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Study of noise pollution during Nawruz festival in Duhok city, Iraq

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ABSTRACT

The present study is an attempt to assess and to find out the impact of human activities during the festival of Nawruz in Duhok City in Iraq. The study was conducted to determine the trends and variations of noise levels at various areas of the City. Noise levels were monitored during Nawruz Festival with the help of sound level meter. The results of noise monitoring show an enhanced pressure of noise during the festival of Nawruz. The average noise level on festive day show a rise of more than 20% compared to non-festive day. It was found that the noise level was higher as comparison to the standard limit of noise.

1. Introduction

Noise pollution, unlike air, water, and land pollution, is one such phenomenon which goes unnoticed by all, but has a very serious negative impact on the health of all life forms. It is said, "You may forgive noise but your body will never" (Agarwal and Yadav, 2013). The sources of noise pollution are extremely varied and they are mainly classified as community noise and industrial noise. One of community noise produces during celebrating specific events, such as Nawruz.

Nawruz, meaning in Persian "The New Day" is the name of the Iranian and Kurdish New Year celebrated on the spring equinox (21st March) (KRG. 2015; Gunter, 2004). Nawruz is celebrated by people from diverse ethnic communities and religious backgrounds for thousands of years. It is a secular holiday for most celebrants that is enjoyed by people of several different faiths, but remains a holy day for Zoroastrians. Explosive pyrotechnic devices are widely used for celebrating causing an unusual environmental effect, such as noise and air pollution. Fireworks are used worldwide as a part of national and cultural celebrations. Intensive fire ignition and cracker work activities takes place during the festival and celebration of Nawruz, with great enthusiasm all over Kurdistan of Iraq, every year during March for a period of few days. Fireworks, Crackers of varied colors and sounds fill the skies heralding Kurdistan of Iraq. Nawruz festival is traditionally celebrated with songs and dance, together with musical instruments (drums, etc.), using Loud speakers, and thus consequently produce a lot of infuriating noise. Besides Nawruz there are also other festivals during which noise and air pollution is observed. In Iraq, the problem caused by noise pollution is increased during celebration, festival, marriage, religious functions, etc.

Crackers during Nawruz emit large amount of particulate matter (PM) and poisonous gases in the air. They deteriorate the air quality as well as they cause noise pollution. This noise pollution is beyond tolerable limits, and disturbs social as well as human life, and disturbance in the ecosystem. The effects of noise pollution on human health have been considered by the WHO [World Health Organization] to be the third most dangerous type of pollution after air and water (WHO, 1995, Berglund et al., 1999). Further effects of fireworks are associated with serious injuries that are preventable, together with economic costs. Studies from countries around the world stress the importance of these global issues (Singh et al., 2005; Vassilia et al., 2004; Greene and Joholske, 2007). Environmental noise has been defined as an unwanted outdoor sound, or any sound that has the potential to annoy or disturb humans or cause adverse psychological or physiological effects to humans (Paul and Armah, 2011). Researchers and society are increasingly concerned about the noise, and there has been a surge in the development of researchers and the creation of laws and regulations to mitigate the impact of the noise in the social environment (Zannin et al., 2006).

Noise levels are commonly measured using a logarithmic scale named the decibel scale (dBA). For analysis purposes the environmental noise level is often converted into a single number called the "equivalent" sound level (L_{eq}). The L_{eq} (A) indicator is defined as the average acoustic intensity over time, or the equivalent noise energy level of a steady,

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unvarying tone (Davis and Masten, 2008). World Health Organization (WHO) published the L_{eq} (A) levels for some situations (Table 1).

Table 1: The L_{eq} (A) levels for noise, for some situations (WHO, 1995)

situation	bedrooms	Steady state	outdoor living	schools and preschools	Playgrounds children	hospitals	Ward-rooms	Patron to hospitals during a 4-hour period
L_{eq} dB (A)	30	45	55	35	55	35	30	>100

In comparison with other pollutants, the control of environmental noise has been hampered by insufficient knowledge of its effects on humans and of dose–response relationships, as well as by a lack of sufficient data, especially in developing countries like Iraq. Noise from fire crackers is one of the most important environmental problems mainly during festive occasions in Iraq and other countries.

Noise not only disturbs man's work, sleep, rest and communication but it also damages his hearing capacity and evokes other psychological, physiological and possibly pathological reactions (Agarwal and Yadav, 2013). Exposure to noise in the residential as well as work situation can lead to a range of health effects which are usually subdivided in well-being effects (annoyance and sleep disturbance) and clinical effects such as hearing damage and cardiovascular diseases (Yousif and Mahdi, 2013). Some distinct health effects of environmental noise and transport noise in particular are now well documented (Van Kamp, 2010). Effects of noise on human health and comfort could be divided into four categories depending on the exposure time and intensity. They are– [a] physical effects such as damage to hearing ability, which may be temporary or permanent depending on its duration and volume, [b] physiological effects, such as increased blood pressure, irregularity of heart rhythms (pulse), Nausea, headache, giddiness and ulcers; [c] psychological effects, e.g. disorders, sleeplessness and going to sleep late, irritability and stress; and [d] effects on work performance, e.g. reduction of productivity and misunderstanding what is heard (Evans and Hygge, 2000).

Noise pollution due to fireworks not only distracts our attention but also causes psychological stress. The most dangerous effect of noise from firecrackers is loss of hearing ability, which may be temporary or permanent (Jamrah et al., 2006; Zannin et al., 2006).

Excessive noise may cause severe sleep disturbance, fatigue and irritation due to community noise (Afsar, 2007).

A Review was conducted by Verma and Deshmukh (2014), about the ambient air and noise quality in India during Diwali (or Deepawali) festival. The review suggested the development of serious strategies to control the use of firecrackers during the festival of light in the major cities of India to protect human health. Several Researches regarding Study of Noise pollution during Diwali (or Deepawali) festival in India, and its consequences for the community has been published (Mahecha et al., 2012; Lad et al., 2011; Patel and Prashant, 2014; Ahirwar, and Bajpai, 2015). They observed the equivalent noise level was increased in residential and commercial areas on Diwali (or Deepawali) day. Also, many Researches regarding Noise pollution due to traffic was carried out in several countries, such as Japan (Yoshida and Yammamole, 1997), Canada (Michaud et al, 2005) and Iran (Moshtaghi et al., 2015).

To our knowledge, no published studies to date reported about Noise pollution (NP) in Duhok City (DC), Iraq, due to fireworks during Nawruz festival. The present study is an attempt to monitor the ambient noise levels for normal and during Nawruz festival days, in March (2014), from 16 pm to 24 am, at various locations in DC. The study was conducted to determine the trends and variations of noise levels at various areas of the DC, as well as to create awareness about NP through availability of scientific monitoring data.

2. Materials and methods

2. 1. The study area

Duhok City (DC), lies in the northwest of Iraq and western part of Kurdistan region, (latitude 36°5′N, longitude 43°0′). It is the 3rd most populous city of Kurdistan of Iraq (see Fig. 1), situated about 430-450 meters above sea level. The city population is (around 1000000). DC covers about 5 km^2. It is embraced by two chains of mountains, White (Bekhair) to the north, Shindokha to the south, and Zaiwa in the southeast. These mountains confer the city a linear shape and special landscape. To study the NP in DC during Nawruz festival, monitoring of noise level has been conducted in 3 different zones. The zones are Commercial zone-(CZ) near Duhok University, Residential zone (RZ) near Safen Secondary school, and Silent zone (SZ) (near Azadi Hospital). The measurement sites are displayed in Fig. 1.

2. 2. Weather parameters measurement

The micro-meteorological parameters like temperature (°C), relative humidity (%), wind speed (m/s) and wind direction have been measured during the study period, which included (1-normal day-NRD, 2- Pre-Nawruz Eve- PNZ Eve, 3- Nawruz

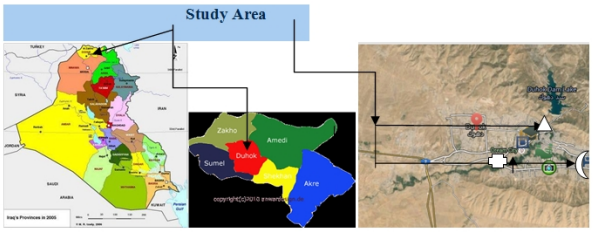
Eve- NZ Eve, 4-Nawruz day- NZ day, 5-post-Nawruz- PNZ day).

2. 3. Measurement of environmental noise

The entire measuring procedure was conducted according to standard acoustical measurements (Harris, 1991), and to the ISO (ISO 1996). i.e., at least 1 m from the walls or façade of the building, or any reflects surface, and 1.2 to 1.5 m above the floor. Our acoustic surveys were conducted in March (2014) in Duhok city (DC) during the festival of Nawruz. The study period was as mentioned above. Sound level is measured by following standard procedure using calibrated Sound Level Meters (SLM) Digital meter, (Castle 450). Sound was measured between 16pm to 24am.The equivalent noise level (L_{eq}) in dB(A) were calculated. Total monitoring period = 8hrs. Noise descriptor L_{eq} for equivalent noise has been calculated using the following formula (Davis and Masten, 2008).

$$L_{eq} = 10 \log (1/t) \int_{t=0}^{t=t} 10^{L(t)/10}\, dt$$

Where, t = time over which L_{eq} is determined.
L (t) = time varying Sound Level in dB (A).



a b c

Fig. 1: Map showing the sampling locations. a) Map of Iraq. b) Map of Duhok governorate. c) Map of Duhok city. Δ is commercial zone, ((is silent zone and the other is residual zone

Generally, there is no well- defined relationship between L(t) and time. So a series of discrete samples of L(t) have to be taken. This modifies the expression to (Davis and Masten, 2008).

$$L_{eq} = 10 \log \sum_{i=1}^{i=n} 10^{L_i/10}\, t_i$$

Where, t_i = fraction of total sample time, i= time intervals, n = number of observations (total number of samples taken), L_i = sound intensity level of the i th sample.

3. Results and Discussion

Fig. 2 shows some of the micro-meteorological parameters like temperature (°C), and relative humidity (%) during the day and the Night. Table 2 shows the Mean Values of wind speed (m/s) and wind direction during the study period. It was found that the temperature, relative humidity, and wind speed values where between 1.2–26.3°C, 45.5–80.9%, and 0.4–2.4 m/s respectively over Duhok city (DC) during the entire study period. It can be seen from Fig. 2 that the average relative humidity on normal days were almost same as during festival days, while there is more variations in the average temperature on normal days compared with festival days.

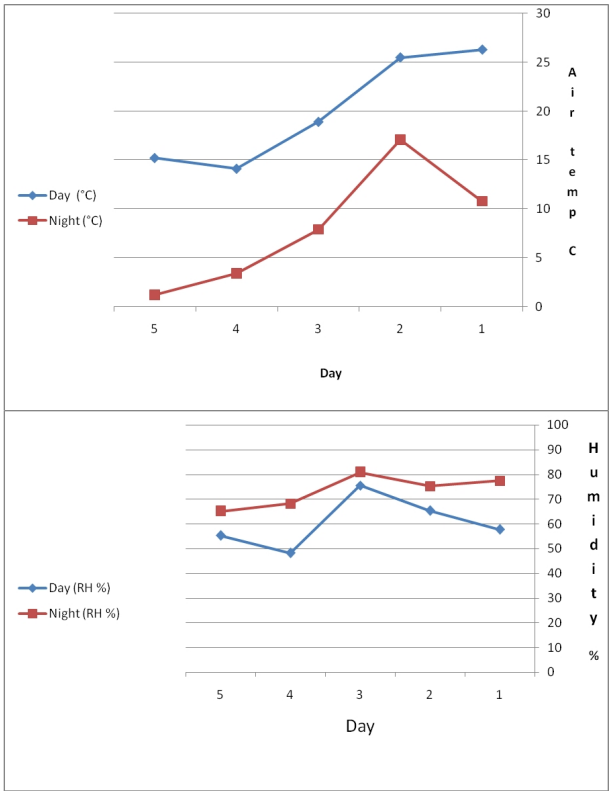


Fig. 2: Day and Night time average of a-(upper) temperature (°C), b- (bottom) relative humidity, over DC, during the study period (1-NRD, 2-PNZ Eve, 3-NZ Eve, 4-NZ, 5- post NZ)

The average wind speed was found to be slightly higher on NZ day, NZ Eve, and PNZ day-time compared to other days. The prevailing wind direction was SE, and about 25% of the time, wind speed was 1.5 m/s; and about 50% of the time, wind was calm. It is essential to declare that there was good climatic situation on NRD and, NZ Eve, NZ day, and PNZ day during the monitoring of sound level in Duhok city. Fire crackers generate instantaneous impulsive noise, which when measured in free field condition, gives peak sound pressure level. It is quite obvious that a number of crackers when bursting serially can easily form a band of continuous noise in the presence of reflecting surfaces. The reverberation of sound wave due to repeated reflection in the surfaces prolongs the time interval of prevailing sound intensity. The continuous band of noise thus formed. The variations in ambient noise level (equivalent noise L_{eq}) at different locations of DC (i.e. CZ, RZ, and SZ during the entire study period

are depicted in Fig. 3 to Fig. 5 respectively during the Nawruz festival. In the day time monitoring the Minimum value observed at Silent zone (SZ) = 35 L_{eq}.dB(A) on Normal days. The maximum value observed at Commercial Zone (CZ) = 84.7 L_{eq}.dB(A) on Nawruz Eve (see Fig. 3).

Table 2: The Mean Values of wind speed (m/s) and wind direction during the study period

Day	Direction	Night (m/s)	Day m/s)
Normal day -NRD	E	0.9	0.5
Pre-Nawruz Eve-PNZ Eve	NE	1.1	0.4
Nawruz Eve-NZ Eve	SE	1.5	1
Nawruz day-NZ day	SE	2.4	2
Post-Nawruz day-PNZ day	S	1.4	0.7

At location (SZ) (which include hospital and educational institutes), the maximum value recorded was 78.8 Leq.dB(A) during evening hours on NZ Eve, while the minimum was 39.9 dB on NRD (see Fig. 5). Both the maximum and average noise levels values in the SZ are higher than that of the standard limits. The noise pollution levels at SZ are due to their closeness to the main road. Therefore, apart from noise due to various activities, there is traffic noise from vehicle horns, ambulance siren, engines, and traffic volume. However, it is anticipated that the noise levels in the (Azadi Hospital) will be maintained below 50 dB (A). Earth mounds and plantations in the zone between the Azadi Hospital and the surrounding area would further attenuate noise in the Azadi Hospital. The maximum noise levels values was recorded in the CZ zone. Equivalent sound level was 84.7 dB on NZ Eve. It is clearly indicate that the noise levels values at both the (CZ), and (RZ), are much higher than that of SZ. The NP level, *L*eq ranges from about 57 dB (A) to about 85 dB (A) on NZ Eve, at the (CZ), while L_{eq} ranges from about 55 dB (A) to about 83 dB (A), on NZ Eve at the (RZ). Shops are located on main road (within a residential area). Generally, motor vehicles, which are a very significant part of the urban environment, are an important source of noise emission at both the (CZ) and (RZ), contributing 55% to the total noise (Banerjee et al., 2008). However, the noise survey results reveal moderate increase in the ambient noise level in various (CZ) and (RZ), areas in DC during festival days of Nawruz in comparison to any normal day. The main cause of increase in ambient noise level on festival days is bursting of crackers, whereas in NRD, the main contributions to the ambient noise level of any residential area are from trade activities, the transport system (the rolling noise produced by tires of vehicle and noise generated aerodynamically), generating electricity from generator (Yousif, 2010) and other various activities such as TV and radio players and etc. It was observed, that burning of crackers was more during 6.30 - 8.30 pm, and decreased considerably in CZ and SZ areas.

4. Conclusions

This study led to the following conclusions:

1. The noise level was increased during festival days of Nawruz day when compared with normal day in all the locations. This is mainly due to the bursting of crackers.
2. All selected study locations were recorded higher noise level than the Standard limit (Standard limit 45 - 55 dB (A) L_{eq}).

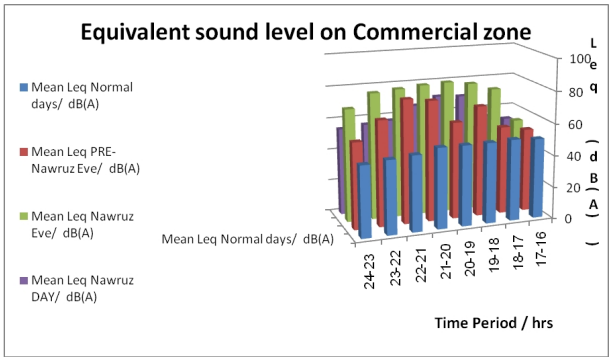


Fig. 3: Ambient noise level at commercial zone-(CZ) in Duhok city during Normal Day & Nawruz festival through the entire study period

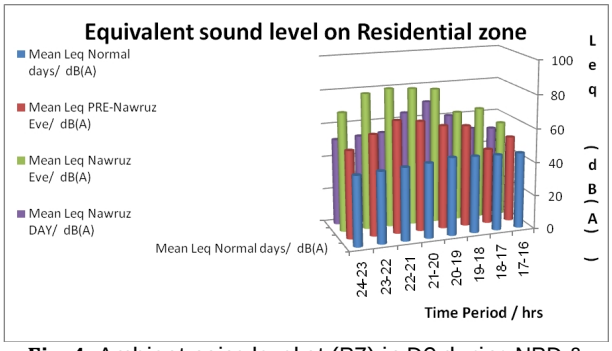


Fig. 4: Ambient noise level at (RZ) in DC during NRD & Nawruz festival, through the entire study period

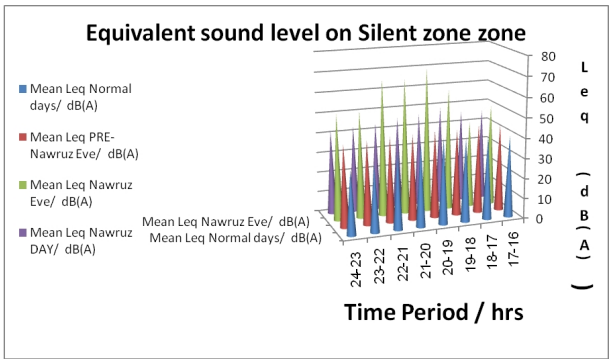


Fig. 5: Ambient noise level at (SZ) in DC during NRD & Nawruz festival through the entire study period

3. Burning of crackers was more during 6.30 pm to 8.30 pm and decreased considerably in (CZ) and (SZ), areas.

4. The maximum noise level found at Commercial area of Duhok city i.e. 85 dB(A) followed by the Residential area of the same city i.e. 82 dB(A) during Nawruz festival days.
5. At residential area, the noise levels during festival days of Nawruz are increased by more than 30dB (A) with respect to noise levels during normal day.

5. Recommendations

The following are some Recommendations from this study:

1. The people living in noise pollution prominent area especially noise level above 75 dB (A) should take proper precaution in order to avoid noise induced hearing loss and other health related problems.
2. There is a need for increased awareness among people as well as Government officials to prevent the long term prevention of health risks associated with noise pollution. The impact of bursting crackers must published in several newspapers for public awareness. However, government and NGOs can play a significant role in this process.
3. We should discourage the use of fire-crackers for mitigating the noise pollution. Or Celebrate Nawruz with lamps, candles and fireworks. We should encourage the use of eco-friendly crackers which produce paper flutters and colored lights on bursting and not the painful sound.
4. We should encourage the use of Safe, eco-friendly alternatives to festival days of Nawruz, such as using The Laser-Show Spectacular (Recently, applied in some states in the USA).

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