



Impact of firecrackers on atmospheric pollutants during Diwali festival in Tamil Nadu

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Abstract

This study aims to investigate the impact of firecrackers on atmospheric pollutants during Diwali festival in Tamil Nadu. This study delves into the multifaceted impact of firecrackers on atmospheric pollutants both human health and environment. Diwali festival in Tamil Nadu is renowned for its exuberant celebrations, characterized by the widespread use of firecrackers. However, this tradition comes with a significant environmental cost, as firecrackers release a plethora of pollutants into the atmosphere, deteriorating air quality and posing serious health risks to the populace. This study aims to comprehensively analyze the impact of firecrackers on atmospheric pollutants during the Diwali festival in Tamil Nadu. Through a combination of ground-level measurements, satellite observations, and atmospheric modeling, we investigate the concentration levels of key pollutants, including particulate matter (PM_{2.5} and PM₁₀), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), and carbon monoxide (CO). Our analysis reveals a substantial increase in pollutant concentrations during the Diwali period, with peak levels coinciding with the peak of firecracker activity. Furthermore, we assess the spatial distribution of pollutants across different regions of Tamil Nadu, identifying hotspots of pollution and vulnerable communities disproportionately affected by firecracker emissions. The implications of heightened pollutant levels on human health, environmental sustainability, and climate dynamics are discussed, highlighting the urgent need for mitigation strategies.

This research underscores the importance of public awareness campaigns, regulatory interventions, and community engagement initiatives to address the environmental challenges associated with festive celebrations. Sustainable alternatives to traditional firecrackers, along with stricter enforcement of regulations governing their use, are essential for safeguarding air quality and promoting a healthier living environment for all residents of Tamil Nadu.

Keywords: Firecrackers, impact, human health, pollutants, atmospheric, environment, communities

Introduction

In the current climate, the firecrackers pollutants is causing many environmental impact pollution problem. The pollutants of the firecrackers produce adverse impact on air, human health. The entire world is currently confronting significant difficulties in terms of the degradation of air quality due to an alarming rise in anthropogenic emissions brought on by rapid industrialization, motorization, urbanization, and a lack of sufficient understanding of air quality. High air pollution emission levels in India are a natural consequence of rising population density and rapid economic growth. Short-term air quality degradation events have recently attracted the attention of the scientific community and have become an important topic of discussion at all levels. India is regarded as the land of festivals due to its ancient traditions and diverse culture in its various states. Diwali is a "Festival of Lights" that is observed throughout India and often falls in October or November of a year. Since firecrackers are extensively used during this festival, it has a significant negative impact on the environment. Firecrackers, which are made of oxidizing chemicals (such as nitrates of barium and strontium, potassium chlorate, potassium perchlorates, potassium nitrates, and iron oxide) and fuels, are burned as part of celebrations. Fireworks emit loud noises and hazardous substances into both indoor and outdoor surroundings.

The explosion of firecrackers releases a variety of harmful gases and particles of various sizes. According to the Environmental Protection Agency (EPA), fine particulate matter (PM_{2.5}) poses substantial health risks to people and can cause premature death, respiratory and cardiovascular disorders, and impact the neurological system. During the

Diwali season, noise pollution is produced in addition to air pollution. Even though there is more firework activity during the Diwali celebration in Tamil Nadu state, India, there has been less research reported in the state to understand the variations in air quality during the celebrations. The study was carried out at the residential site in Erode City which is situated in the western region of Tamil Nadu. Erode is frequently affected by air pollution caused by particle matter. For this study, continuous measurements of PM_{2.5}, PM₁₀, CO, CO₂, TVOC, and noise levels during the Diwali period for 5 consecutive days on October, 2022. To understand the impact of firework activities on the air quality of Erode city throughout the Diwali celebration period, the particulate matter and trace gas concentrations on pre, during, and post-Diwali day were assessed and analysed. The findings of this study would help understand the changes in urban air quality that have taken place in Erode, a city in western Tamil Nadu, India. The dense smoke restricts human visibility in the air to a greater extent, persisting for up to several hours, depending on the prevailing climatic conditions. Several researchers have examined degradation in air quality due to the Diwali celebration in various regions of India and have also reported an increase in particulate matters and pollutant gases, such as PM_{2.5}, PM₁₀, O₃, NO₂, SO₂, and trace metals during the Diwali celebration.

Research problem

It investigates the various dimensions of this relationship, including the environmental impact on firecrackers atmospheric pollutants such as air and human health problems, and resources depletion, as well as the potential

health risks posed to including firecrackers pollutants. By examining the mechanisms through which firecrackers atmospheric pollutants may contribute to environmental degradation.

Review of literature

N.K. Udaya Prakash, N. Sripriya, K. Gotham, S. Surest, B. Sampathkumar, S.B.

Bhuvaneswari

Article: A study on the impact of firecrackers on airborne microflora during Diwali

Description: Diwali is celebrated widely in Asian countries with a custom of firing crackers, crackers pollute the environment with noise, particulate matters and chemicals.

Durban Dubey & Awadhesh Kumar rai

Article: Assessments of components and constituents in prevailing firecrackers, responsible for crackling, sparkling and toxin using spectroscopic techniques.

Description: In the present manuscript the compositional study of the six types of prevailing fine crackers is performed using laser- induced breakdown spectroscopy that work on the principle of atomic emission spectroscopy.

Shankar. S, Abbas G, R. Nithyaprakash, R. Naveen Kumar, Ramesh Mohanty.S,

Sabarinath. A, karthick. S,

Article: study on impact of firecrackers on atmospheric pollutants during Diwali festival in Tamil Nadu.

Description: The current study focuses on the impacts of firecrackers emission on particular matters(PM_{2.5} and PM₁₀), Carbon monoxide (CO), Carbon dioxide (CO₂) and total volatile organic compound (TVOC) and the noise was analyzed on pre, during, and post- Diwali period in a residential area of Tamil.

Scope and limitations on the study:

- This study will focus on assessing the impact of firecrackers on atmospheric pollutants concentration specifically during the Diwali festival period in Tamil Nadu.
- The study will also explore the implications of heightened pollutants levels on human health, environmental sustainability, and climate dynamic in Tamil Nadu.
- To improve the health and well- being of human health beings, animals, environment.
- This study focuses on the impact of firecrackers pollutants particularly in Tamil Nadu.
- The study findings may be subject to interpretation bias or limitations inherent in the methodologies used for data collection and analysis.

Aims and objectives

- To study the effects of firecrackers pollutants on environmental quality.
- To evaluate the implications of heightened pollutant levels on human health, environmental sustainability, and climate dynamics in Tamil Nadu.

- To analyse the temporal variation in pollutant concentration, focusing on peak firecrackers activity periods during the duration festival.
- To study impact of firecrackers emission on human health and environment

Hypothesis

Null Hypothesis (H₀): There is no significant difference in atmospheric pollutant concentrations during the Diwali festival period compared to non-festival periods in Tamil Nadu.

Alternative Hypothesis (H₁): Atmospheric pollutant concentrations significantly increase during the Diwali festival period compared to non-festival periods in Tamil Nadu, indicating the impact of firecrackers on air quality.

Research methodology

In this study, the researcher has used Non Doctrinal Research Methodology. The researcher obtained the primary source of data by conducting an empirical study on seeking responses from the General Public living near the areas with high firecrackers atmospheric pollution levels. The research method is based on questionnaires.

Firecrackers pollutants

Firecracker pollution refers to the environmental and health impacts caused by the combustion of firecrackers, particularly during festive occasions such as Diwali. These impacts include the release of various pollutants into the atmosphere, such as particulate matter (PM), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), carbon monoxide (CO), heavy metals, and volatile organic compounds (VOCs). The combustion of firecrackers generates high levels of pollutants, contributing to air pollution, which can have significant adverse effects on human health, ecosystems, and the environment. Short-term exposure to firecracker pollution can lead to respiratory problems, exacerbate existing health conditions such as asthma, and increase the risk of cardiovascular diseases. Additionally, the pollutants emitted by firecrackers can have long-term effects on air quality, contributing to smog formation, acid rain, and ozone depletion.

Impact on firecrackers pollutants

1. **Air Quality:** Firecrackers release pollutants such as particulate matter (PM), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), carbon monoxide (CO), and volatile organic compounds (VOCs) into the air. This leads to a sharp increase in air pollution levels, particularly during festivals like Diwali, affecting both indoor and outdoor air quality.
2. **Health Effect:** Exposure to firecracker pollution can have adverse health effects, especially for vulnerable populations such as children, the elderly, and individuals with pre-existing respiratory or cardiovascular conditions. Short-term effects include respiratory irritation, exacerbation of asthma, and cardiovascular problems, while long-term exposure may increase the risk of chronic diseases.
3. **Environmental Impact:** Firecracker pollution contributes to environmental degradation by

contaminating soil, water bodies, and vegetation. Heavy metals and other toxic substances released during combustion can accumulate in the environment, posing risks to ecosystems and biodiversity.

4. **Noise Pollution:** In addition to air pollution, firecrackers also generate high levels of noise pollution, which can disturb wildlife, pets, and individuals sensitive to loud sounds. Excessive noise from firecrackers can lead to stress, hearing damage, and sleep disturbances in humans and animals.
5. **Climate Impact:** The release of greenhouse gases such as carbon dioxide (CO₂) and methane (CH₄) from firecrackers contributes to climate change by trapping heat in the atmosphere and exacerbating global warming.

Legal measures for mitigation firecrackers pollutants
M.C. Mehta v. Union of India (1986)

This landmark case before the Supreme Court of India addressed various environmental issues, including air pollution. Although not specific to Tamil Nadu or Diwali, the principles established in this case regarding the protection of the environment and public health can be relevant. The court issued directives to control air pollution, which could apply to the regulation of firecrackers during festivals.

T.N. Godavarman Thirumulpad v. Union of India & Ors. (2006)

This case, also known as the Forest Case, dealt with issues related to environmental conservation and protection of forests. While not directly focused on firecracker pollution, the court's rulings on the preservation of environmental resources could have implications for regulating activities such as firecracker use during festivals.

Noise Pollution (V) In Re: Noise Pollution (2005)

In this case, the Supreme Court of India addressed noise pollution issues and established guidelines for controlling noise levels in public spaces. While not specific to firecracker pollution during Diwali, the principles laid down by the court regarding noise pollution control could be

relevant to regulating the use of firecrackers during festivals in Tamil Nadu.

Constitutional Provisions

Article 21 (Right to Life): The Constitution of India guarantees the right to life and personal liberty, which includes the right to a clean and healthy environment. The impact of firecracker pollution during Diwali can infringe upon this fundamental right, necessitating measures to protect public health and the environment.

Article 48-A (Protection and Improvement of Environment): This article places a duty on the State to protect and improve the environment and safeguard forests and wildlife. Measures to mitigate firecracker pollution align with the constitutional mandate to preserve and enhance the environment.

Article 51A (g) (Fundamental Duties): It is the duty of every citizen to protect and improve the natural environment, including forests, lakes, rivers, and wildlife. This provision underscores the importance of individual responsibility in addressing environmental challenges, including firecracker pollution.

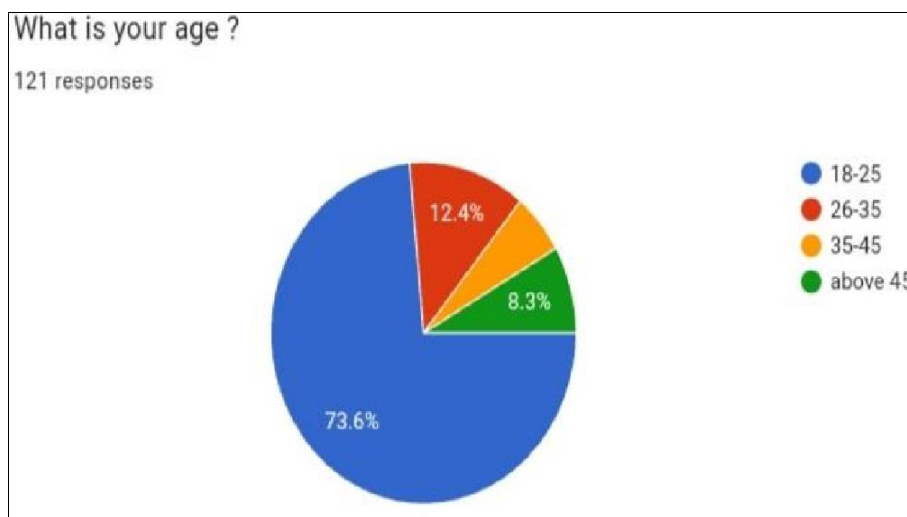
Environmental Provisions

The Air (Prevention and Control of Pollution) Act, 1981: This legislation aims to prevent, control, and abate air pollution. It provides a regulatory framework for controlling emissions from various sources, including firecrackers. Tamil Nadu may enforce provisions of this Act to regulate the use of firecrackers during Diwali and mitigate atmospheric pollution.

The Environment (Protection) Act, 1986: This Act empowers the Central Government to take measures to protect and improve the quality of the environment. It provides for the regulation of activities that may cause environmental pollution or degradation, including the use of firecrackers during festivals.

The Noise Pollution (Regulation and Control) Rules, 2000: These rules aim to regulate and control noise pollution from various sources, including firecrackers. Tamil Nadu can enforce these rules to limit the noise levels generated by firecrackers during Diwali, protecting public health and tranquility.

Analyse the survey conducted

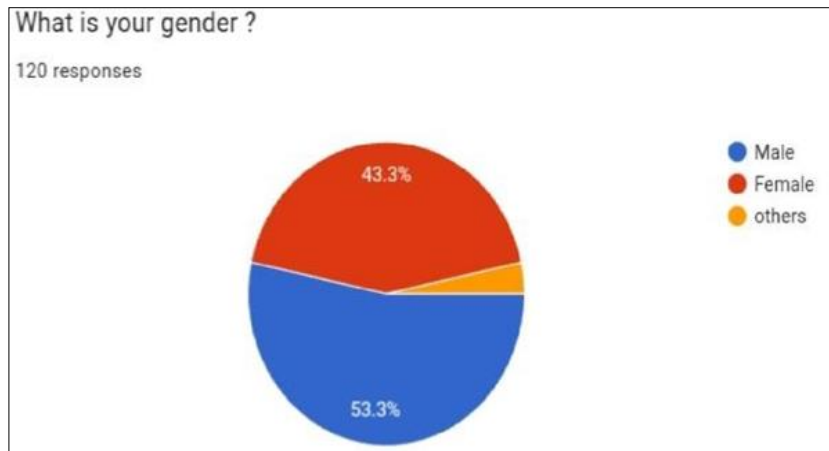


Graph 1:

Legend: From the graph, it is observed it exhibits the age distribution of the respondents and their opinion on the impacts of firecrackers pollutants.

Result: the survey in graph 1, it is observed that is exhibits

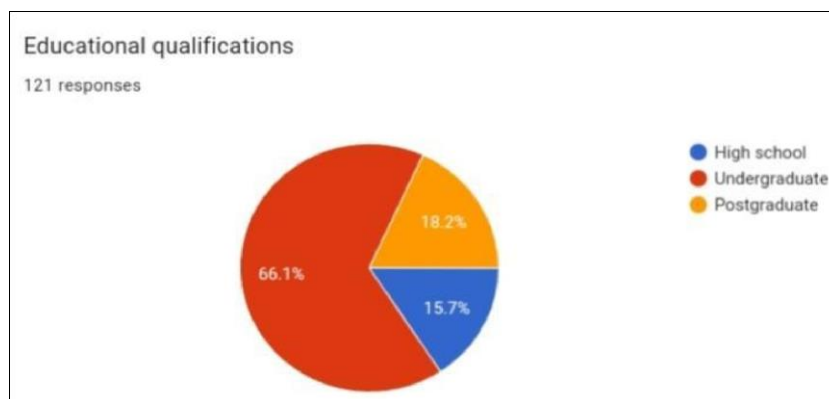
the age distribution of the respondent and their opinion on the impact of firecrackers pollutants. The maximum number of responses was collected between the age group of 18-25& 26-35 whereas minimum response was between the age group 36-45.



Graph 2:

Legend: From the graph, it is observed that it exhibits the gender distribution of the respondents and their opinion on impact of firecrackers pollutants.

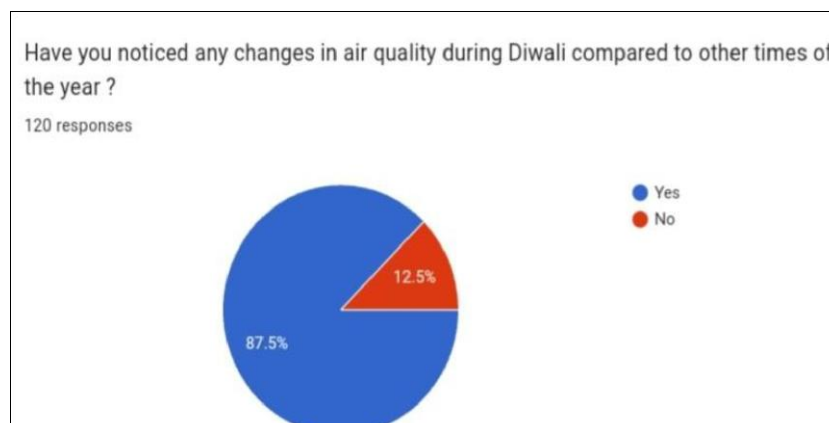
Result: the survey in graph 2, it is observed it is observed that is exhibits the gender distribution of the respondents and their opinions on the impact of firecrackers pollutants. The maximum number of was collected between the males.



Graph 3:

Legend: From the graph that it exhibits the educational qualifications distribution of the respondents and their opinions on the impact of firecrackers pollutants.

Results: the survey in graph 3, it is observed that it exhibits the educational qualifications of the respondents and their opinions on the impact of firecrackers pollutants. The maximum number of responses was collected from the undergraduate.

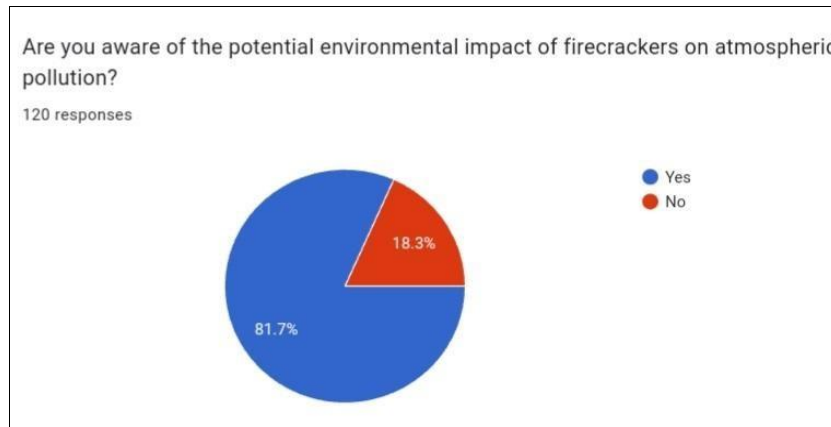


Graph 4:

Legend: From graph 4, it is observed that it exhibits have you noticed any changes in air quality.

distribution of respondents and their opinion on any changes in air quality. The maximum number of responses was collected they noticed the changes in air quality such as compared to other times of the year.

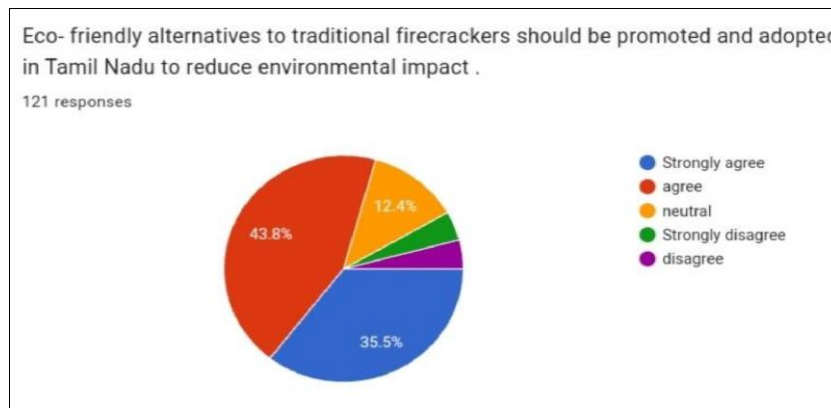
Result: The survey in graph 4, shows that it exhibits the



Graph 5:

legend: from graph 5, it is observed that it exhibits the aware of the potential environmental impact of firecrackers on atmospheric pollution.

Result: the survey in graph 5, it is observed that it exhibits the distribution of respondents and their opinion on the impact of firecrackers pollutants to potential environmental, the maximum number of responses was collected they said to know their statement.

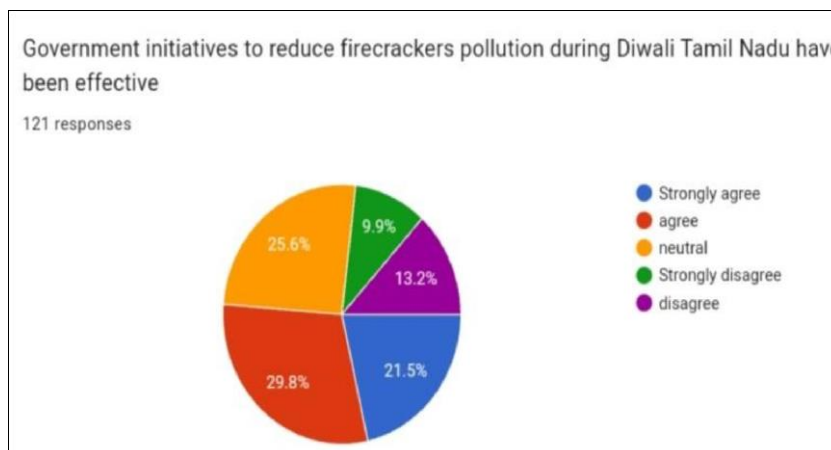


Graph 6:

Legend: from graph 6, it is observed that it exhibits the eco friendly alternative to traditional firecrackers should be promoted and adopted in Tamil Nadu to reduce environmental impact.

the distribution of respondents and their opinion on the eco friendly alternative to traditional firecrackers should be promoted and adopted in Tamil Nadu to reduce environmental impact. The maximum number of the responses was collected they agree with the statement.

Result: the survey in graph 6, it is observed that it exhibits

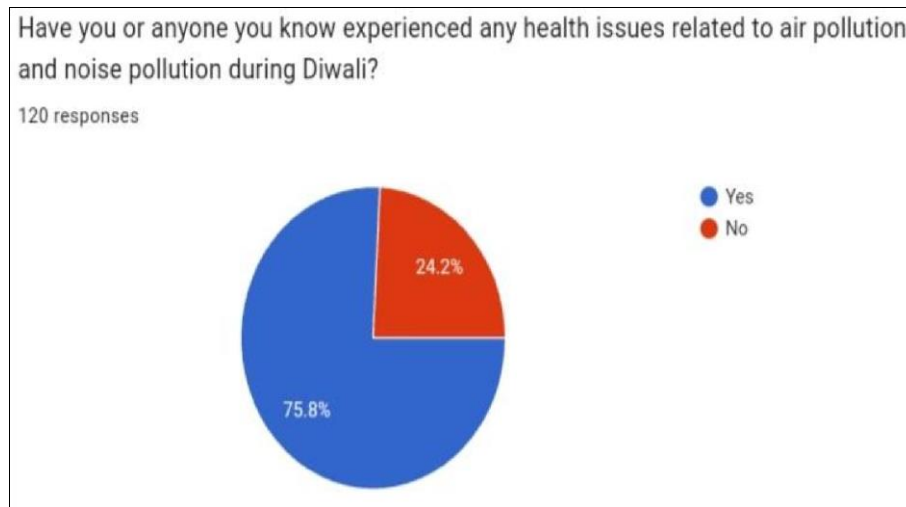


Graph 7:

Legend: from graph 7, it is observed that it exhibits the government initiative to reduce firecrackers pollution during Diwali festival in Tamil been effective.

Result: the survey in graph 7, it is observed that it exhibits

the distribution of respondents and their opinion on the government initiative to reduce firecrackers pollution during Diwali festival in Tamil been effective. The maximum number of the responses was collected they agree with the statement.



Graph 8:

Legend: the graph 8, it is observed that it exhibits the have you or anyone you know experienced any health issues related to air pollution and noise pollution during Diwali.

Result: the survey in graph 8, it is observed that it exhibits the distribution of respondents and their opinion exhibits the you or anyone you know experienced any health issues related to air pollution and noise pollution during Diwali. The maximum number of the responses collected they observed the experienced the health issues

Result of the research

The study of the research, it reveals that tamilnadu underscores the significant impact of firecrackers atmospheric pollutants on human health and the environment. Therefore the alternative Hypothesis is provided Atmospheric pollutant concentrations significantly increase during the Diwali festival period compared to non-festival periods in Tamil Nadu, indicating the impact of firecrackers on air quality.

Conclusion

In conclusion, could highlight the significant increase in atmospheric pollutants during Diwali festival due to firecrackers usage in Tamil Nadu. The Diwali festival in Tamil Nadu exacerbates air pollution levels due to the widespread use of firecrackers, leading to a surge in atmospheric pollutants such as sulfur dioxide, nitrogen dioxide, particulate matter, and heavy metals. This increase in pollutants not only deteriorates air quality but also poses serious health risks, especially for vulnerable populations such as children, the elderly, and individuals with respiratory conditions. To address this issue, it is imperative for policymakers to implement stringent regulations on firecracker usage, promote the adoption of eco-friendly alternatives, and invest in public awareness campaigns to educate the community about the environmental and health impacts of fireworks. By taking proactive measures, we can

work towards ensuring cleaner and safer celebrations while preserving our environment for future generations.

Reference

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