP (formerly ENVIS) Hub Centre was started on 22nd September, 2005. Our centre located at the Puducherry Pollution Control Committee (PPCC), Puducherry, focuses on special reference to "Status of Environment Related Issues". Activities of our centre include collection, analysis, storage, retrieval and dissemination of information in the subject area allotted. The information is being disseminated through the quarterly newsletter and various environmental awareness program in schools and colleges for imparting Environmental comprehension among students.

Aims and Objectives

 To nurture green, sustainable and inclusive workforce in order to enhance both living and environment standards while fostering gainful and self-employment of youth.

 To conduct skilling courses not only in traditional areas but also in new emerging areas like electric vehicles, hazardous waste/ Bio-medical waste etc. considering their future scope, requirements and prospects.

 To be involved in the Mission LiFE (Lifestyle for Environment) being conceptualized by the Ministry.

 To facilitate technical and environmentally conscious industrial participation focused on sustainable development.

 To develop national and international collaboration for knowledge exchange and skilling and facilitating attainment of the SDGs.

 To aid sustainable livelihoods of tribal population especially in NER based on traditional knowledge and crafts.

 To facilitate informed decisions and policy making by catering to demand for research, innovation and data on emerging issues related to environment.

 To facilitate transition to environmentally conscious futuristic citizens including awareness among public/communities on environment related issues.

INTRODUCTION

The Diwali festival in India, characterized by fireworks and festivities, significantly increases air pollution levels in urban areas of the Puducherry region. Data from various sources shows a significant increase in particulate matter (PM), sulfur dioxide (SO₂), and nitrogen dioxide (NO₂). The noise pollution from firecrackers also poses a threat to public health and the environment.

Diwali, also known as the Festival of Lights, is a significant Indian and global festival celebrated with fireworks, decorations, and joy. However, it also raises environmental concerns, especially air and noise pollution. The Assessment of Diwali Mentoring using Ambient Air Parameters aims to evaluate the environmental impact of Diwali celebrations, balancing cultural traditions with environmental stewardship, and providing insights for sustainable practices for future festivities.

This assessment aims to quantify changes in ambient air quality and noise levels during the Diwali period, exploring potential solutions and mitigation strategies. Engaging stakeholders like community members, policymakers, and environmental experts, the assessment seeks to promote dialogue and collaboration towards sustainable and eco-friendly approaches to celebrating Diwali. The Assessment of Diwali Mentoring using Ambient Air Parameters aims to promote awareness, accountability, and innovation in managing the environmental consequences of cultural festivities. Through empirical data and collaborative efforts, it aims to create a future where Diwali celebrations coexist with environmental preservation for a cleaner, more sustainable future.

STUDY AREA

The Union Territory of Puducherry comprises the former French colonies of Puducherry, Karaikal, Mahe, and Yanam, surrounded by Tamil Nadu, Kerala, and Andhra Pradesh. The Puducherry district covers 294 square kilometres and consists of 12 scattered areas. The 2011 census reported a total population of 950,289, with 69.16% in urban areas and 30.84% in rural areas. This study selected urban areas under the two municipal regions of Oulgaret and Puducherry for analysis.



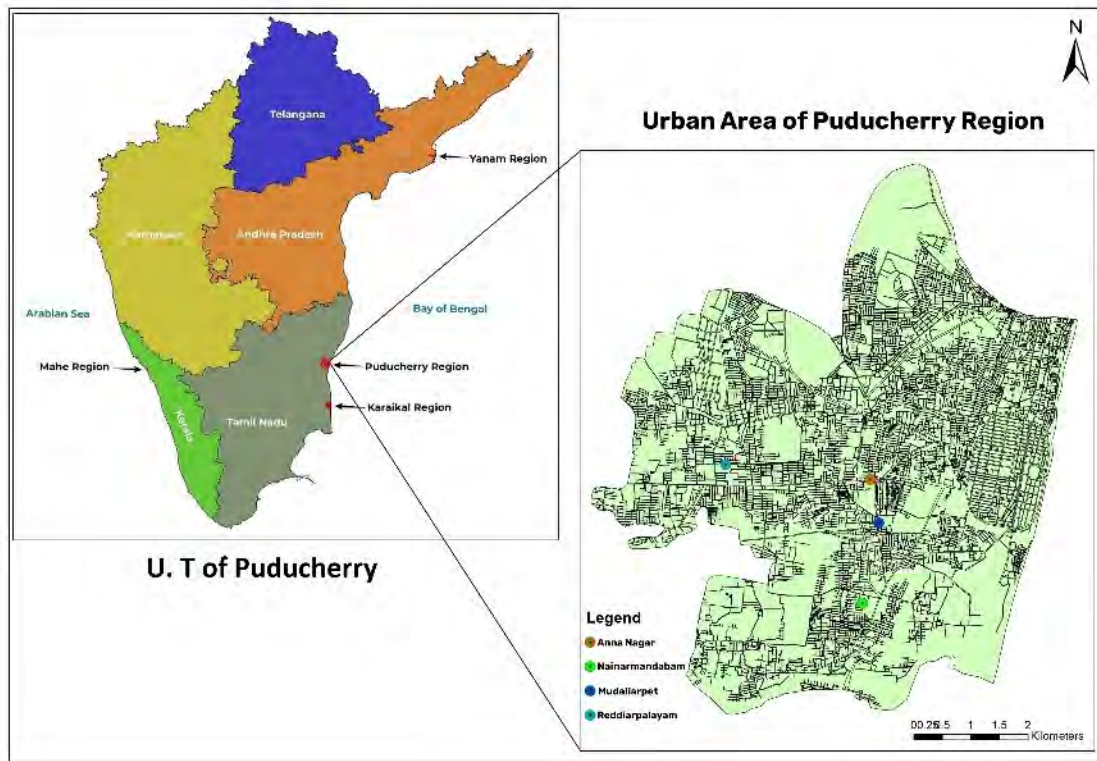


Fig.1: Study area

METHODS

1. Period & Pollutants Measured

The data collection focused on the days leading up to, during, and immediately following the Diwali festival for the years 2020, 2021, 2022, and 2023. Specifically, data were collected for one week before Diwali and on Diwali day.

The primary pollutants measured included:

-  Particulate Matter ($PM_{2.5}$ and PM_{10}),
-  Sulfur Dioxide (SO_2) and
-  Nitrogen Dioxide (NO_2).

2. Air Quality Monitoring Stations:

Air quality data were collected from various monitoring stations across Puducherry. These stations were strategically located in residential and commercial areas to provide a comprehensive overview of the air quality. The air quality data were collected from the Puducherry Pollution Control Committee and entered into the Excel sheets. The areas of sampling for air pollution are around 24 hours.

Sl.No.	Name of the Location	Municipal Limit	Coordinates		ID	Site Classification
			Latitude	Longitude		
1	Anna Nagar	Puducherry	11°55'54.80"N	79°48'33.64"E	RC1	Residential – cum – Commercial
2	Mudaliarpet	Puducherry	11°55'31.51"N	79°48'38.45"E	RC2	Residential – cum – Commercial
3	Reddiarpalayam	Oulgaret	11°56'02.47"N	79°47'14.82"E	R1	Residential
4	Nainarmandabam	Puducherry	11°54'48.24"N	79° 48' 29.7"E	R2	Residential

AMBIENT AIR QUALITY STATUS

Diwali, the festival of lights, is celebrated fervently across India, accompanied by various festivities, including fireworks. While these celebrations foster joy and camaraderie, they also pose environmental challenges, particularly concerning air quality. Recognising the importance of assessing the impact of Diwali on ambient air quality, this study focuses on evaluating the air quality status at three locations in the Puducherry region.

The assessment involves the deployment of air quality monitoring stations equipped with sensors to measure key pollutants such as particulate matter ($PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2). Data collection spans the duration of Diwali festivities, encompassing Pre-Diwali and Diwali days.



Location Name	District	Status	Date of Monitoring	Parameter				AQI
				SO ₂	NO ₂	PM ₁₀	PM _{2.5}	
Anna Nagar	Puducherry	Pre Diwali	09-11-2020	2.1	8.6	48	-	57
		On Diwali	14-11-2020	3.3	5.5	112	-	108
		Pre Diwali	28-10-2021	2.7	13.9	76	55	92
		On Diwali	04-11-2021	11.3	12	176	129	307
		Pre Diwali	17-10-2022	2.0	28.9	95	49	95
		On Diwali	24-10-2022	2.0	25.5	287	281	424
		Pre Diwali	06-11-2023	2.1	7.7	31	22	37
		On Diwali	12-11-2023	4.7	17.6	224	216	374
Nainarmandabam	Puducherry	Pre Diwali	28-10-2021	4.7	11.4	56	44	73
		On Diwali	04-11-2021	14.3	5.0	159	114	280
Reddiarpalayam	Puducherry	Pre Diwali	09-11-2020	28.3	4.7	62	53	88
		On Diwali	14-11-2020	5.2	5.9	164	112	273
		Pre Diwali	17-10-2022	2.7	11.7	29	22	37
		On Diwali	24-10-2022	4.8	19.0	372	195	358
		Pre Diwali	06-11-2023	3.0	7.7	27	16	27
		On Diwali	12-11-2023	2.4	9.5	201	95	218
Mudaliarpet	Puducherry	Pre Diwali	09-11-2020	2.8	5.3	53	48	80
		On Diwali	14-11-2020	2.8	5.3	152	105	250
		Pre Diwali	28-10-2021	5.5	4.5	60	47	78
		On Diwali	04-11-2021	21.7	6.2	159	123	302
		Pre Diwali	17-10-2022	2.2	9.7	41	32	53
		On Diwali	24-10-2022	4.1	26.4	345	329	461
		Pre Diwali	06-11-2023	2.1	8.7	24	5	24
		On Diwali	12-11-2023	7.7	13.3	241	165	335
NAAQ Standards				80	80	100	60	-

Table – 1: The Concentration of Pollutants monitored during pre-Diwali and Diwali days in the Puducherry region during the period from 2020 – 2023.

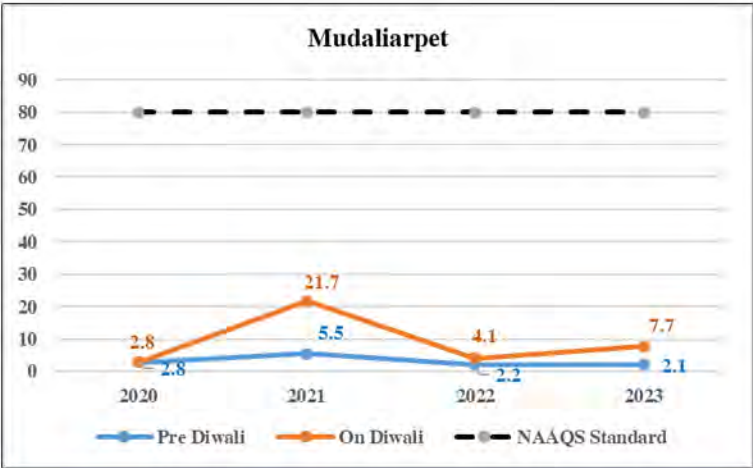
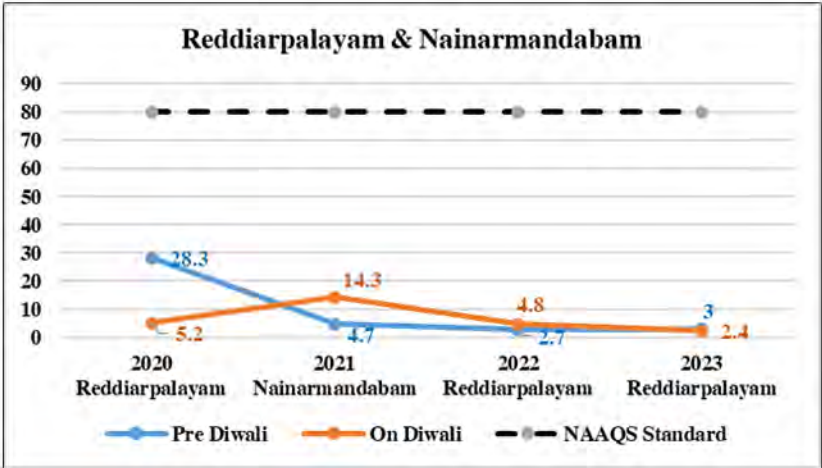
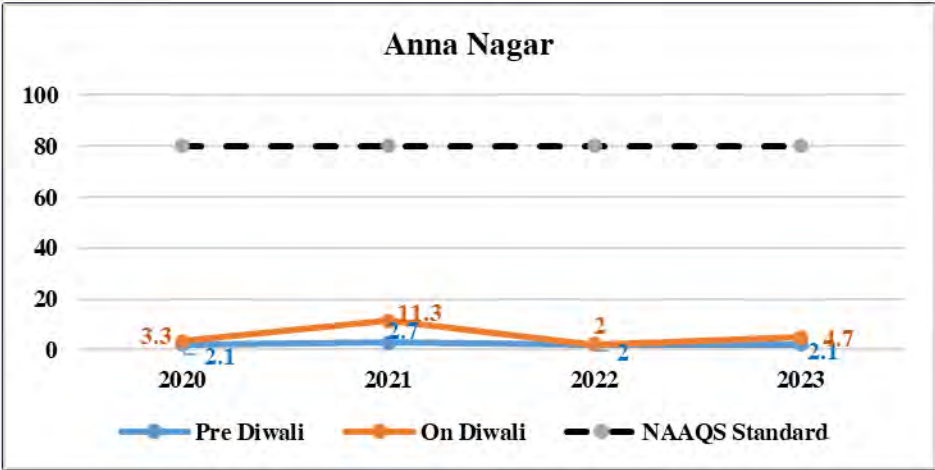
Source: Puducherry Pollution Control Committee (PPCC).



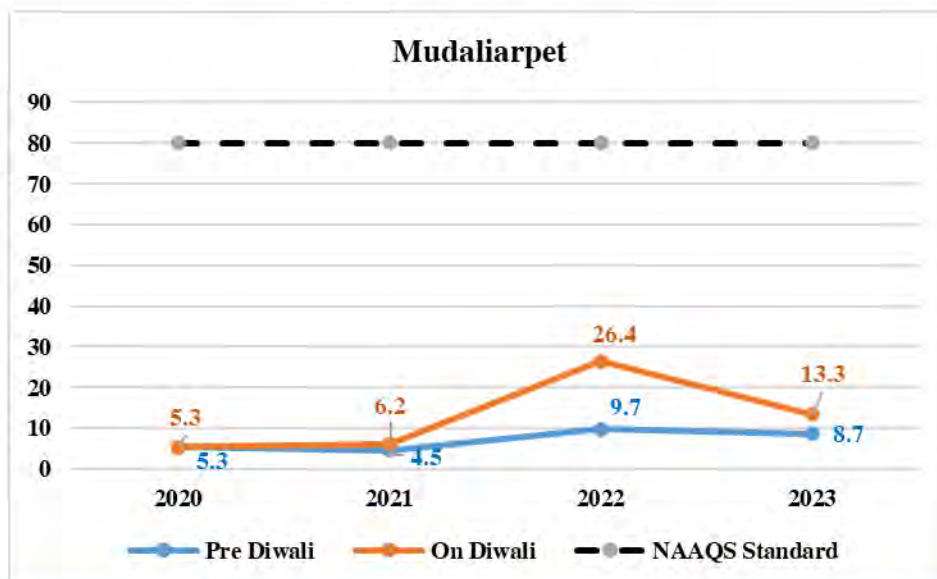
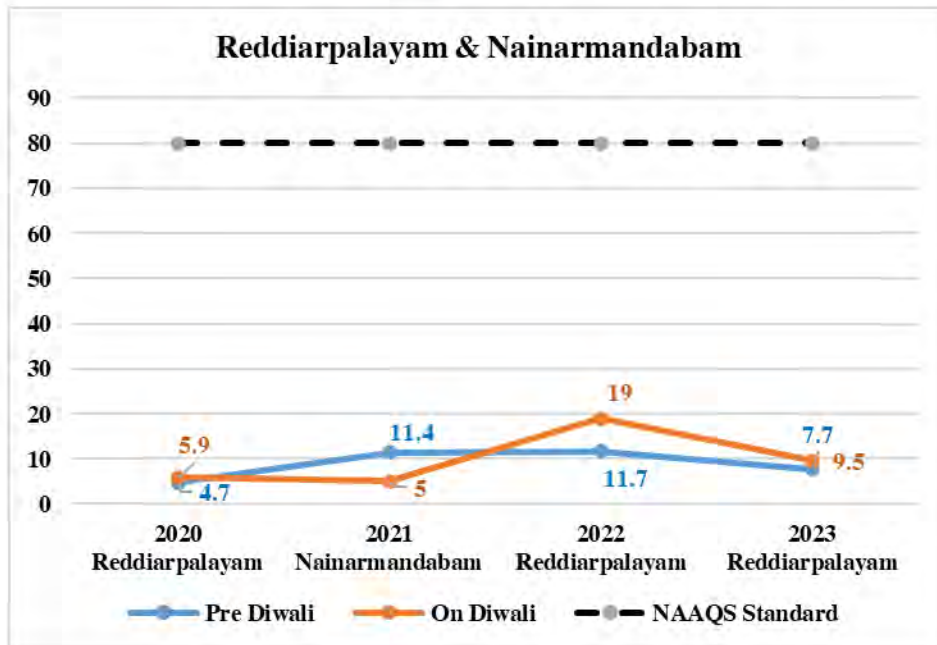
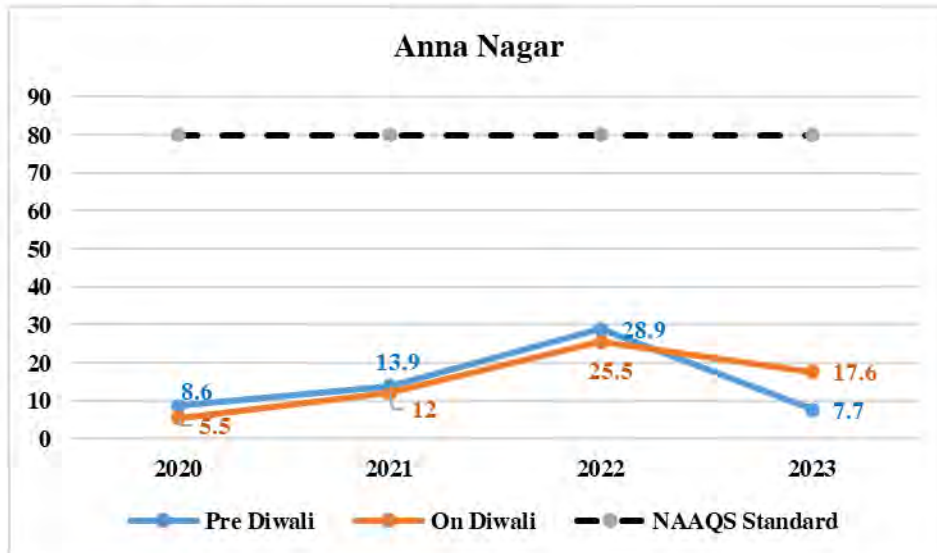
TREND ANALYSIS

Trend analysis was performed to assess the variation in the air quality on the Pre-diwali and Diwali days for the four-year period (2020-2023). Trends indicate the Concentration of PM₁₀, PM_{2.5}, SO₂ & NO₂ in various locations in the urban area of Puducherry region.

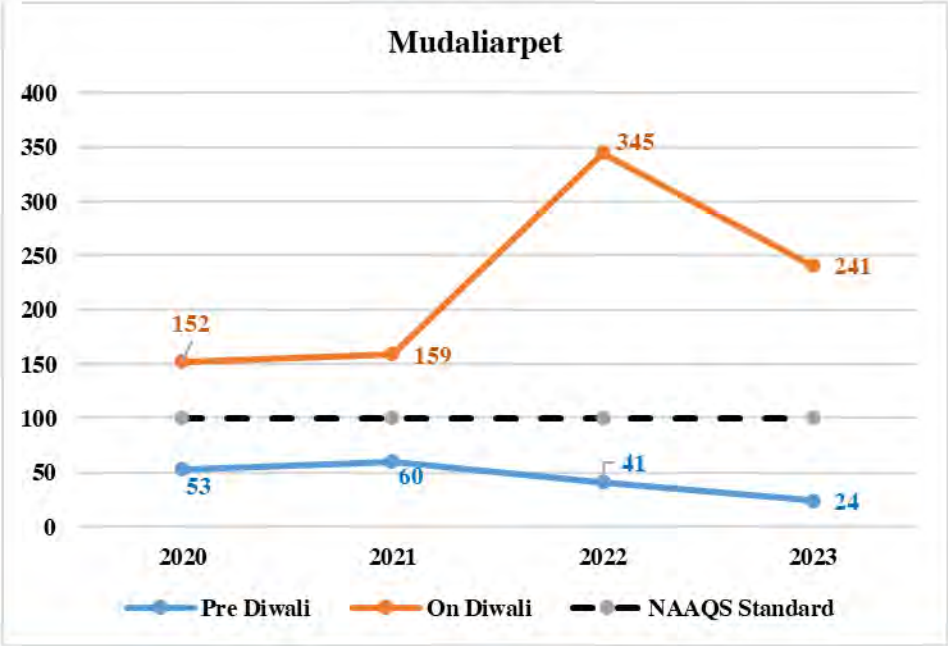
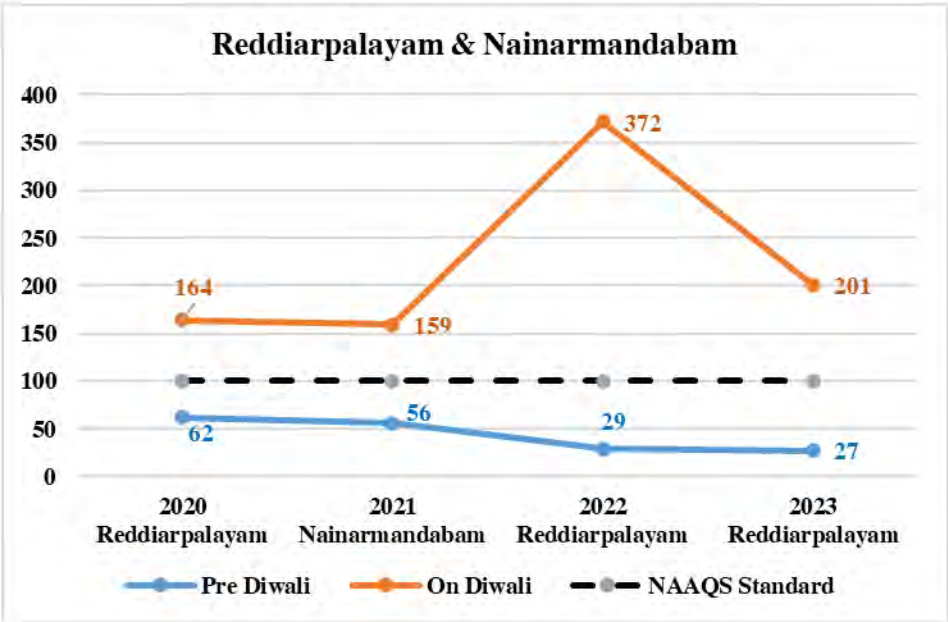
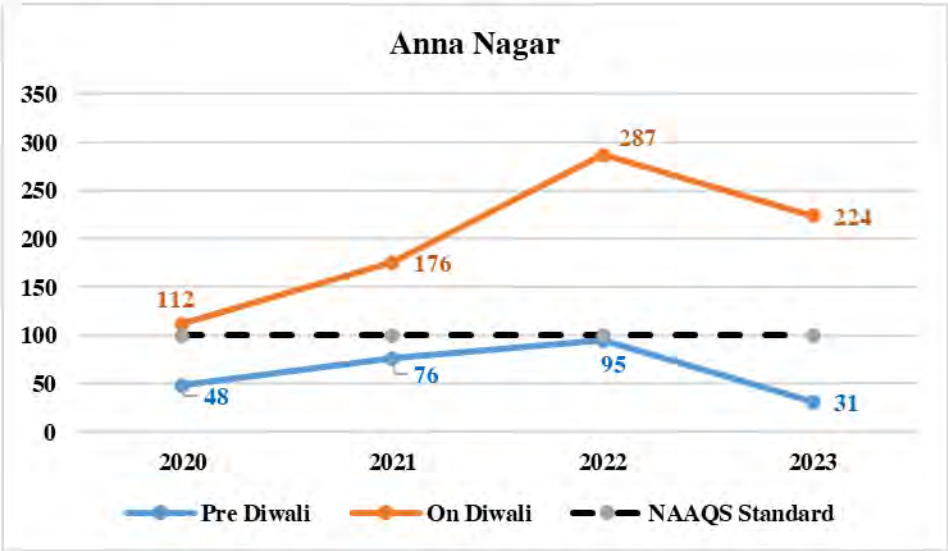
Concentration of SO₂:



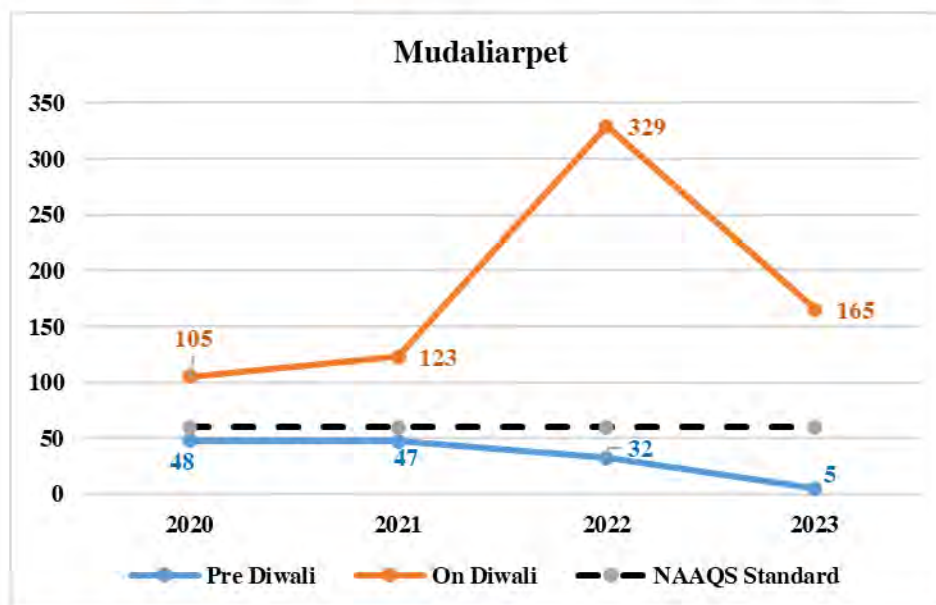
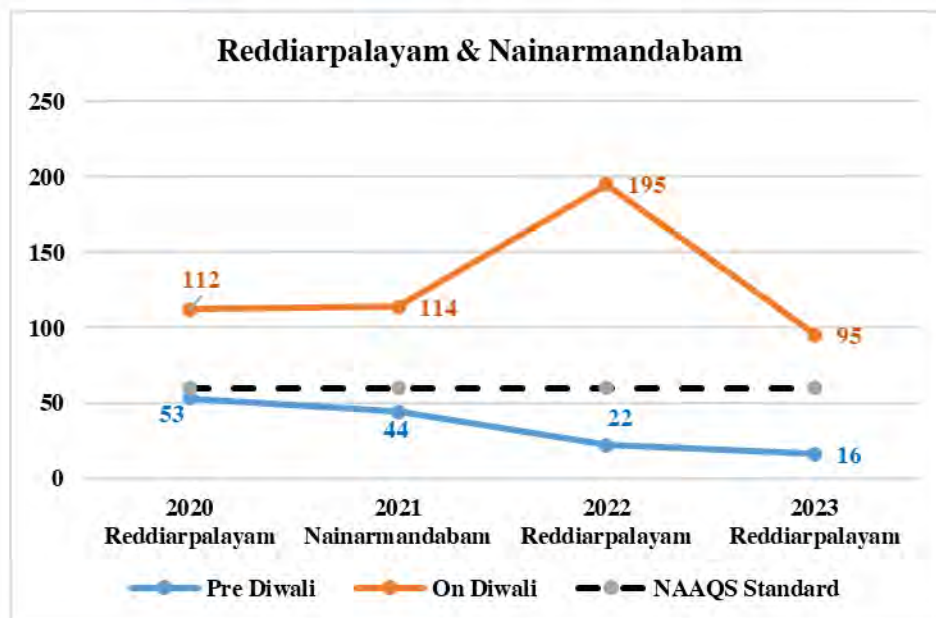
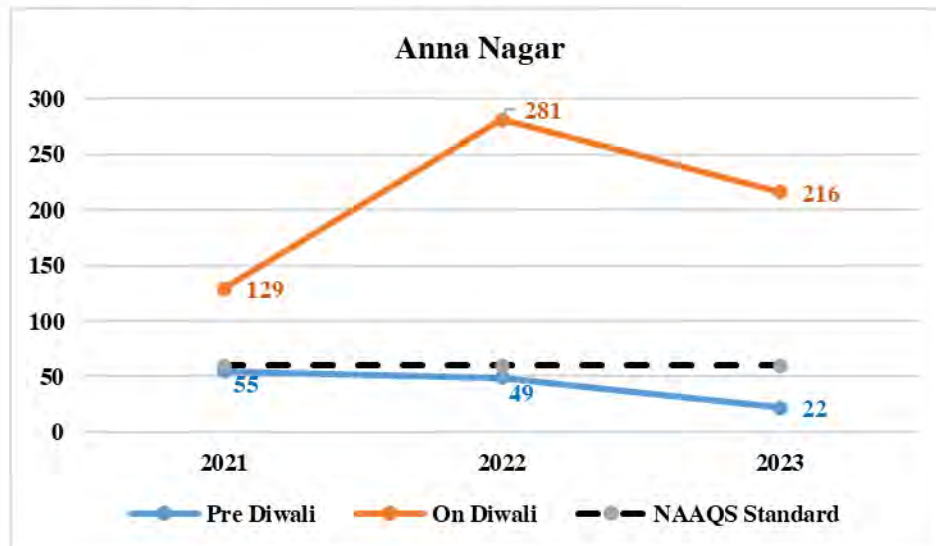
Concentration of NO₂:



Concentration of PM₁₀:



Concentration of PM_{2.5}:



Note: * PM_{2.5} was not monitored during 2019

Ambient air quality monitoring in the urban areas of the Puducherry region from 2020 to 2023 reveals notable trends, particularly concerning the concentrations of particulate matter (PM_{10} and $PM_{2.5}$) during Diwali.

 **2020:** On Diwali day (14.11.2020), PM_{10} concentrations were significantly higher when compared to the pre-Diwali day of the same year, with average PM_{10} and $PM_{2.5}$ concentrations rising by 163% and 115%, respectively. The city-level averages were $143 \mu\text{g}/\text{m}^3$ for PM_{10} and $109 \mu\text{g}/\text{m}^3$ for $PM_{2.5}$.

 **2021:** In a similar vein, $PM_{2.5}$ concentrations were higher on Diwali day (04.11.2021) than compared to pre-Diwali day of the same year with $PM_{2.5}$ and PM_{10} average values increasing by 151% and 157%, respectively. A rise of 11% in $PM_{2.5}$ and 13% in PM_{10} is observed during Diwali day of 2021 on comparison to the Diwali day of 2020. On Diwali 2021, the city-level averages for $PM_{2.5}$ and PM_{10} were 122 and $165 \mu\text{g}/\text{m}^3$, respectively.

 **2022:** Particulate matter levels increased significantly on Diwali 2022 (24.10.2022), with PM_{10} and $PM_{2.5}$ concentrations rising by 508% and 682%, respectively, over pre-Diwali values of the same year. PM_{10} and $PM_{2.5}$ readings rose by 51% and 54%, respectively, in comparison to the Diwali day of 2022 to the Diwali day 2021. PM_{10} and $PM_{2.5}$ averages at the city level were 335 and $268 \mu\text{g}/\text{m}^3$, respectively.

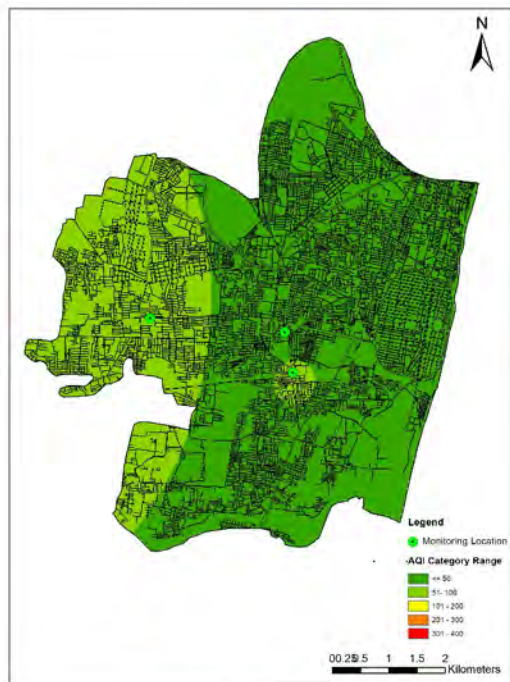
 **2023:** In comparison to pre-Diwali 2023 values, the PM_{10} and $PM_{2.5}$ concentrations increased by 712% and 1007%, respectively, on Diwali day (12.11.2023). However, there was a 51% drop in PM_{10} and a 69% drop in $PM_{2.5}$ between Diwali 2023 and 2022. For Diwali 2023, the city-level averages for PM_{10} and $PM_{2.5}$ were $222 \mu\text{g}/\text{m}^3$ and $159 \mu\text{g}/\text{m}^3$, respectively.

From the assessment of air quality for the Diwali days of the years 2020-2023, it is observed that the 24-hour average concentrations of SO_2 and NO_2 remained well below the prescribed standards, with no discernible trend or pattern of the pollutant levels over these years of assessment.

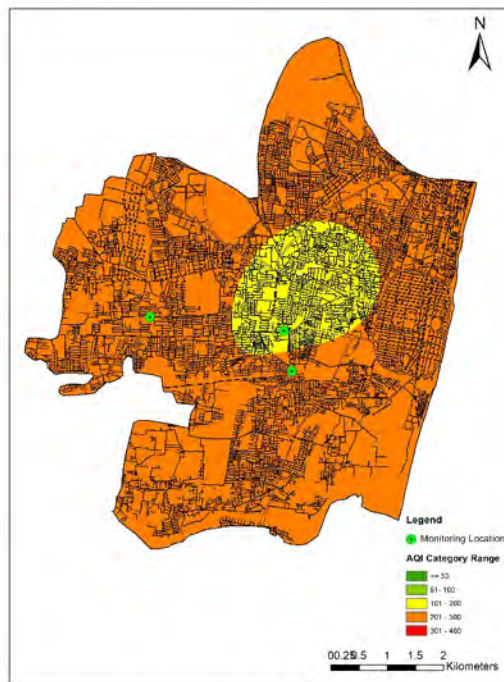


SPATIAL VARIATION OF AIR POLLUTANTS

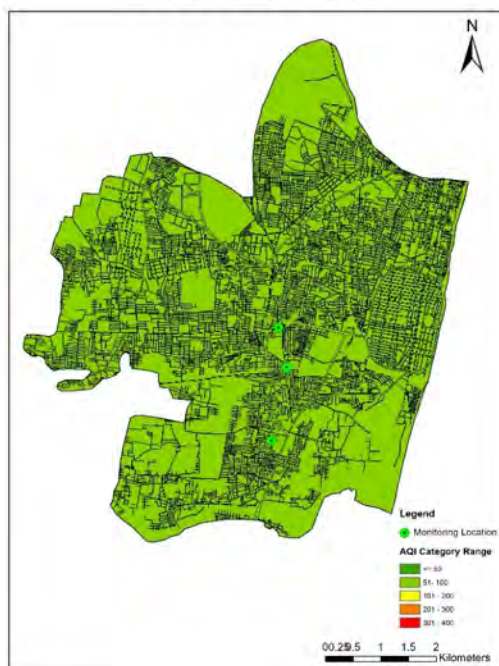
The Spatial variation of Air quality was assessed using ArcGIS Desktop v10.3. ArcMap was utilized for mapping procedures. An Excel sheet containing air quality data with latitude and longitude details was imported into ArcMap to create a point file that locates the sampling stations as point features. The calculated AQI values were then interpolated across different stations, providing a visual representation of ambient air quality using Inverse distance weighted (IDW) interpolation.



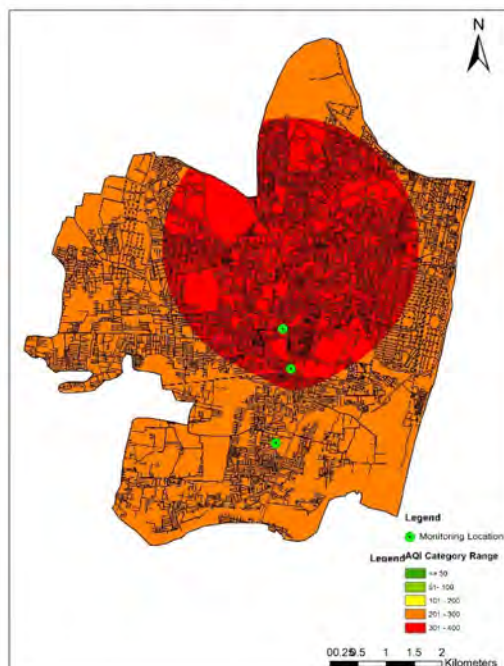
2020 Pre Diwali



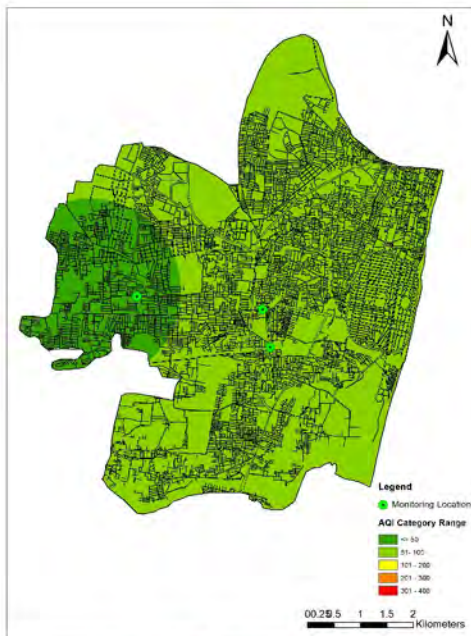
2020 On Diwali



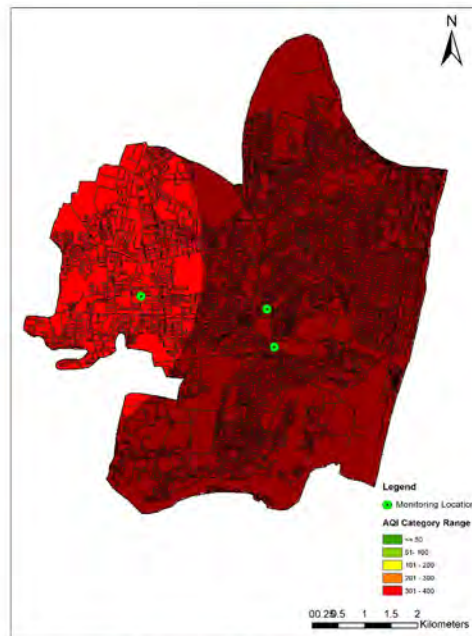
2021 Pre Diwali



2021 On Diwali



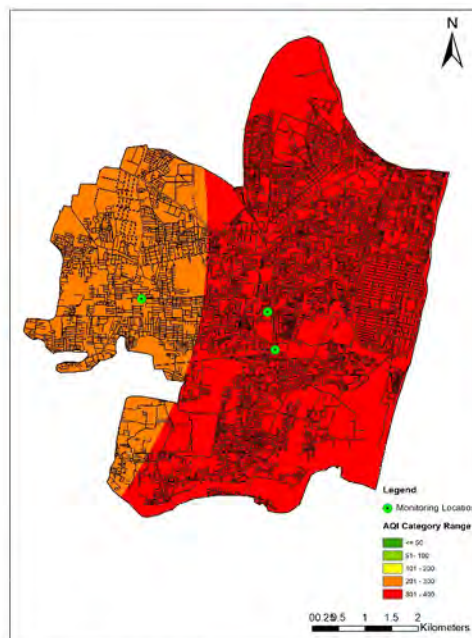
2022 Pre Diwali



2022 On Diwali



2023 Pre Diwali



2023 On Diwali

AQI Color Code:

Good (0–50)	Minimal Impact
Satisfactory (51–100)	Minor breathing discomfort to sensitive people
Moderate (101–200)	Breathing discomfort to people with lung, and heart disease, children and older adults

Poor (201–300)	Breathing discomfort to people on prolonged exposure
Very Poor (301–400)	Respiratory illness in people on prolonged exposure
Severe (>401)	Respiratory effects even on healthy people

The concentration of pollutants tracked between 2020 and 2023 is shown on the GIS map. In 2020, the Air Quality Index (AQI) in Puducherry urban area was classified as "Moderate & Poor," indicating greater levels than during the pre-Diwali period of the same year. The AQI fell into the "Poor & very poor" category in 2021 as a result of greater pollution levels than those observed prior to Diwali. The pattern persisted in 2022, with pollutant concentrations surpassing those of the pre-Diwali period in 2021, which led to the AQI being classified as "Very Poor & severe". Similarly, in 2023, pollution levels were greater than they had been prior to Diwali, with the AQI in Puducherry urban area being categorized as "Poor & Very Poor".

CONCLUSION

The preliminary findings from the air quality assessment during Diwali 2024 indicate notable variations in ambient air quality across the selected locations. The data reveals elevated levels of particulate matter ($PM_{2.5}$ and PM_{10}) and other pollutants, particularly during the peak hours of celebration when firecracker usage is at its highest. These pollutants pose significant health risks, exacerbating respiratory and cardiovascular conditions. In Puducherry, the pollution levels were relatively higher, which can be attributed to the higher population density and the concentrated use of fireworks in densely populated areas. The coastal geography of Puducherry may also play a role, where the sea breeze could have temporarily dispersed pollutants before they accumulated again due to ongoing firework activity. These findings underscore the importance of location-specific strategies for managing air quality, especially during events like Diwali, where human activities significantly impact the environment.



Puducherry ENVIS Hub Environment Events (July - Sept., 2024)

Event: Conducted awareness programme on importance of forests and their conservation, Competitions i.e., Drawing, Quiz, Essay Writing & Elocution Competitions, Plantation Drive and Oaths on Plantation drive at 8 schools from 02.07.2024 to 05.07.2024 on the occasion of Van Mahotsav celebration.

No. of Participants: 1,116



Event: An awareness talk on 'Marine Litters in Mangrove ecosystem' and clean up drive programme at Art and Craft Village, Murungapakkam, Puducherry on 26.07.2024.

Stakeholders: Line Departments, Staff from University/Educational Institutions, NSS, NGO, Public etc.

Venue: Art and Craft Village, Murugapakkam, Puducherry.

No. of Participants: 150

Event: Organized an awareness talk on the importance of trees, environmental protection, and Mission LiFE, plantation drives and oath-taking ceremonies under the themes of "Tree Plantation Drive" and "Mission LiFE" across 17 schools from August 8th to August 27th, 2024. Promoted the initiatives "Mission LiFE – Lifestyle for Environment" and "Ek Ped Maa Ke Naam" to encourage sustainable living and environmental stewardship.

No. of Participants: 2,179

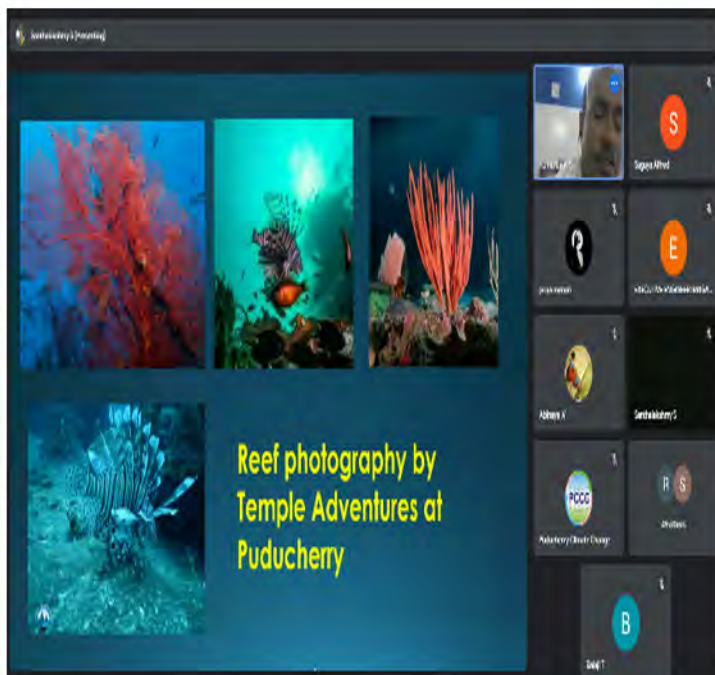


Event: Webinar on 'Marine Biodiversity and Ecosystem Conservation in Puducherry's Changing Climate' on 29.08.2024.

Resource Person: Dr. Kumaresan S, Assistant Professor, Centre of Advanced Study in Marine Biology, Annamalai University.

Stakeholders: Line Departments, Environmentalists, College & School Students.

No. of Participants: 110



Event: Elocution Competition (English and Tamil) on the topic "Montreal Protocol: Advancing Climate Action" on 13.09.2024.

Stakeholders: School Students

Venue: Dr. Abdul Kalam Science Centre and Planetarium, Lawspet.

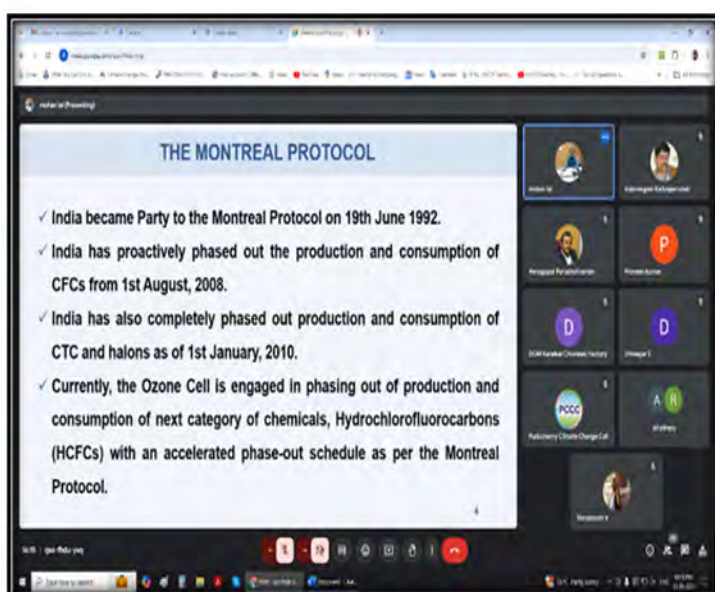
No. of Participants: 81

Event: Webinar on "Montreal Protocol: Advancing Climate Action," on 13.09.2024.

Resource Person: Dr. D. Mohan Lal, a Professor, Department of Mechanical Engineering, Anna University.

Stakeholders: Line Departments, Environmentalists, College & School Students.

No. of Participants: 72



Event: Technical Seminar was conducted on the theme 'Montreal Protocol: Advancing Climate Action'.

Resource Person: Thiru. R. Kamalakannan, Organizer-cum-Technical Trainer, HPMP & Thiru. S. Kanagasabapathi, Technical Trainer, HPMP

Stakeholders: polytechnic students and industrial representatives

No. of Participants: 186



Event: Coastal Clean-up drive on International Coastal Clean-up Day on 21.09.2024.

Stakeholders: Line Departments, Staff from University/Educational Institutions, NSS, NGO, Public etc.

Venue: Veerampattinam to Chinna Veerampattinam Beach, Puducherry.

No. of Participants: 212

Event: Coastal Clean-up drive on International Coastal Clean-up Day on 21.09.2024.

Stakeholders: Line Departments, Staff from University/Educational Institutions, NSS, NGO, Public etc.

Venue: Karaikal Beach.

No. of Participants: 230



Event: Awareness talk and Quiz competition on "Challenges and Solutions for Sustainable Development" on 26.09.2024.

Venue: Oulgaret Municipality

Stakeholders: College & School Students.

No. of Participants: 45



Event: Attended Two-Day Workshop on 'Implementation of Marine Spatial Planning for the U.T. of Puducherry'

Stakeholders: Secretary to Government (Science, Technology & Environment), the Country Governor of Agder and Mayor of Arendal Municipality along with Delegates from Norwegian Institutes, Officials from NCCR, Stakeholder Departments of Government of Puducherry and NGOs and other stakeholders

No. of Participants: 89



How Fireworks Kill you: Part by Part

Chemical composition of commonly available fireworks, their role and physiological effects

Toxic Element | Aluminum
Usage | Coloring agent - White
Toxic Effect | Skin conditions, accumulation within the body, Cause of Alzheimer's disease

Toxic Element | Nitric Oxide
Usage | By-product
Toxic Effect | Poisonous, reacts with lung tissue

Toxic Element | Cadmium compounds (banned)
Usage | Coloring agent
Toxic Effect | Lung damage, Cancer, Gastrointestinal Problems

Toxic Element | Lithium Compounds
Usage | Coloring agent - Red
Toxic Effect | Poisonous, Respiratory irritation

Toxic Element | Lead Dioxide/Nitrate/Chloride
Usage | Oxidizing agent
Toxic Effect | Poisonous to plants and animals, detrimental to physical and mental growth in infants and unborn children, accumulation within the body

Toxic Element | Ozone
Usage | By-product
Toxic Effect | Respiratory irritation, cause of global warming

Toxic Element | Strontium Compounds
Usage | Coloring agent - Red
Toxic Effect | Detrimental to physical growth in infants, Poisonous

Toxic Element | Nitrogen Dioxide
Usage | By-product
Toxic Effect | Highly poisonous, fatal for infants, source of acid rain

Toxic Element | Sulphur Dioxide
Usage | By-product
Toxic Effect | Poisonous, source of Acid rain

Toxic Element | Antimony Sulphide
Usage | Coloring agent - Glitter effect
Toxic Effect | Respiratory irritation, Lung Cancer

Toxic Element | Perchlorate (Ammonium and Potassium)
Usage | Oxidizing agent
Toxic Effect | Poisonous, contaminated ground and surface water, Lung Cancer, cause of Thyroid complications

Toxic Element | Potassium Nitrate
Usage | Fuel
Toxic Effect | Poisonous, Lung Cancer

Toxic Element | Arsenic Compounds
Usage | Coloring agent
Toxic Effect | Lung cancer, Skin conditions

Toxic Element | Mercury (Chlorides)
Usage | Reducing agent
Toxic Effect | Poisonous, accumulation within the body

Toxic Element | Barium Nitrates
Usage | Coloring agent - Green
Toxic Effect | Poisonous, Respiratory Irritation, Radioactive effects, Gastrointestinal Problems, Muscular Weakness

Toxic Element | Copper compounds
Usage | Coloring agent - Blue
Toxic Effect | Poisonous, accumulation within the body, Cancer, skin conditions, Hormone imbalance

Source: Attri, Arun K. "Microclimate: Formation of Ozone by Fireworks." *Nature* Volume 411, June 28, 2001
Russell, Michael S. *The Chemistry of Fireworks*. 2000
Steinhauser, Georg. "Heavy metals from pyrotechnics in New Years Eve snow." *Atmospheric Environment* Volume 42, Issue 37, December 2008
Hexachlorobenzene (HCB) in Fireworks - Guidance Note" *The Environment Agency*, September 2010



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