India must ban firecrackers in the year of G20 Presidency & build a landmark contribution to climate action and COP28

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ECIPH WORKING PAPER SERIES

August, 2023

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Readers citing this document are asked to use the following format:

Isha Agrawal, Edmond Fernandes (2023), 'India must ban firecrackers in the year of G20 presidency & build a landmark contribution to climate action and COP28'. ECIPH Working paper 1. Mangalore, Edward and Cynthia Institute of Public Health

Available at: https://eciph.in/

Acknowledgement

The authors would like to acknowledge Ajfan Fathima, Amon Wa-l-Sumer, Ashish Thakur, Ayisha Shamna, Damaya Myrphet, Fathimath Kausar, Fathimath Safreena, and Umu Salma, the students of the Masters of Public Health programme at Yenepoya (Deemed to be University) in association with the Edward and Cynthia Institute of Public Health, for their contributions and inputs in this working paper.

We would also like to extend our appreciation to Mr. Harshith Shetty for the graphics and design of the working paper.

Contents

Table of Figures

India must ban firecrackers in the year of G20 presidency & build a landmark contribution to climate action and COP28

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1. INTRODUCTION

Fireworks are spectacular displays invented by ancient Chinese inventors, using a mixture of flammable substances to produce explosive displays and extravaganza. They are among the most breath-taking outdoor events performed in the celebration of traditional, religious, or cultural festivities in both advanced and developing countries over centuries.(Abdulwadud & Ozanne-Smith, 1998)

Celebrations are no longer regarded complete without the use of firecrackers, which briefly light up the entire sky but have detrimental effects on both our environment and our health. Fireworks raise the amount of dust and other pollutants in the air. After firing, the dust and pollutants packed with chemicals like Sulphur, zinc, copper and sodium settles down in the exposed areas and start destroying the environment and easily increases the health risk besides adding more people into the arena who become at risk populations.

Firecrackers superficially add flavour to occasions but have impacts that present as a threat multiplier to human sustainability and disrupts the ecosystem in many different ways.

Firework-related injuries are a global phenomenon, affecting countries at all stages of development. In the United Kingdom, between 30 to 40 children are admitted to hospitals and between 500 to 600 kids visit emergency rooms each year.(Avery & Jackson, 1993). Similarly, about 400 people suffer injuries annually in the Netherlands, with 80% of instances involving young boys between the ages of 12 and 20 years(Kon, 1991). In the United States, 12,000 people need treatment each year for injuries caused by fireworks(Centers for Disease Control and Prevention, USA, 1995). On an average, per year around one to eight deaths and about 1000 injuries have been reported in Italy (D'Argenio et al., 1996).

In India, the rate of firecracker-related injuries is reported to be 7 cases per 100,000 population annually (Kalita, n.d.) and this low ratio could also be due to under-reporting at healthcare set ups. It is worth noting that India ranks as the second-largest producer of fireworks worldwide, following China(Control of Urban Pollution Series, 2017).

Despite various laws and regulations that prohibit the use of firecrackers after a particular time, many injuries and fatalities are reported from different parts of the world that shows the lack of concern, poor implementation of legal frameworks, and weak strategies directed towards curbing the firecracker bursting at a global level. The lack of global political will and the absence of judicial presence of mind to suo-moto put brakes on the firecracker impact on human health will turn out to be a water-shed moment for developmental priorities and also a continuous threat to the ecosystem, animals included. The climate change centered dialogue will additionally fall flat in the absence of plugging this unwanted menace that serves no fruit.

2. Bursting of Firecrackers as a Public Health concern

Firecrackers universally produce vibrant lights in different colours, create sound effects, and release smoke containing gases and tiny particles. Children and teenagers are primarily affected by fireworks injuries, with a particularly higher incidence among males. However, a considerable portion of those injured consists of bystanders, making up 40% to 50% of the total (Bitter et al., 2021). Every year, an estimated 160,000 to 280,000 children under the age of 15 suffer ocular injuries globally (John et al 2015). A number of studies conducted in in different parts of the world with the majority in Europe, India, Canada, and China, have found, a significant increase in the levels of several components of firecrackers in the atmosphere, impacting the air quality(Gouder & Montefort, 2014)

Case study 1

New years' firecrackers and acoustic trauma: A case study from Germany

Globally, there exist many policies and programme to address the noise pollution, yet it is apparent that noises caused by fireworks receive scant attention.

In order to assess the incidence of blast and explosion trauma caused by the burning of New Year's firecrackers in a western industrialized society, a research study was conducted in Germany with 562 centres, including the otorhinolaryngology departments of 31 university hospitals and of 87 city hospitals. According to estimates, there were 8,160 cases of acoustic trauma brought on by firecrackers, with a rate of 28 incidents per 100,000 people between the ages of 6 and 25.

Moreover, over one in every 1,000 men aged nineteen were traumatised on New Year's Eve and obtained medical assistance from a professional. In merely a few days surrounding the New Year's Eve in Germany, almost 8,000 patients experienced acoustical trauma. Several children, teenagers, and adults develop a lifelong, irreversible hearing loss.

Hence, it is evident that firecrackers bursting is a serious social and public health issue that needs to be handled at the priority with their strict involvement in international laws, and a creative approach to aware community.

The aforementioned case study of Germany depicts the severe impact of fireworks leading to the impairment among the vulnerable population. (Plontke et al 2002)

2.1. Conceptual framework

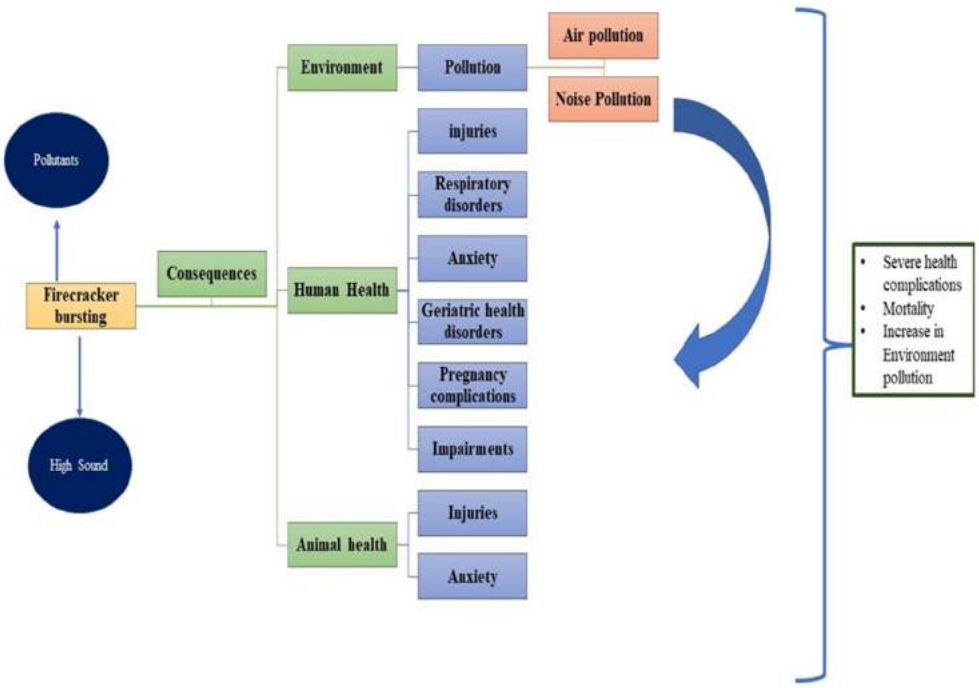

Figure 1: Conceptual framework

Bursting fireworks have a detrimental effect on the environment, animal health, and human health. Because of the numerous pollutants that firecrackers emit, including PM2.5, PM10, black carbon, etc. as well as their capacity to produce loud noises leads to air and noise pollution that further affect both human and animals. In addition to causing pollution, firecrackers can cause severe wounds, burns, amputations, mutilations and other disabling conditions. Animals, the elderly, children, and pregnant women are particularly susceptible to the harm that firecrackers can do. The chemicals present in firecracker can even impact the plants, it is supported by research conducted in Orissa, India, where the plant samples have shown a rise in the elements like CaO, SO3, ZnO, NiO post-Diwali, 2019(Mandal et al., 2020).

Firecracker bursting is a social and a public health issue as people spent thousands of rupees on firecrackers on various occasions, harming the environment, animals, and their own health in the process. They suffer additional financial hardship as they are compelled to pay for their healthcare. In severe cases, they may have to take time off from their workplace, which can be burdensome, especially for the daily wage employees leading to sick absenteeism.

2.2. Impacts of Firework

The fireworks industry is widely recognized for its inherent hazards, encompassing every stage from manufacturing to transportation and storage of fireworks in stores. The industry poses a significant risk to both life and property throughout these processes. During the manufacturing process of fireworks assembly, workers are exposed to hazardous substances, significantly increasing the risk to their health and well-being(Control of Urban Pollution Series, 2017). This direct contact with such substances can result in severe issues such as lead poisoning, ulcers, and damage to the central nervous system. Furthermore, the presence of unhygienic conditions and inadequate training further amplifies the dangers faced by these individuals. Regrettably, the prevalent use of child labour in this industry not only contributes to these risks but also leads to the untimely loss of lives at a young age(Control of Urban Pollution Series, 2017)

In India, most of the firework industries are situated at Sivakasi, Tamil Nadu. The safety and occupational health survey report, 2014, by Regional Labour Institute suggests that a total of about 783 fireworks are functioning in the Sivakashi town of Virudhunagar. Most of the fireworks that the country consumes come from Sivakasi, Tamil Nadu. Unfortunately, the lack of awareness and non- adherence on safety measures has led to many severe accidents in the firework industries(Elangovan, 2014). A severe fire catastrophe at the Sivakashi firecracker industry in September 2012 resulted in about 40 fatalities and 25 injuries. In response, the Madras High Court Madurai Bench issued an interim directive to close the 200 unauthorised fireworks units in Sivakashi based on a public interest litigation(Times of India, 2013).

The graph below explains the number of accidents that have taken place in firecracker industries from (2001 to the date of study)

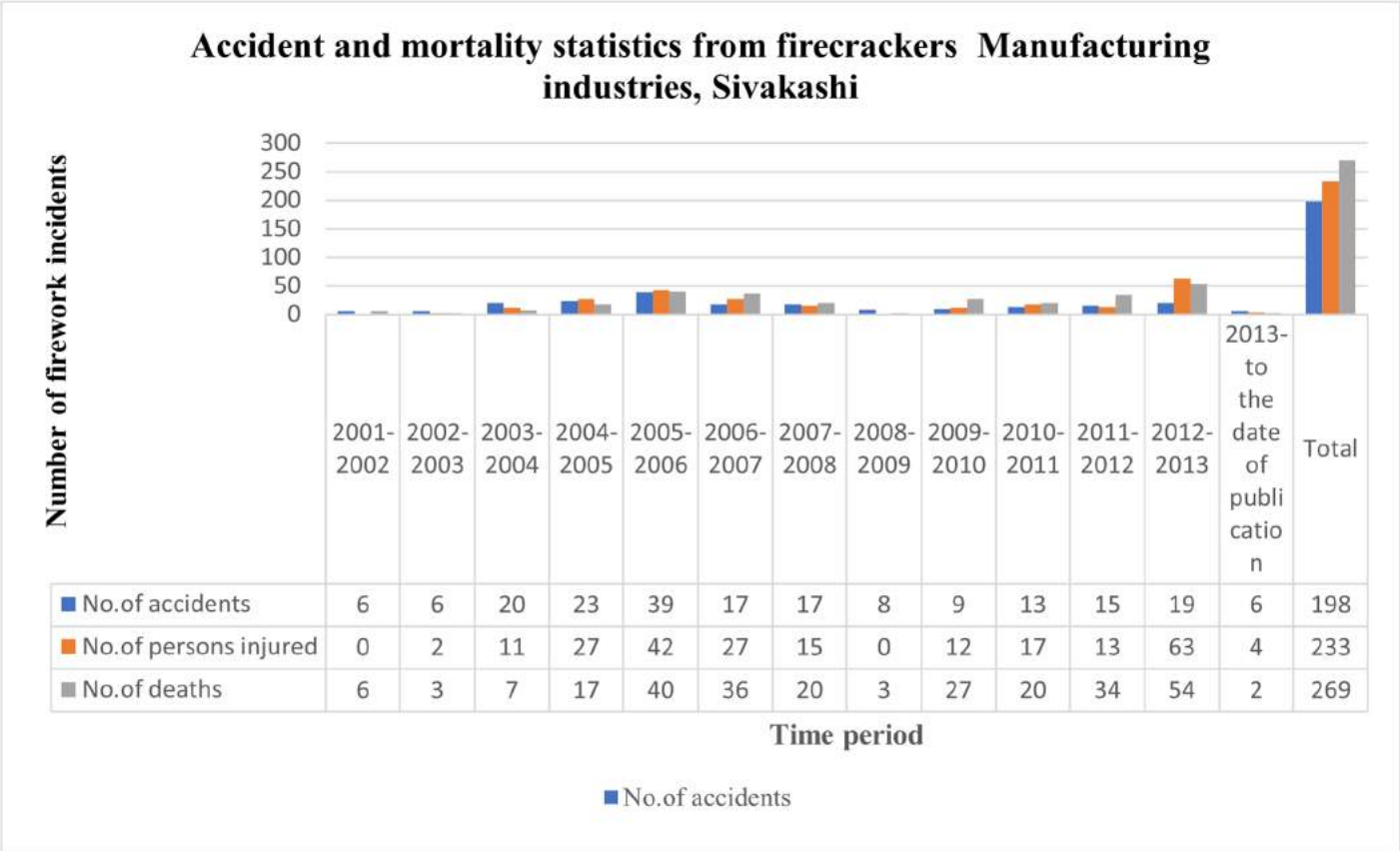

Figure 2: Accidents and mortalities statistics from fireworkers manufacturing industries, Sivakashi(Elangovan,2014)

The graph explains that in the given time period, about 269 deaths, and 233 number of persons were injured in accidents due to firecracker bursting, which are preventable injuries and fatalities and therefore, is highly unacceptable.

2.2.1. Impact of firecrackers on human health

The detrimental impact of air pollution on human health is increasingly acknowledged, both in the short and long term. Individuals exposed to high levels of ambient air pollution, particularly adults and children, have demonstrated a higher prevalence of chronic cough, phlegm, and breathlessness. Consequently, they face an elevated risk of developing respiratory diseases such as, asthma, chronic obstructive pulmonary disease (COPD), allergic rhinitis, lower respiratory tract infections, and even lung cancer and blindness (CPCB, South Zonal Office, 2013; Schindler et al., 2001) Particularly, the people with co- morbidity were more susceptible to impact of firecracker burning during the COVID-19 pandemic (Report-O.A.No.-249-2020) According to a study conducted in Lucknow during Diwali festival bursting of firecrackers presented as a source of particulate pollutants and also released other harmful gaseous

pollutants. It was determined that there had been a 50–70% rise in patients after Diwali, with respiratory problems accounting for 57.1% of them, followed by allergic reactions (Khan et al., 2022). According to research studies carried out by the Institute of Environmental Assessment and Water Research, firecrackers containing metallic particulates exposes the asthmatics to a higher health risk (Moreno et al., 2010).

India reported to have, a rise of about 30 % to 40% in the cases of respiratory diseases, bronchitis patients irrespective of ages and gender during the Diwali festival (Gouder & Montefort, 2014). Indian cities in addition to firecracker induced pollution, also face compounded air pollution challenges that stem as an offshoot of urbanization, industrialization and vehicular emission. This holds good for many low- and middle-income countries around the world.

Firecrackers pollute the environment with noise, particulate matter and chemicals. Additionally, the sudden explosion of a firecracker may induce fear, stress, and depression, particularly among people with poor mental health. It may also lead to headaches, nausea, trigger high blood pressure, etc. Therefore, under the Noise Pollution (Regulation and Control) Rules (Rule 5 A) 2000 it has been mentioned that sound emitting firecrackers shall not be burst in the silence zone or during the night time. Silence zone is defined as the area of about 100 meters around hospitals, educational institutions and courts (Control of Urban Pollution Series, 2017; Ministry of Environment & Forests, 2000)

The explosive sounds of the firecrackers can have a serious negative effect on those with Post-Traumatic Stress Disorder (PTSD), associated with sound, and other kinds of noise sensitivity. Even, fireworks may interfere with a person's sleep cycle, depriving them of sleep, which has an adverse effect on their health and other aspects of their lives (López, 2020)

Exposure to the smoke and explosive noises of fireworks can cause harm to the baby and it can also lead to difficulty in breathing in the mother (Mali, 2022).According to Centre for Disease Control and Prevention (CDC), noise travels from the mother’s body to womb and frequent exposure to high intensity noises can lead to the stress that further can affect the developing baby (Noise - Reproductive Health | NIOSH | CDC, 2023)

Central Pollution Control Board (CPCB) had conducted the noise surveys from 2011 to 2015 in 7 different cities of India that includes Delhi, Bangalore, Bhopal, Lucknow, Agra, Vadodara, Kolkata, and Shillong.

In all these cities, different locations were selected for noise monitoring during Deepawali festival.

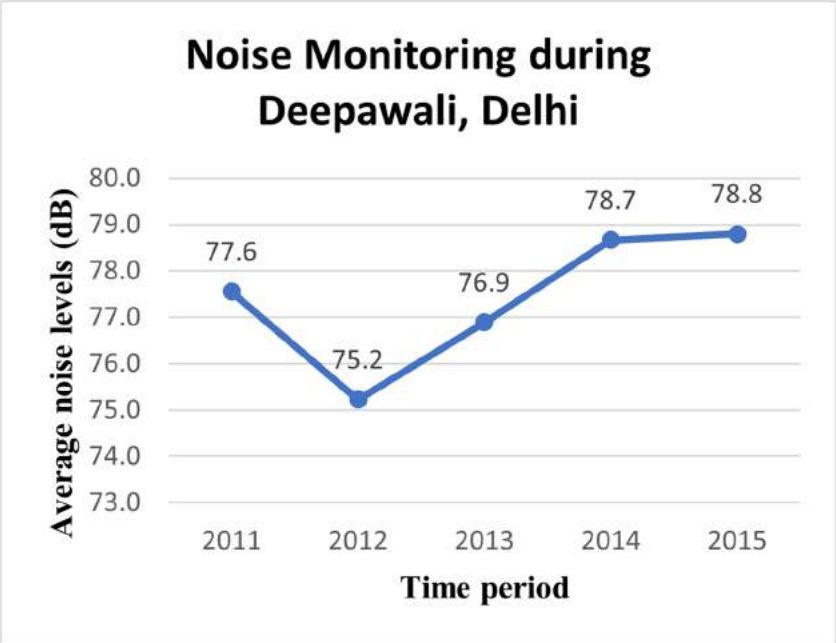

Figure 3: noise monitoring during Deepawali festival, Delhi

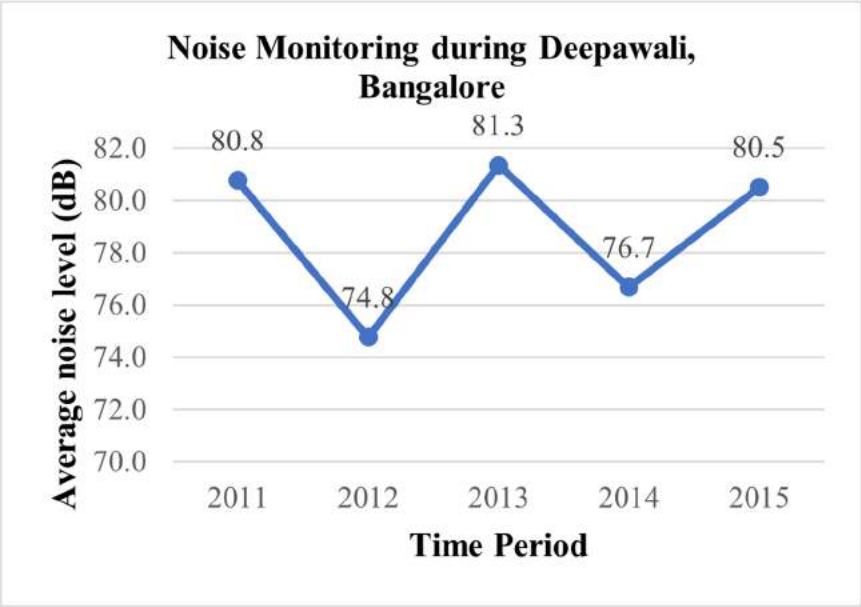

Figure 4: noise monitoring during Deepawali festival, Bangalore

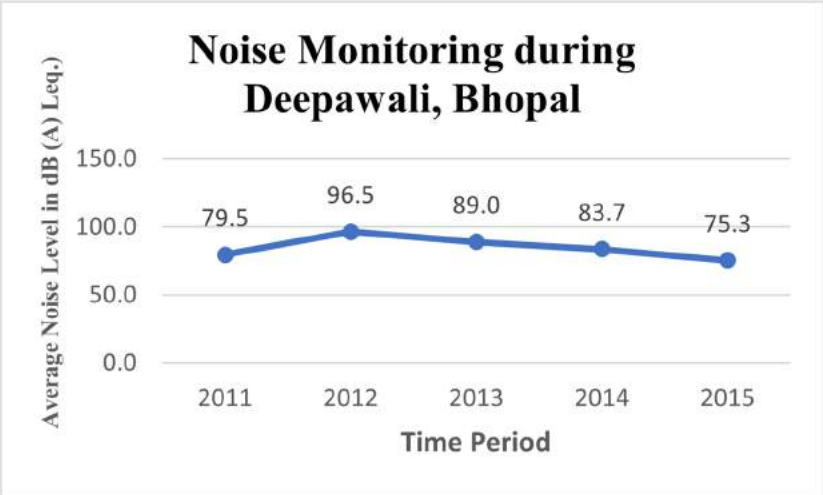

Figure 5: noise monitoring during Deepawali festival, Bhopal

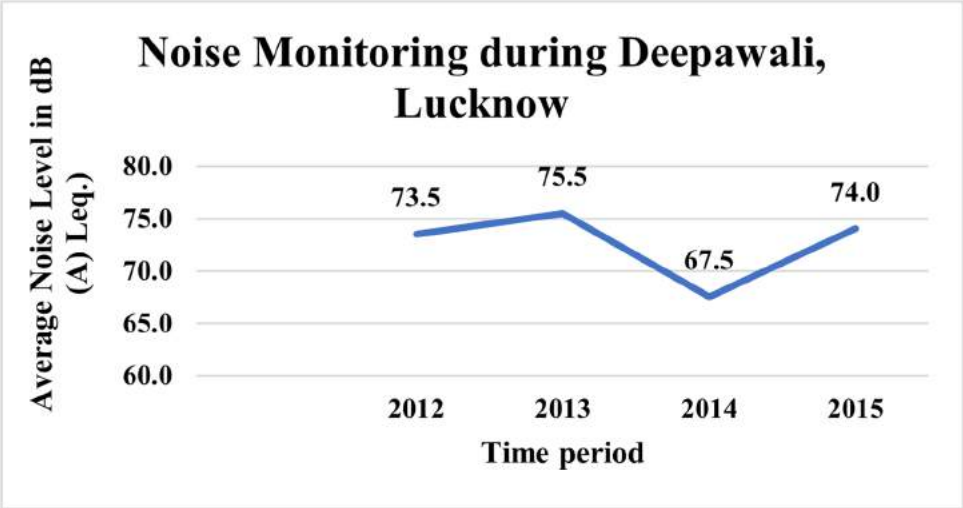

Figure 6: noise monitoring during Deepawali festival, Lucknow

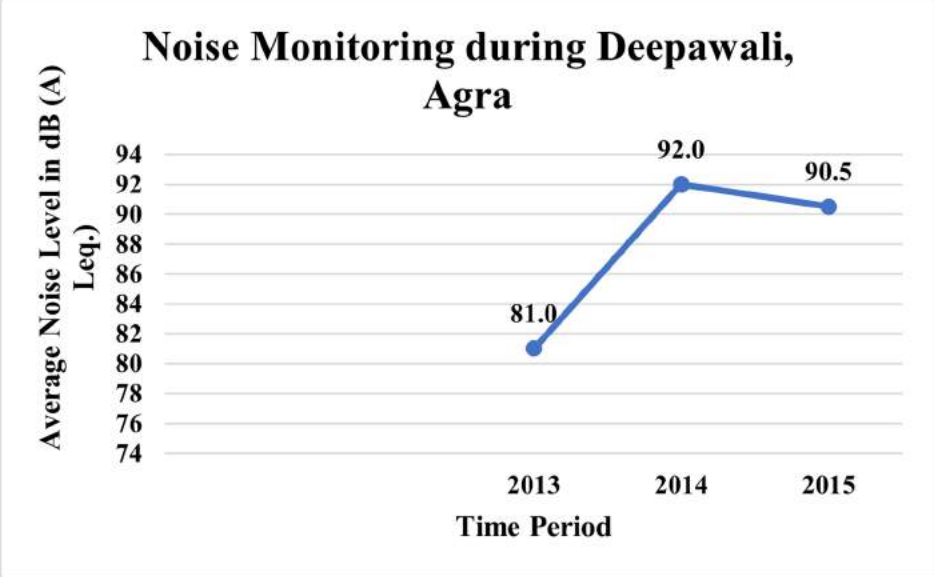

Figure 7: noise monitoring during Deepawali festival, Agra

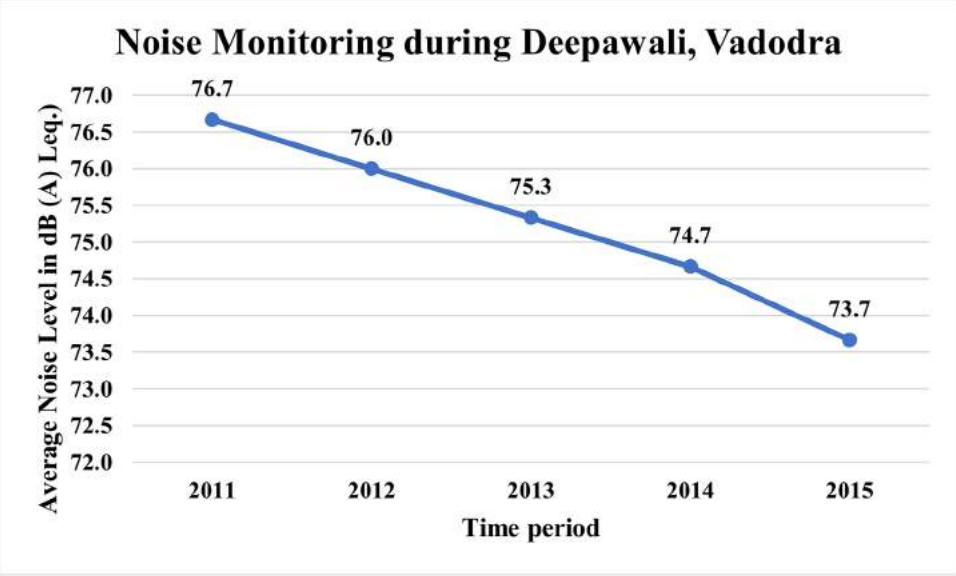

Figure 8: noise monitoring during Deepawali festival, Vadodra

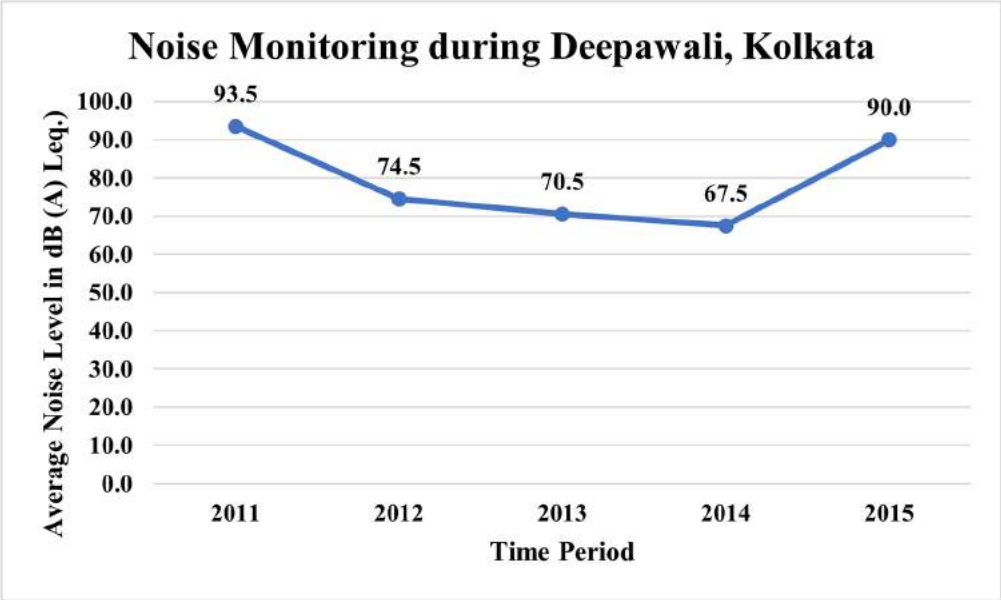

Figure 9: noise monitoring during Deepawali festival, Kolkata

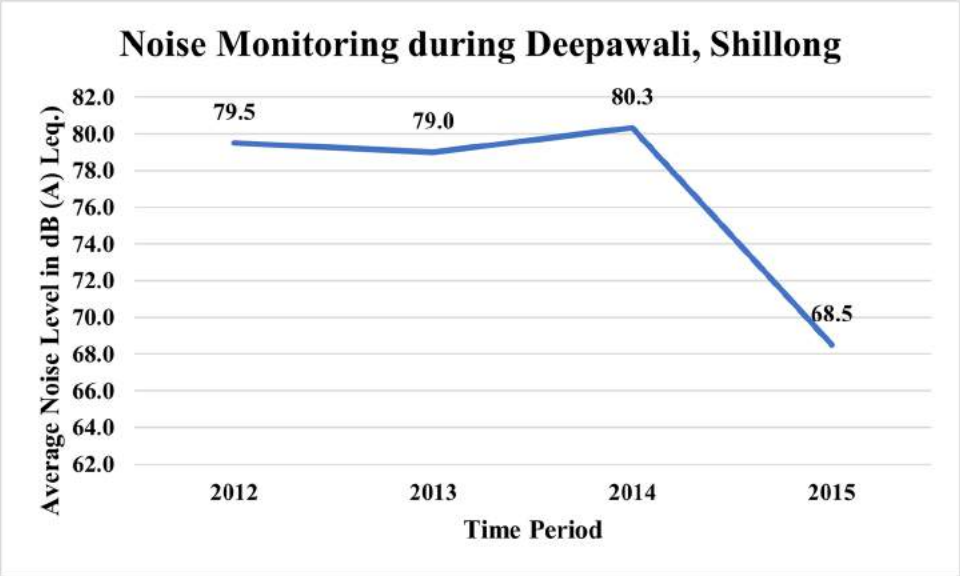

Figure 10: noise monitoring during Deepawali festival, Shillong

The average noise monitoring data of all the target locations in the particular city is estimated for all the years from 2011 to 2015. Majority of the cities have reported the average sound levels of more than 70 dB every year, irrespective of the number of selected locations.

For instance, in Bhopal, the data for the year 2012 was only available for two locations, and the average of which was about 96 dB. Similarly, in Agra only two locations were selected for the monitoring. In 2014 (one location) and 2015, the average noise level estimated was above 90 dB

In Kolkata, separate monitoring was conducted for North Kolkata and South Kolkata. Overall, the Kolkata reported to have noise levels of 93.5 dB in 2011 and 90 dB in 2015(Control of Urban Pollution Series, 2017)

Although, Government of India has passed a law in 2005 mandating the time limits for the firecracker bursting, yet the above statistics and the mentioned case study suggests that these laws are weakly implemented. In many tier II and tier III cities, this problem is further made worse due to lack of regulatory controls.

Mangaluru city in Karnataka is a city which suffers from this peculiar problem where the city police have been casual to regulate fire crackers and ensure that fire crackers are not blasted post 10 pm. The city suffers from fire cracker bursting at odd hours of the night creating panic among people, disrupting animal safety and inducing animal cruelty and also putting high risk patients in old age homes and hospitals at further risks. This is particularly also seen during festivals like Dasera, Diwali, Christmas, New Year, Eid, Yakshagana and Kola celebrations.

Case Study 2

Firecracker injuries in spite the Implementation of Laws: A case study from Government hospital in Delhi

A hospital-based study involving patients with emergency burn casualties at a government hospital in India was undertaken between the years of 2002 and 2010 at pre Diwali, Diwali and post Diwali.

The study's findings revealed that 1373 patients seek emergency care for burn injuries caused by firecrackers, with the youngest patient being 14 months old and the oldest being 88. The major causative agent for the injuries was determined to be the bombs and flower pot.

Despite the fact that legislation was passed in India in the year 2005 that prohibits the bursting of firecrackers after 10 pm the study statistics show an increasing trend for firecracker injuries during the study period (with the exception of the years 2003 and 2007). This raises concerns regarding the effectiveness of law enforcement to curb the incidents of preventable injuries and fatalities caused by exploding firecrackers but it also points towards the importance of community engagement in order to mitigate the bursting of firecrackers by informing citizens about the serious repercussions (Tandon et al., 2012) Along with impacting the organs and causing disorders, firecrackers cause severe injuries as well, which can be understood from the following case studies:

Case study 3

Fire cracker explosion disaster: a case study of public firework display event at Puttingal in Kerala, India

Puttingal festivities in Kerala have a public display of traditional fireworks that consumes hundreds to thousands of kilogrammes of gun powder. A tragic incident occurred in Kerala's Kollam region early on April 10, 2016, when the stored fire crackers burst within 20 to 30 seconds, leaving the area in total darkness and filled with screams and dread. Serious injuries were brought on by the incident.
In addition to 1250 injuries, the incident claimed 109 lives. Other structures that were damaged included homes, stores, offices, electrical infrastructure, and wells. Along with harming the power and water networks, it has cost the building infrastructure a loss of roughly 0.3 million US dollars

The case study of Kerala stated above indicates how these fire crackers, which were a major part of celebrations, can be the cause of accidents and fatalities. Ultimately, it leaves the community with the devastating financial problems and disrupts sustainability that aids restoring normalcy(Illiyas & Mani, 2018)

Another case study is of the Chahashanbeh soori festival in Iran that led to the life-threatening injuries owing to the fire crackers in the year 2011.(Hatamabadi et al., 2013)

Case study 4

Chahashanbeh Soori festival in Iran and the firecracker injuries

Chahashanbeh Soori festival is celebrated in Iran on the last Wednesday of every year. However, these celebrations of joy and prosperity also claim many injuries due to the bursting of firecrackers to celebrate the festivals.

In this context, a cross-sectional study was carried out in 2011 in the emergency rooms of three educational hospitals in Tehran.

The study revealed that 35 patients were admitted due to firecracker injuries. Most of the patients were under 30 years old and mainly men (83%) and 17 % of women. The injuries involved laceration, burn, amputation, scratch, etc. Hand and face injuries were the most often reported ones.

In the past few years, the sound of bursting firecrackers has captivated teenagers and youth to mark the celebration, which unfortunately has led to life-threatening injuries during the same celebration. This also suggests that along with strict law enforcement and behavioural change, communication needs to be in place for the community, especially for teenagers and youth.

2.2.2. Impact of fire crackers on Animal Health & well-being

Firecracker bursting, especially unexpected loud noises, can cause discomfort and nervousness in many animals (Patange et al., 2011).For example, it is reported that 45 percent of dogs exhibit indications of fear when they hear fireworks (Gates et al., 2019). Firecracker explosions cause severe diarrhoea and other respiratory problems in animals as well. According to various zoologists, more than 700 birds were burned by the cracker explosion, and several birds lost their ability to move due to full feather damage. The firecrackers cause severe physical and psychological injury to the animals.(Madhumitha, 2018)

There are many animal welfare organisations in India that appeals for restricting the fire cracker bursting near animals and birds due to its adverse health outcomes. Many birds are claimed to perish each year as a result of the bursting of firecrackers. It has been reported that during the Diwali of 2016, about 40 birds were admitted in charity hospital of Gurgaon, among which majority of them had respiratory and skin disease problems (Patra, 2016).

Similarly, the responses from pet owners , animal welfare society, veterinary officers in Hyderabad and animal right activist in Mangalore have mentioned the instances of behavioural change, anxiety, shivering, not eating food and being aggressive to the loud noises induced by the firecrackers at all times regardless of the time frame guidelines. In addition, to the noises , they also get subjected to the lethal chemicals(Gatty, 2019; Hussain, 2019)

The following case study from New Zealand explains the severity of firecrackers on Animals(Gates et al., 2019)

Case Study 5

Impact of fireworks on animals: Lets understand it through the glasses of the owners

Studies have shown the potential impact of firecrackers on human health and environment, but undoubtedly, it negatively influences the attitude and health of animals too.

A study conducted with companion animal owners in New Zealand to collect their perceptions on the ill-effect of the fire crackers on the animals' behaviour suggested that above 70 % of the pets were scared of fireworks. Shivering, hiding and cowering are the reported adverse behaviours of their pets. Even, 5 % of them remain affected by the firework for about a week, which shows the severe impact of these fireworks and the trauma these animals must have gone through. It was noted that about 345 animals were injured directly and indirectly by firecrackers and more than 45 % of them required veterinary assistance and even about 5 % were subjected to euthanasia. More than 80% of the owners support the ban on the sale of firecrackers. Evidently, these are all the preventable injuries and mortalities caused by humans that now needs strict actions to prevent further severities.

Animals not only suffer psychological discomfort, but they can also inflict severe damage on themselves as they attempt to run or hide from the noise, and also end up pulling down available materials which can be a cause for injury. The large noises of crackers make them unstable and leads to shivering, drooling, howling, psychosis or excessive barking (NCPCS Srilanka, 2022)

Many birds and animals become temporarily or partially blind as a result of the pollutants, smoke and the extreme light from crackers It not only weakens their vision but also causes respiratory difficulties and other problems. Many birds ran away from shelters, since they have very less eyesight during at night, they may die or meet with accidents (P. Singh, 2017).These death of animals and birds may lead to ecological imbalances.

The majority of scavenging birds are remarkably efficient in quickly removing the bodies of large animals; they are crucial for the recycling of nutrients, alerting other scavengers to dead animals, and preventing the spread of illnesses to human settlements as a result of slowly decaying carcasses. As a result of declining pollination and seed dissemination brought on by the loss of birds, dependent plant species might become extinct.(Robertson et al., 1999)

2.2.3. Impact of Firecrackers on Planetary Health & climate

Bursting firecrackers increases heat, carbon dioxide, and many other poisonous chemicals in the atmosphere, which raises earth's temperature and pollutes the air, contributing to global warming.

The figure 11 explains the relation between Firecrackers, pollution and climate change. These interactions ultimately have adverse outcomes on human health, animals and ecosystem.

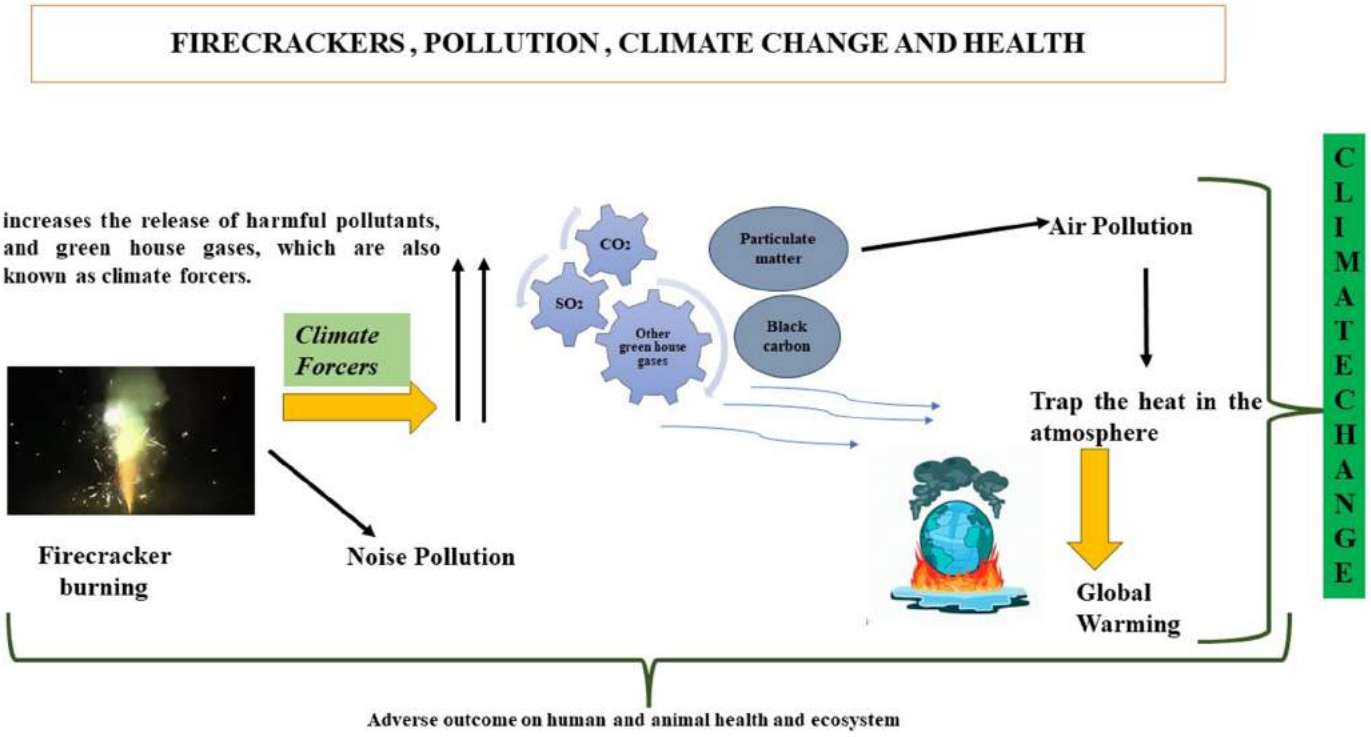

Figure 11: Infographic Insight into Firecrackers and climate change

Black powder, also known as gunpowder, is used in fireworks. This powder contains potassium nitrate, carbon or charcoal, and sulphur, all of which are elements that naturally occur in the environment. Explosive materials used in fireworks cause hazardous environmental pollutants and greenhouse gases to be released into the atmosphere.

Metals and salts are released from fireworks as a result of the chemical reaction of combustion. This procedure releases fumes and smoke, containing nitrogen, carbon dioxide, and carbon monoxide. Sadly, these three gases are to blame for climate change(GrrlScientist, 2019).

A study from Jamshedpur city, India, report indicates, during Diwali firecrackers harm the ambient air quality due to emission and significant accumulation of PM_{10}, SO_2, NO_2, O_3, and trace metals. On Diwali, it was estimated that ambient PM_{10} was increased by 21-27% as a result of firework aerosol (Ambade, 2018)

Research conducted in Kannur to evaluate the effects of the fireworks on the air quality during the Vishu festival in April for the years 2015, 2016, 2017, and 2018. The levels of PM_{10}, O_3, NO_2, and NO significantly increased with the extensive burning of firecrackers. In contrast to 2017, 2016, and 2015, the O_3 content during Vishu was observed to be greater in 2018.The levels of O_3 and NO_2 were found to have increased by more than 100% on Vishu day compared to the control days (before and after Vishu festival). The 24 hour average PM_{10} concentration rose to 195 g/m3 on April 15, and the air quality index (AQI) demonstrated a decrease in air quality ,which was underscored by the extreme firecracker burning at the study location (Ct et al., 2019)

The ambient air quality during Diwali festival, 2013 was monitored by Central Pollution Control Board, indicates a significant increase in the concentrations of PM_{10} in two out of three monitoring stations in Bangalore, where a rise of about 28.5 $\mu g/Nm^3$ was noted at one study location and 33.3 $\mu g/Nm^3$ in other. Moreover, about 95 cases of eye injuries and 7 cases of burns, associated with fire crackers were also reported(CPCB, South Zonal Office, 2013)

The following case study from western coastal place explains the rise in the level of pollution during Diwali festival(Chanchpara et al., 2023)

Case Study 6

Man – made disasters adversely influencing planetary health: a case study of a western coastal place during Diwali festival

Firecrackers are mostly set off during Diwali festivities in India which has an effect on both human and environmental health. In connection with this, in Bhavnagar, India, from pre- to post-Diwali in 2021, CSIR-CSMCRI conducted an air quality assessment study over the course of five days.The study's findings showed that the air quality index (AQI) elevated around Diwali, directing towards the poor air quality during the festival owing to the excessive firecracker and sparkler burning.

This can be understood by the significantly higher average 24-h concentrations of PM10 (380 μg/m^3), PM2.5 (182.2 μg/m^3), and SPM (403 μg/m^3) during Diwali, exceeding the National Ambient Air Quality Standards (NAAQS). The highest pollution levels were observed to be on day 3 (Diwali), with an increase in noise during the night time of Diwali (50.5 to 69.7 dB).

A study done over the festival of Diwali in mega city, Ahmedabad clearly demonstrates the strong aerosol loading from black carbon, the particle emissions from the firecrackers that are lit during the festival, and reported values that are three to four times higher than the National Ambient Air Quality Standards of 100 and 60μ g/m^3 for PM_{10} and $PM_{2.5}$, respectively. In comparison to the pre-Diwali day, the daily averaged BC, PM_{10}, and $PM_{2.5}$ concentrations rose by almost 286%, 89.5%, and 60.5%, respectively (Chhabra et al., 2020)

It must be understood that Diwali is not the only time when firecrackers get exploded. This is also practiced for festivals such as Christmas, Eid, New Year and also spills over for rituals such as BhootaKola, Yakshagana etc besides also being used during personal events such as birthday parties, marriages, deaths and other occasions. Over time with more education and more availability of fire cracker business seeping into the mindset, this trend has transitioned from a mark of an event to now a regular fashionable process which creates confusion, disrupts normalcy and has no real-world value to anything concrete and good.

2.2.4. Misinterpretation of Firecrackers

Sometimes, the cracker bombs can be confused with other bomb attacks. For instance, in the historic terrorist attack that took place at Mumbai in 2008 , reports suggests that many people have initially assumed it to be the noise of fire crackers, as the hotel had wedding event going-on (Deb Roy, 2020)

Overall, these assumptions can interfere with the emergency responses to the actual bomb blast or terrorist attack circumstances. Therefore, it is important to control the sound of the cracker bombs.

Furthermore, in some instances, the scenario might be turned around, whereby cracker bombs could be mistaken for terrorist attacks, prompting unnecessary actions. A panic scenario was generated in France in 2016 at a French Riveria resort when people rushed in in response to the explosive sound of firecrackers bursting, which they mistakenly interpreted for a terrorist threat(Batchelor, 2016).The administration in Jammu and Kashmir's Rajouri district has outlawed the use of firecrackers during wedding celebrations because it causes the military to mistake them for terrorist attacks, especially during nights (Bhargav, 2023)

Laws and Policies related to Firecrackers in India

According to the Environment Protection Act,1986, the manufacture, sale or use of fire cracker generating noise level exceeding 125 dB (A) or 145 dB (C) pk at 4 meters distance from the point of bursting shall be prohibited (CPCB,Ministry of Environment, Forest & Climate Change, 2021)

The noise standards for fire crackers were notified by the Environment Protection Second Amendment rules, dated on 5th October 1999 and were included in the Environment (Protection) rules 1986.These rules were amended by the Environment (protection)second amendment rules ,2006 under the Environment Protection Act 1986 (CPCB, ENVIS, 2006)

Supreme Court of India directions on firecrackers

- The bursting of firecrackers would strictly be from 8:00 p.m. till 10:00 p.m. only on Diwali days or on any other festivals, and from 04.00 am till 05.00 am and 09.00 pm till 10.00 pm on Gurpurab, when such fireworks generally take place.

- The Firecracking would be from 11:55 p.m. till 12:30 a.m. only on Christmas Eve and New Year Eve, when such fireworks start around midnight, i.e. 12:00 a.m.

- Fire crackers shall not be used at any time in silent zones (Delhi Police, 2022)

In 2019, green crackers were made and manufactured for which eight labs participated CSIR-NEERI, CEERI, IITR, IICT, NCL, CECRI, NBRI and CMERI, with CSIR NEERI overseeing the complete operation, These crackers were declared to be environment friendly and curbed pollution up to 30% (Ministry of Science & Technology, 2019).The National Green Tribunal enforced a total ban on the sale and as well as the use of fire workers in the NCR along with directly all states and union Territories to take up initiatives to limit air pollution from all possible sources.

The Hon'ble Supreme Court of India established restrictions against noise pollution and firecrackers in 2005 (Control of Urban Pollution Series, 2017; Delhi Police, 2022) to the rules, manufacturers must follow the requirements established by the department of explosives and must also include information about the chemicals used to make the firecrackers.

The Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, outlawed the import, possession, and sale of firecrackers with foreign origin in 2014 (Ministry of Commerce & Industry, 2014)

In Punjab a window of two hours was given from 8pm to 10pm which was kept open for bursting firecrackers on Diwali. On Christmas eve and New Year eve, when such fireworks start around midnight, i.e. 12:00 a.m., it would be from 11:55 p.m. till 12:30 a.m. only. On the occasion of Gurpurab, fireworks shall be allowed for one hour in the morning i.e., 4 am to 5 am and one hour in the evening i.e., 9 pm to 10 pm (Memo number 4530-A Vide order dated 14/09/2022 "Guidelines under explosive rules 2008", Government of Punjab, 2022)

In order to safeguard the health of vulnerable individuals, including those with co-morbidities, the Indian states of Odisha, Rajasthan, Sikkim, NCT Delhi, and Chandigarh have prohibited the sale and usage of firecrackers during the COVID-19 pandemic. West Bengal has also passed an order stating that the state will ensure that there will be no instances of firecracker burning during Kali Puja, Diwali festival, Chhat Puja, Jagadhatri Puja, or Guru Nanak's birthday. Due to the COVID-19 epidemic, the Karnataka government has allowed only the bursting of green crackers and that too for 2 hours on festival days from 8.00 PM to 10.00 PM (Report-O.A.No.-249-of- 2020)

Despite a tight ban on imports without a license, there has been no discernible decrease in the illegal imports of Chinese fireworks into India (Vikram, 2016)

The legislation and prohibition have been successful in limiting the usage of firecrackers to some extent, but Delhi's and many other states' air quality continues to deteriorate.

The paper clearly depicts that despite of many national and state level laws, the fire crackers are still fired throughout the country, even after the legal permitted timings and durations. For example, the case study 2 mentioned in this paper, clearly depicts the instances of fire cracker burning g after the permitted timings of 10.00 p.m. to 6.00 a.m. (Tandon et al., 2012)

3. Situation analysis of Karnataka

It is evident from the case studies and evidence noted in the paper that firecracker increases the level of the particulate matter and other hazardous pollutants that leads to many non- communicable diseases like respiratory disorders, cardiovascular diseases etc. besides hampering wellbeing outcomes for elders, patients in hospitals, animals, pets and the greater environment at large.

The following figure explains the impact of firecrackers on the ambient noise levels in 24 cities of Karnataka during Diwali festival, that clearly depicts an increasing trend in the level of ambient noise in majority of the cities (KSPCB, 2022)

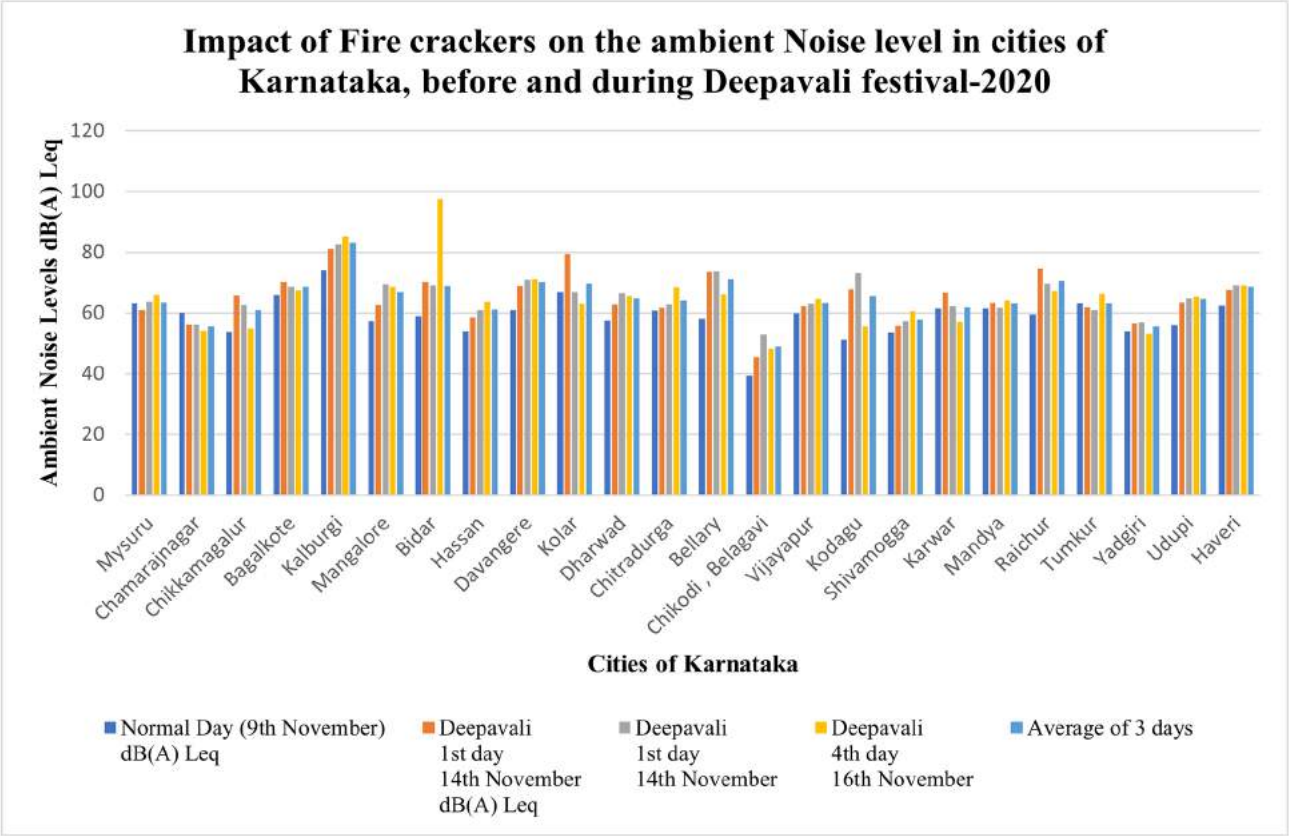

Figure 12: Impact of Firecrackers on the Ambient Noise Pollution during Deepavali festival, Karnataka, 2020

Source: Pollution Control Board, Karnataka, 2020-2021(KSPCB, 2022b)

With concrete evidence of linkage between IHD and particulate matter existing, regulating the explosion of crackers will be a case in preventive health which custodians of health and well-being must see a reason towards bettering health outcomes.

However, along with the industrial pollution, and emissions from the vehicles, the immediate increase in the levels of these pollutants by firecrackers during the festivals may lead to the cardio- vascular and other related diseases(A. Singh et al., 2019). It can also exacerbate the existing respiratory -conditions as well. A recent cross sectional study conducted between 2018-2019 in Bangalore reveals, among 19% school children who were suffering from allergic rhinitis, and around 4 % who were asthmatic, about 48 % and 63 % respectively have experienced a worsening of the symptoms.

Karnataka state is blessed to have a superior healthcare facility available in abundance. Naturally this comes with responsibility as the proximity to civilians is situated in desirable radius of access. Hospitalised patients need care in full measure to achieve speedy recovery, thus the explosion of firecrackers like a dirty bomb may have devastating effects not just on physical health, but also mental health.

A cross- sectional study conducted in the rural areas of Karnataka with more than 300 elderly population revealed that majority of them are suffering from some major morbidities like impaired vision, hypertension, and joint problems (Hameed et al., 2015).Another study carried out in Coastal Karnataka have also resulted the similar findings, indicating the prevalence of hypertension, osteoarthritis, severe impairments and other morbidities among elderly population(Kamath et al., 2014)

In Karnataka, it has been estimated that in 2017-18, around 7% of the elderly people are physically immobile, either they are confined to bed, to their homes or are wheel chair bound and more than 3 % are living alone (Ministry of Statistics and Programme Implementation, 2021)

The above-mentioned statistics and findings explain the health and living conditions of old age people in the state of Karnataka, which is crucial for conceptualizing the detrimental effect of the firecracker bursting on the well- being of the elderly population as firecracker burning can increase the health risk, particularly for those who have respiratory disorders, hypertension, etc. The intersectionality of impairment, old age, and poor safety net will further aggravate the condition by interfering in their immediate response to the emergency conditions and in accessing healthcare services owing to fire cracker bursting like burn injuries and accidents, anxiety, trauma, heart diseases etc, the problem gets worse for those elderly who are living alone. This has cascading effects when cracker bombs are exploded during night hours. Wisdom tells us that we must rise as responsible civilians and also align with global goals on climate change and focus on climate action.

The airborne smoke from the crackers reacts with the atmosphere and generates acid rain, which then lead to soil erosion while lowering forest productivity. Firecrackers and acid rain can contaminate the water bodies as well. Given that Karnataka is the second-most vulnerable state to drought(Biradar & Kumar, 2013) and that the state already hosts industries that degrade air and water quality at some instance, it is important to maintain the quality of existing waterbodies to prevent the spread of water-borne diseases and health-risk due to scarcity of water. The deteriorating air quality of our cities is testimony to the urgency that must be tabled to introduce a complete evening hour ban on firecrackers.

The figure 13 explains an increasing trend in the concentration of PM 10 and PM 2.5 in Mangalore from 2019-20 (KSPCB, 2022a) to 2020-21(KSPCB, 2022b)

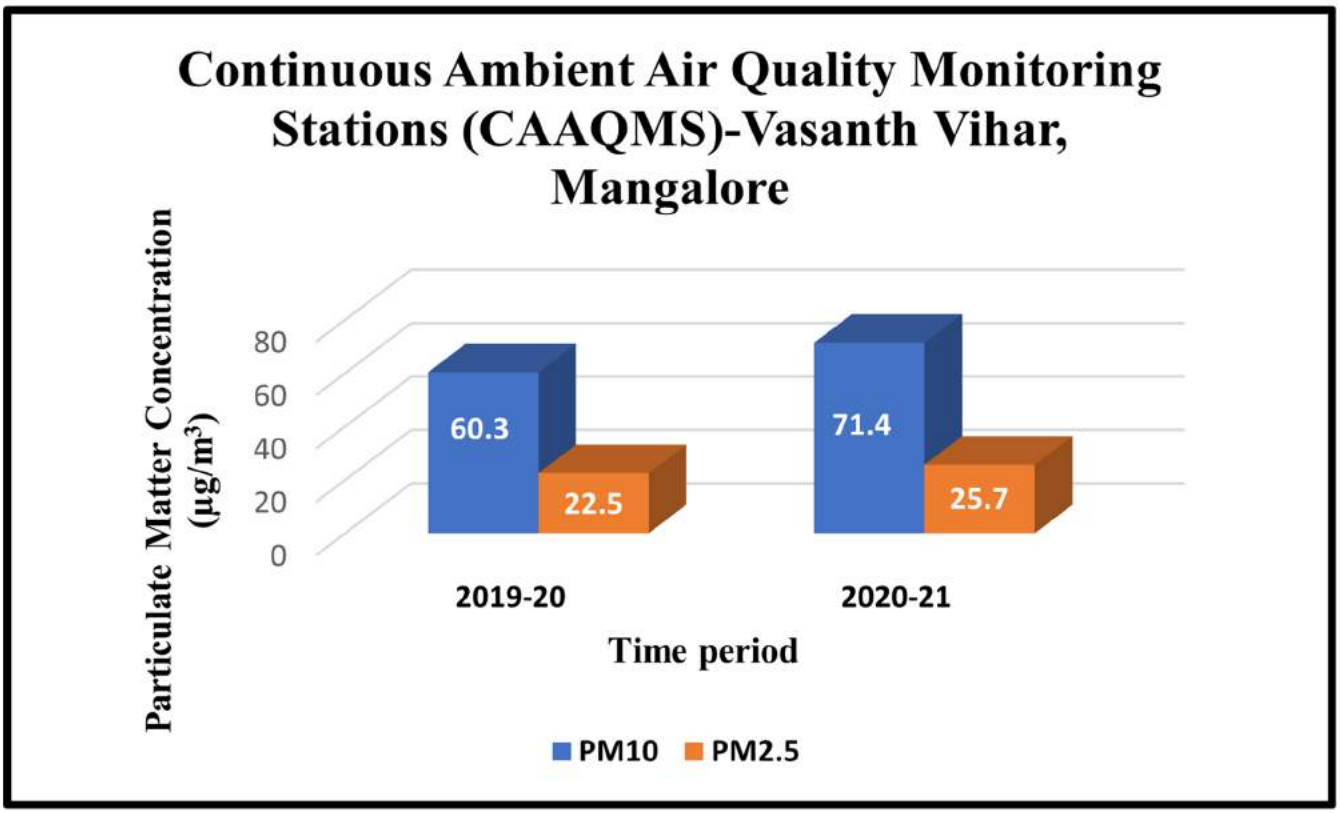

Figure 13: Trends of PM 10 and PM 2.5 from 2019-20 to 2020-21, Vasanth Vihar, Mangalore

Another study conducted at six different sites of Mangalore, on the particulate matter concentration in the district, estimates the levels of PM 2.5 and PM $_{10}$ to be higher than the National Ambient Air Quality Standards (NAAQS) limits vary from 71.7 to 131.9 mg/m^3 at all six sample locations for PM_{10} The highest concentration of 231.5 µg/m^3 at town hall and between 34.9-48.5 µg/m3 for PM $_{2.5}$, with the highest concentration of 120.3 µg/m^3 at KMC Attavar. The post-monsoon season yielded almost 70% of the overall mass concentrations of PM_{10} and $PM_{2.5}$ particles(Kalaiarasan et al., 2018) Adding to this, the regular bursting of firecracker bursting in the district will further detoriate the air quality, and worsens the temperature ultimately impacting the health and environment(Cutinha, 2023).

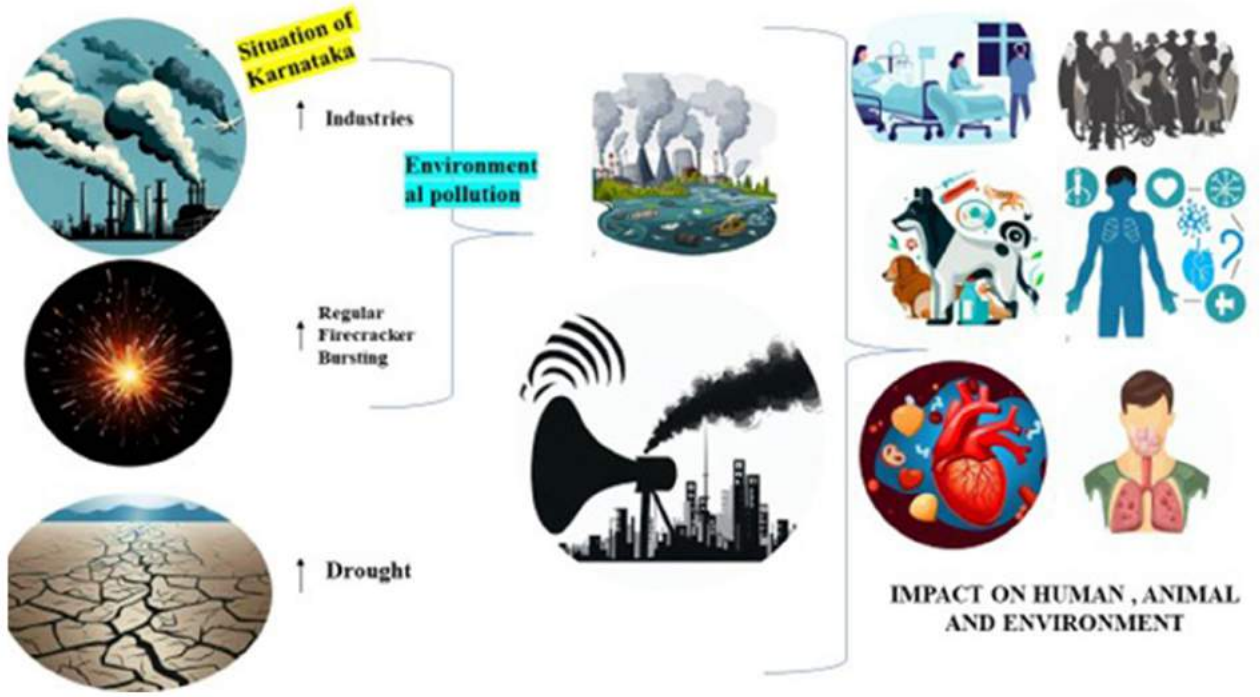

Figure 14 Situation analysis of Karnataka, India

In this light, as the firecracker industry has a minimal contribution to the economic development of the country and have a devastating impact on the health and environment.

The state must take action to restrict the use of known exposures and culprits like firecrackers, thereby contributing towards preventable air, noise and associated pollution and effectively addressing public health issue.

4. Conclusion and Recommendations

It is now evident that firecracker bursting is one of the major public health concerns and yet remains painfully ignored by researchers, government agencies, policy makers, developing partners, academia, etc. Although, the firecrackers are not the only means of celebrating festivals, marriages and other major activities, yet people enjoy the sound, fireworks and colours with their families during festivities.

Given the detrimental effect of firecrackers, it is incumbent on stakeholders to implement a full ban on firecrackers as India is also a signatory to the Paris Agreement on Climate Action and also needs to achieve the Nationally Determined Contribution to UNFCCC by reducing Emission Intensity by 45% by 2030 and also achieving the vision of the Hon'ble Prime Minister of India for a mass movement which centers around Lifestyle for Environment" as a key to combat climate change (The Union Cabinet, 2022).

A full closure of firecracker production factories must be executed with all employees being moved to other job sectors. Furthermore, factory laws need to be strictly monitored in order to protect the lives of factory workers, to check the standards of chemicals and sound limits.

Following are some recommendations in addition to the aforementioned:

• Ban: A full night time ban from 7 pm to 7 am must be nationally executed with strict enforcement. No special permission must be granted for any festivals irrespective of religion, case, creed, practice.

• Taxation: A 300% rise in tax for purchase of fire crackers must be put in place.

• Monitoring: There needs to be a strict monitoring of the law enforcement, especially during festival times.

• Research: There are very few studies that have been carried out which depicts the association of firecrackers with human health (inclusive of mental health), and planetary health. Therefore, it is recommended that more advanced research should be conducted in order to advocate evidence – based changes

• Data: A compulsory data base needs to be maintained as there is insufficient data at national and state level on the injuries and fatalities due to firecrackers

• Community engagement: A high level of community sensitization and participation is important in order to restrict the use of firecrackers on any occasion. Education and awareness should be given to the community about the hazards and risk of firecrackers as well as to purchase the crackers from reputable or licensed dealers and to avoid homemade or illegally manufactured firecrackers.

• Guidelines for individuals at risk: special guidelines for individuals at health risk like people with respiratory disorders, should be advertised on the public channels.

• Multi-sectoral participation: multi-sectoral participation involving stakeholders from concerned government agencies, policy makers along with educational sector, health system and developing partners should participate in community sensitization on the consequences of firecrackers on human health and overall well-being, animal health and environment.

• Sensitization and training of factory workers: There is need to sensitize the fire cracker manufacturing company workers through training sessions and workshops on fixing the sound and percentage of chemicals under the minimum acceptable range. The shopkeepers should always suggest the customers on the use of protective equipment

• Law enforcement for children: It should be strictly advised that the children under the age of 14 should always be accompanied by the adult while bursting the firecracker or just watching the fireworks.

• Health system preparedness: The emergency departments of every hospital should be equipped with all the medicines, staffs and services during the festival times.
• Household mandates: It is advisable to maintain a fire extinguisher or a container of water or sand close by the location where the fireworks will be displayed so that they may be quickly deployed in an emergency along with the safety equipment.

India must lead the way in the year of the G20 and C20 Presidency to ensure firecrackers are banned as a landmark contribution to curbing air and noise pollution but also with a larger focus on climate change leading to climate action.

5. References

1. Abdulwadud, O., & Ozanne-Smith, J. (1998). Injuries associated with fireworks in Victoria: An epidemiological overview. Injury Prevention, 4(4), 272–274. https://doi.org/10.1136/ip.4.4.272

2. Ambade, B. (2018). The air pollution during Diwali festival by the burning of fireworks in Jamshedpur city, India. Urban Climate, 26, 149–160. https://doi.org/10.1016/j.uclim.2018.08.009

3. Avery, J. G. (J G., & Jackson, R. H. (Robert H. (1993). Children and their accidents. Edward Arnold. https://ci.nii.ac.jp/ncid/BA24173379

4. Batchelor, T. (2016). France on edge: Stampede injures dozens at Med resort after ‘gun shots’ spark terror fears. https://www.express.co.uk/news/world/700113/Stampede-Juan-les-Pins-resort-gun-shots-spark-terror-attack-fears

5. Bhargav, S. (2023). Storage, sale of fire crackers banned in Rajouri. https://www.greaterkashmir.com/pir-panjal/storage-sale-of-fire-crackers-banned-in-rajouri

6. Biradar, N., & Kumar, V. (2013). Analysis of fodder status in Karnataka. The Indian Journal of Animal Sciences, 83, 1078–1083.

7. Bitter, C. C., Zhang, Z., Talbert, A. W., Weber, A. K., & Hinyard, L. (2021). Firework injuries are increasing in the United States: An analysis of the National Emergency Department Sample. Journal of the American College of Emergency Physicians Open, 2(6), e12600. https://doi.org/10.1002/emp2.12600

8. Centers for Disease Control and Prevention, USA. (1995). Serious eye injuries associated with fireworks—United States, 1990-1994. MMWR: Morbidity and Mortality Weekly Report, 44(24), 449–452.

9. Chanchpara, A., Muduli, M., Prabhakar, V., Madhava, A. K., Thorat, R. B., Haldar, S., & Ray, S. (2023). Pre-to-post Diwali air quality assessment and particulate matter characterization of a western coastal place in India. Environmental Monitoring and Assessment, 195(3), 413. https://doi.org/10.1007/s10661-023-11018-x

10. Chhabra, A., Turakhia, T., Sharma, S., Saha, S., Iyer, R., & Chauhan, P. (2020). Environmental impacts of fireworks on aerosol characteristics and radiative properties over a mega city, India. City and Environment Interactions, 7, 100049. https://doi.org/10.1016/j.cacint.2020.100049

11. Control of Urban Pollution Series. (2017). Status of Pollution Abatement measures: Fire crackers (Patakas) (pp. 1–83).

12. CPCB, ENVIS. (2006). Noise Standards for Firecrackers.

13. CPCB, South Zonal Office. (2013). Report on ambient noise and status of air pollution during Deepawali festival -2013 in Bengaluru city, Karnataka.

14. CPCB,Ministry of Environment, Forest & Climate Change. (2021). Pollution Control Acts, Rules & Notifications issued there under.Pollution Control Law Series: PCLS/02/2021. https://cpcb.nic.in/7thEditionPollutionControlLawSeries2021.pdf

15. CT, R et al. (2019). Temporal Changes in Air Quality during a Festival Season in Kannur, India. Atmosphere, 10(3), Article 3. https://doi.org/10.3390/atmos10030137

16. Cutinha, D. (2023). Too hot to handle! People in Dakshina Kannada struggle with rising temperature. https://www.newindianexpress.com/states/karnataka/2023/mar/13/too-hot-to-handlepeople-in-dakshina-kannada-struggle-with-rising-temperature-2555495.html

17. D'Argenio, P., Cafaro, L., Santonastasi, F., Taggi, F., & Binkin, N. (1996). Capodanno Senza Danno: The effects of an intervention program on fireworks injuries in Naples. American Journal of Public Health, 86(1), 84–86. https://doi.org/10.2105/AJPH.86.1.84

18. Deb Roy, L. (2020). 4 Survivors Of 2008 Mumbai Terror Attacks Recall Their Brush With Death. https://www.outlookindia.com/website/story/india-news-2611-mumbai-terrorist-attack-12-years-on-horrific-memories-still-afresh/365375

19. Delhi Police. (2022). Guidelines for obtaining temporary fireworks license (pp. 1–8). https://licensing.delhipolice.gov.in/V2/PublicNoticeFile?fileName=Guidelines%20for%20Firecracker%20License.pdf

20. Elangovan, D. R. K. (n.d.). REGIONAL LABOUR INSTITUTE.

21. Gates, M., Zito, S., Walker, J., & Dale, A. (2019). Owner perceptions and management of the adverse behavioural effects of fireworks on companion animals: An update. New Zealand Veterinary Journal, 67(6), 323–328. https://doi.org/10.1080/00480169.2019.1638845

22. Gatty, H. R. (2019, October 28). "Green" or otherwise, crackers are sheer agony for animals. Citizen Matters. https://citizenmatters.in/green-crackers-during-deepavali-no-help-for-animals-14398

23. Gouder, C., & Montefort, S. (2014). Potential impact of fireworks on respiratory health. Lung India : Official Organ of Indian Chest Society, 31(4), 375–379. https://doi.org/10.4103/0970-2113.142124

24. GrrlScientist. (2019). Festive Fireworks Create Harmful Pall Of Pollution. https://www.forbes.com/sites/grrlscientist/2019/12/31/festive-fireworks-create-harmful-pall-of-pollution/

25. Hameed, S., Kumar, N., Naik, P. M., K, S., & S, P. K. (2015). Morbidity Pattern Among the Elderly Population in A Rural Area of Dakshin Kannada, Karnataka–A Cross Sectional Study. National Journal of Community Medicine, 6(02), Article 02.

26. Hatamabadi, H. R., Tabatabaey, A., Heidari, K., & Khoramian, M. K. (2013). Firecracker Injuries During Chaharshanbeh Soori Festival In Iran: A Case Series Study. Archives of Trauma Research, 2(1), 46–49. https://doi.org/10.5812/atr.9250

27. Hussain, M. (2019, October 27). Animals bear brunt of loud cracker noise the most. The Siasat Daily. https://www.siasat.com/animals-bear-brunt-loud-cracker-noise-most-1707492/

28. Illiyas, F. T., & Mani, S. K. (2018). Routine to Rare Risk—A Case Study of Firecracker Explosion Disaster in India. PLoS Currents, 10, ecurrents.dis.d5a27e47c8decbd4263813a15c47e07e. https://doi.org/10.1371/currents.dis.d5a27e47c8decbd4263813a15c47e07e

29. John, D., Philip, S. S., Mittal, R., John, S. S., & Paul, P. (2015). Spectrum of ocular firework injuries in children: A 5-year retrospective study during a festive season in Southern India. Indian Journal of Ophthalmology, 63(11), 843–846. https://doi.org/10.4103/0301-4738.171966

30. Kalaiarasan, G., Balakrishnan, R. M., Sethunath, N. A., & Manoharan, S. (2018). Source apportionment studies on particulate matter (PM10 and PM2.5) in ambient air of urban Mangalore, India. Journal of Environmental Management, 217, 815–824. https://doi.org/10.1016/j.jenvman.2018.04.040

31. Kalita. (n.d.). Fire-cracker burn injuries during Diwali, a seasonal and preventable epidemic. Retrieved July 14, 2023, from https://www.ijburns.com/article.asp?issn=0971-653X;year=2021;volume=29;issue=1;spage=70;epage=75;aulast=Kalita#ft1

32. Kamath, V., Kulkarni, M., Shetty, R., Kamath, A., B, D., & K, S. (2014). Morbidities among Elderly in a Rural Community of Coastal Karnataka: A Cross-Sectional Survey. Journal of The Indian Academy of Geriatrics, 10, 29.

33. Khan, T., Lawrence, A., Dwivedi, S., Arif, S., Dwivedi, S., Upadhyay, A., & Abraham, A. (2022). Air Pollution Trend and Variation during a Mega Festival of Firecrackers (Diwali) in Context to COVID-19 Pandemic. Asian Journal of Atmospheric Environment, 16, 2022016.

34. Kon, M. (1991). Firework injuries to the hand. Annales de Chirurgie de La Main et Du Membre Supérieur, 10(5), 443–447. https://doi.org/10.1016/S0753-9053(05)80456-9

35. KSPCB. (2022a). Annual Report of 2019-2020. Karnataka State Pollution Control Board. https://kspcb.karnataka.gov.in/sites/default/files/2022-06/A10_final_2019-2020_Eng.pdf

36. KSPCB. (2022b). Annual Report of 2020-21. Karnataka State Pollution Control Board. https://kspcb.karnataka.gov.in/sites/default/files/2022-06/Annual%20Report%202020-21-ENG.pdf

37. López, Q. (2020). How night after night of fireworks affects your body and mind, from increased anxiety to memory problems, according to a psychologist. https://www.insider.com/how-fireworks-affect-you-from-increased-anxiety-and-memory-problems-2020-7

38. Madhumitha, G. (2018). An contravential essay on ban of crackers as a Judicial intervention or intrution. 5(3).

39. Mali, V. (2022). Diwali and pregnancy – Tips for safe and healthy celebrations. Diwali and Pregnancy – Tips for Safe and Healthy Celebrations. https://www.drvarshaliclinic.com/blog/diwali-and-pregnancy-tips-for-safe-and-healthy-celebrations

40. Mandal, U., Panda, M., Routray, S., Panda, S., & Mahalik, G. (2020). Heavy Metal Accumulation by Plants as a Result of Diwali Fire Craker Emission in Urban Areas of Bhubaneswar, Odisha, India. 10, 22715–22719.

41. Memo number 4530-A Vide order dated 14/09/2022 “Guidelines under explosive rules 2008”, Government of Punjab,. (2022). Vide order dated 14/09/2022 “Guidelines under explosive rules 2008”, Government of Punjab, Department of Industries and Commerce, Punjab , Chandigarh (pp. 1–9). https://ppcb.punjab.gov.in/sites/default/files/2022-12/Guidelines%20under%20Explosives%20Rules%202008.pdf

42. Ministry of Commerce & Industry. (2014). Illegal Import, Possession and Sale of Fireworks of Foreign Origin. https://pib.gov.in/newsite/PrintRelease.aspx?relid=110655

43. Ministry of Environment & Forests. (2000). The Noise Pollution (Regulation and Control) Rules, 2000 (pp. 1–9). https://parivesh.nic.in/writereaddata/ENV/noisepollution/noise1.pdf

44. Ministry of Science & Technology. (2019). India launches “Green Crackers” in its bid to curb air pollution. https://pib.gov.in/newsite/PrintRelease.aspx?relid=193646

45. Ministry of Statistics and Programme Implementation. (2021). Elderly in India (pp. 1–137). http://www.indiaenvironmentportal.org.in/files/file/Elderly%20in%20India%202021.pdf

46. Moreno, T., Querol, X., Alastuey, A., Amato, F., Pey, J., Pandolfi, M., Kuenzli, N., Bouso, L., Rivera, M., & Gibbons, W. (2010). Effect of fireworks events on urban background trace metal aerosol concentrations: Is the cocktail worth the show? Journal of Hazardous Materials, 183(1–3), 945–949. https://doi.org/10.1016/j.jhazmat.2010.07.082

47. NCPCS Srilanka. (2022). One Step greener Srilanka. https://www.ncpcsrilanka.org/wp-content/uploads/2022/06/100-ACTIONS-100-DAYS.pdf

48. Noise—Reproductive Health | NIOSH | CDC. (2023, May 1). https://www.cdc.gov/niosh/topics/repro/noise.html

49. Patange, K. B., Khan, A. R., Behere, S. H., & Shaikh, Y. H. (2011). Noise Power Spectrum for Firecrackers: International Journal of Artificial Life Research, 2(1), 62–70. https://doi.org/10.4018/jalr.2011010107

50. Patra, P. (2016). Diwali pollution clips wings of Gurgaon's birds. https://timesofindia.indiatimes.com/city/gurgaon/diwali-pollution-clips-wings-of-gurgaons-birds/articleshow/55227061.cms

51. Plontke, S. K.-R., Dietz, K., Pfeffer, C., & Zenner, H.-P. (2002). The incidence of acoustic trauma due to New Year's firecrackers. European Archives of Oto-Rhino-Laryngology, 259(5), 247–252. https://doi.org/10.1007/s00405-002-0451-4

52. Report-O.A.No.-249-of-. (2020). Report-O.A.No.-249-of-2020 (pp. 1–564). https://cpcb.nic.in/NGT/Report-O.A.No.-249-of-2020.pdf

53. Robertson, A. W., Kelly, D., Ladley, J. J., & Sparrow, A. D. (1999). Effects of Pollinator Loss on Endemic New Zealand Mistletoes (Loranthaceae). Conservation Biology, 13(3), 499–508. https://doi.org/10.1046/j.1523-1739.1999.97471.x

54. Schindler, C., Künzli, N., Bongard, J. P., Leuenberger, P., Karrer, W., Rapp, R., Monn, C., & Ackermann-Liebrich, U. (2001). Short-term variation in air pollution and in average lung function among never-smokers. The Swiss Study on Air Pollution and Lung Diseases in Adults (SAPALDIA). American Journal of Respiratory and Critical Care Medicine, 163(2), 356–361. https://doi.org/10.1164/ajrccm.163.2.9911116

55. Singh, A., Pant, P., & Pope, F. D. (2019). Air quality during and after festivals: Aerosol concentrations, composition and health effects. Atmospheric Research, 227, 220–232. https://doi.org/10.1016/j.atmosres.2019.05.012

56. Singh, P. (2017). Firecracker ban: Animals can breathe easy this Diwali. https://timesofindia.indiatimes.com/city/delhi/pet-peeve-animals-can-breathe-easy-this-diwali/articleshow/61138103.cms

57. Tandon, R., Agrawal, K., Narayan, R. P., Tiwari, V. K., Prakash, V., Kumar, S., & Sharma, S. (2012). Firecracker injuries during Diwali festival: The epidemiology and impact of legislation in Delhi. Indian Journal of Plastic Surgery : Official Publication of the Association of Plastic Surgeons of India, 45(1), 97–101. https://doi.org/10.4103/0970-0358.96595

58. The Union Cabinet. (2022). Cabinet approves India's Updated Nationally Determined Contribution to be communicated to the United Nations Framework Convention on Climate Change. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1847812

59. Times of India. (2013). HC orders closure of more than 200 unlicensed firework units. https://timesofindia.indiatimes.com/city/madurai/hc-orders-closure-of-more-than-200-unlicensed-firework-units/articleshow/21385046.cms

60. Vikram, K. (2016). China to Chandni Chowk: Dangerous and illegal Chinese crackers flooding markets before Diwali. India Today. https://www.indiatoday.in/mail-today/story/chinese-firecrackers-illegal-diwali-indian-markets-340390-2016-09-10