



# Evaluation of Noise Pollution for Four consecutive years throughout Nowruz festival in Dahok city, Iraq

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## Abstract

The study of noise pollution (NSP) is an important subject due to its environmental and health impacts. If the levels of noise prove to be above health criteria, there is a possibility that they may contribute to short- and long-term physiological & psychologically harmful effects. This study aimed to determine the spatial & temporal levels of NSP produced during the Nowruz festival (NZFS) in Duhok city (DKC), Iraq, for 4 consecutive years (2016–2019) and compare the noise levels during these periods. Also, to identify possible sources of noise to assist in the analysis of NSP problematic areas & determine if city noise criteria are exceeded. The noise level measurements were conducted using a sound level meter in 3 different areas of DKC. On Nowruz Eve, 2019, noise reached 102, 92.6, & 70.2 dB in residential, commercial, and silence zones, respectively. The overall study suggests that the city is gradually hurtling towards a high-noise ambience. Most of the results obtained in this work are above the limits allowed both internationally (i.e., the WHO) & locally. This is due to certain erroneous practices in daily activities during NZFS, the spread of electrical generators, as well as heavy traffic in the city. Also, this work could be help to publicize awareness about NSP among the people.

**Keywords:** Noise pollution, Noise levels meter, Environmental noise, Nowruz festival, Health hazard.

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## I. INTRODUCTION

Nowruz (or Nawruz) is the Kurdish and Persian New Year Day. The date falls on 21 St. of March [1]. The simple expression of term noise is an unwanted or undesired sound that may cause some physical or psychological stress to the people exposed to it. Noise is rather one of the most complex and pervasive environmental pollutants, driven by a set of many parameters, including, industrialization, rapid increase in population growth, economic growth, business activities, urbanization, and expanding transport networks [2]. Noise pollution (NSP) is any unwanted or disturbing sound that affects the health and well-being of humans. NSP is an invisible danger, and serious source of discomfort, but has not really been taken seriously enough by policymakers who have tended to prioritize other environmental issues [3]. Noise levels are usually measured by using a log. scale [decibel-scale (dB(A))]. For analysis aims the noise level is often converted into a single number called the “equivalent” sound level (Leq). The Leq (A) indicator is the average acoustic intensity over time [4, 5].

Environmental Protection Agency (EPA), recommended noise threshold limit of 55dB for residential, 70 dB for industrial & commercial zones during weekdays & most weekends [6]. The World Health Organization (WHO) classified NSP to be the 3rd most hazardous pollution coming after air and water pollutions [7]. NSP, in the recent years, has drawn interest of the researchers worldwide due to its physiological, psychological and chronic effects on human beings. The two main sources of NSP are community noise (CMN) & industrial noise [8]. In recent times, CMN has become scattered everywhere and penetrated our lives heavily. CMN are made while celebrating certain events, such as Nowruz festival (NZFS). The CMN mainly coming from, pyrotechnics, vehicles on streets, a crowded numbers of working musical instruments (e.g. trumpeting, drumming, etc.), electricity generators, shriek, human activities, etc. Complaints about NSP started to increase significantly, because of health hazard. The potential health effects of NSP are numerous, pervasive, and persistent. For example, exposure to noise during night-time causes sleep disturbance [9, 10]. NSP has been also linked to poor cognitive

performance, diabetes, hormonal disturbances, stroke & psychological ill health [11, 12].

Many studies have been implemented to study the impact of NSP on health [13-15]. According to the laboratory, field, and epidemiological studies, it was found that there is a link between NSP and health effects (such as heart disease). These may increase risk factors, like blood pressure [16-19]. The pyramid of noises-induced health-effects was given by [16]. Fig. 1, shows and explains how exposure to noise effects health and wellbeing lifestyle, when a certain population is exposed to a lot of noise.

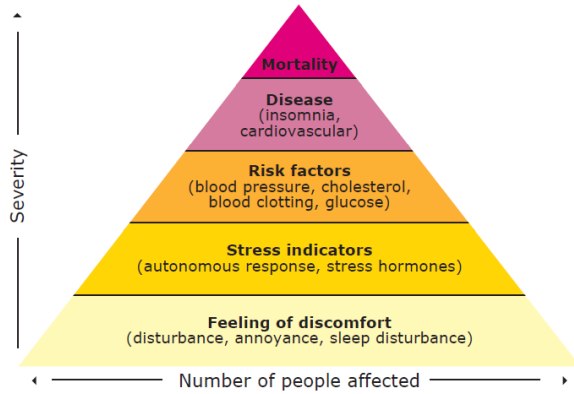


Fig. 1. The pyramid of noise-induced health effects. (Babisch, 2002)

If we compare NSP with others pollutants, the control of NSP has been resisted by incomplete knowledge of its effects on humans and other species, also, there shortage or deficiency of enough data (sufficient data) of NSP, especially in developing countries such as Iraq.

Noises due to fire-crackers (FRC) is one of sever ecological problems during festive season, incident celebration (or festive occasions) in Iraq & many countries. It is known, that exposure to noise can lead to a range of health effects like, clinical effects, hearing damage and cardio-vascular diseases [17, 20, 21]. CMN at high levels could result in, headache, sleep disturbance, irritation, fatigue and increase in blood pressure, which is the main causes of heart attacks [22, 23]. Several researches regarding study of NSP during Deepavali (or Diwali) day or festival, and its NSP has been published [24-28]. Most of these researches observed that the Leq was increased in residential and commercial zones during festive of Deepavali.

It is worth to mention that, NZFS in Duhok city (DKC) is traditionally celebrated with songs, shriek, using horns' cars, musical instruments (e.g. Trumpeting, Drums), loud speakers, explosive pyrotechnic devices, FRC, etc. [1], and thus consequently produce a lot of infuriating noise, during the nights, and they disturb the sleep. Also, FRC during NZFS produce a huge amount of particulates & many toxic gases in the atmosphere [29]. So, both, air and noise pollution caused by activities of celebrating the NZFS.

This investigation on the NSP is an attempt to evaluation noises levels for some normal days and throughout NZFS, in March for four consecutive years (2016-2019), from 3 pm to 1 am, in different zones in DKC. The study was achieved to find variations of noise levels at different regions of the DKC throughout NZFS. In addition, this work aim to create awareness about NSP in DKC and everywhere.

## II. MATERIALS AND METHODS

### A. Study Area

This study was carried out in Duhok city (DKC). The city is one province in northwest of Iraq. It, located in the western part of Kurdistan region (Fig. 2). It extends between latitude 36° 40' -37°20' N and longitude 43° 20' - 44°10' E. It is situated about 430-450 meters above sea level. DKC has an important and strategically location regarding the historical and geographical sides. In this study, 3 zones, or stations (S1, S2, S3) were have been selected to monitor NSP in various positions of the city (see Table I). The climate of DKC is rather semi-arid, and is basically affected by its inland position and prevalence of continental air during most of the years.

### B. Measurements of Environmental Noise

Measurements of NSP were performed in the DKC. In the current study, three zones, or stations (S1- S3) have been selected to measure NSP in various regions in the DKC, as given in Table I or in Fig. 2. The digital Sound Level Meter (SLM), [a portable SLM (Model, Auto Range RS-232, SLM (Model meter Peaktech device 8005, and Model AR824) was used to measure the values of noise levels. Their accuracy = ± 1.5 (dB). The measuring procedure was achieved according to the ISO (i.e. using standard acoustical measurements) [30, 31]. The noise level measurements were conducted in March, 2016, March, 2017, March, 2018, and March, 2019), in DKC during the festival of Nowruz. We carried out sound level measurements for (6) days in every March (2016-2019) during the Pre-Nowruz festival (Pre-NZFS), Nowruz EVE, Nowruz festival (NZFS), Post NZFS, etc. (as given in Table I), using calibrated SLM. The equivalent noise level (Leq) in dB(A) were extracted and calculated. Total monitoring time = 10hrs/day from 3 pm, when children start celebrate NZFS, until post-midnight [ i.e. 1 am]. This is constantly escorted by competing teams operating at full burst on top of moving vehicles, such as trucks, etc. around the city and followed by a colossal crowd all dancing, shouting and chanting. For each zone, measurements of noise, 6 measurements / hr were recorded at an interval of 10 minutes, and the measurements were compared to international standards. Therefore, 60 readings were recorded at a period of 10 hr. each day per station, and the measurements were compared to international standards.

The meteorological parameters (temperature (in °c ), wind-speed (in m /s), wind-direction, and relative humidity (in %)) were measured during the study period. The study period including, 2 normal days-(NRD), Pre-Nowruz eve (PNZ -eve), Nowruz -eve (NZ -eve), Nowruz -day (NZ-day), & post-Nowruz- day (PNZ- day).

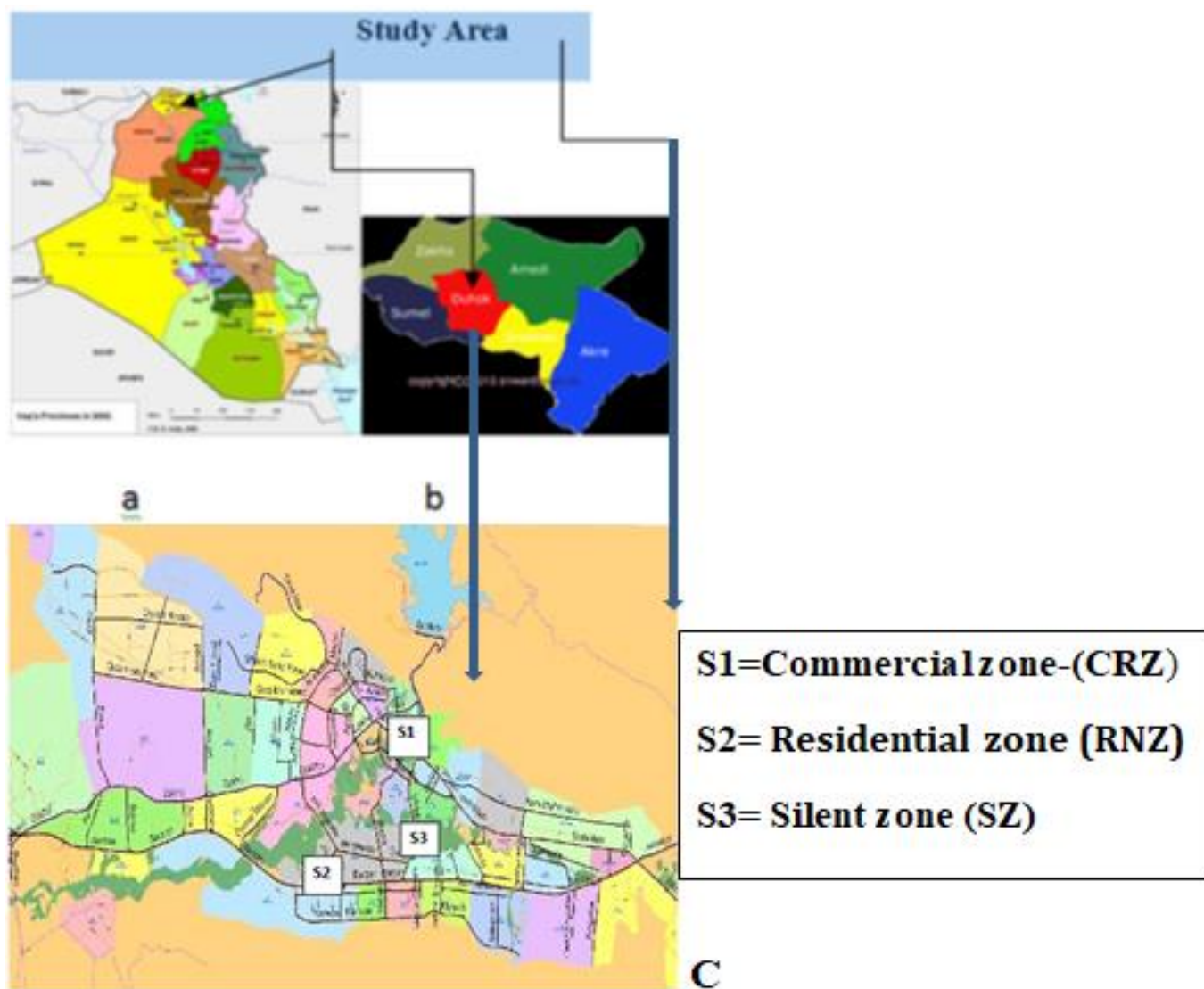


Fig. 2. Maps for illustration the sampling locations. a- Iraq's Map. b- Duhok governorate's Map. c- Duhok city's Map.

TABLE I. MEASUREMENT SITES, CODES, AND MEASUREMENT DATES

Zones	Locations	Codes				
The Commercial zone[CRZ]	Near University of Duhok(UOD)	S1				
The Residential zone [RNZ]	Near Duhok highway	S 2				
Silent zone/ (quiet area) [SZ]	Near Azadi Hospital	S 3				
Day	Normal day-1	Pre-Nawruz day	Nawruz Eve	Nawruz Day	Post-Nawruz Day	Normal day-2

Date	18th March	19th March	20 <sup>h</sup> , March	21-Mar	22-Mar	25th March

### III. RESULTS AND DISCUSSION

Environmental noise (ENS) directly affects human comfort & productivity. Also, high sound levels are related to a variety of health symptoms such as high blood pressure and stress. Therefore, surveillance, and ambient monitoring are important issues for validation and verification of ENS, programs of control health hazard, and for good health sustainability of cities, such as Duhok city (DKC).

Table II gives the minimum, maximum, means and standard deviations of some meteorological parameters such as temperature (°c), wind-speed, etc., during the study period, for years (2016-2019). It was found that the temperature, wind speed, and relative humidity values were between 10.1–29.3°C, 1.4–4.8 m/s, and 39.3–85.5%, respectively, in DKC. It

can founded from Table II, the average atmospheric pressure = 1013.3 mbar on festival days. Fig. 3, shows the wind-rose diagram during the study period in 2018. It can be observed that the wind flowed more frequently from (ENE), (E) and (SE) in 2018. Similar values were obtained in 2019. It flowed more frequently from (E). The seasonal average wind speed in both years 2018 and 2019 is about 1.6 m/s. It was found that the most popular wind-direction is 84° and 0.44 (ENE).

TABLE II. THE MINIMUM, MAXIMUM, MEANS AND STANDARD DEVIATIONS OF METEOROLOGICAL PARAMETERS

Parameters	Min	Max	Means	Standard Deviations
Relative humidity (%)	39.3	85.5	55.47	14.1
Temperature (°C)	10.1	29.3	19.45	4.8
Wind speed	1.4	4.8	1.5	1.1
Atmospheric pressure (mbar)	1003.4	1023.5	1013.3	3.5

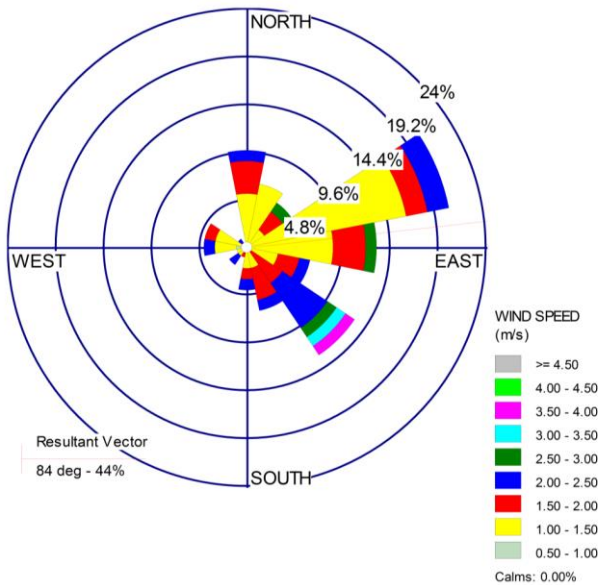


Fig. 3. Wind rose for Duhok city during the study period in 2018.

The changes in NSP (Leq) at various positions of DKC (i.e. CRZ, RNZ, & silent zone (or quiet area) (SZ) during the NZFS are depicted in Fig. 4 to Fig. 7 for years 2016- 2019, respectively. In evening time the minimum value observed at quiet zone-SZ=40 dB(A). We calculate Mean Values (average equivalent LAeq), and standard deviations values of sound levels at each position. The results from the digital SLM showed that the highest reading was in Nowruz Eve (March 20th) in Residential area during the night with (Lmax=102.dB (A), & Lmin=62. dB (A)), about 25 dB higher than the recommended level according to WHO. This is because, explosive pyrotechnic devices, FRC, etc., as well as noise from moving vehicles, such as trucks, etc. around the city, and followed by a colossal crowd all dancing, shouting & chanting. Also this zone lies near the highway, where big and long vehicles are allowed to cross on it

which emit very loud and annoying sound. The detected mean LAeq was high and exceeded the recommended limits set by the WHO.

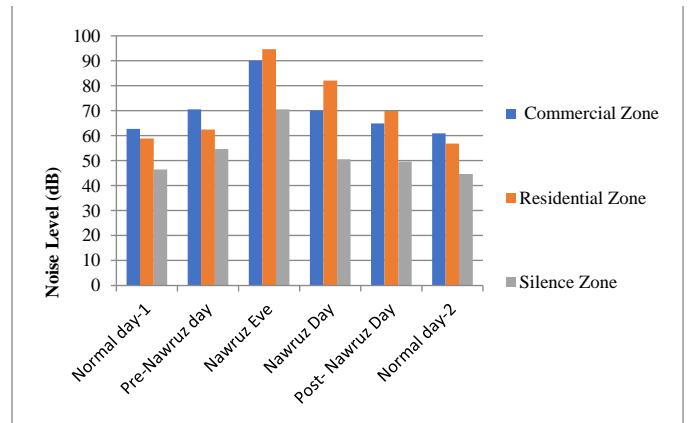


Fig. 4. Noise Level (dB) during Nawruz Day on 2016

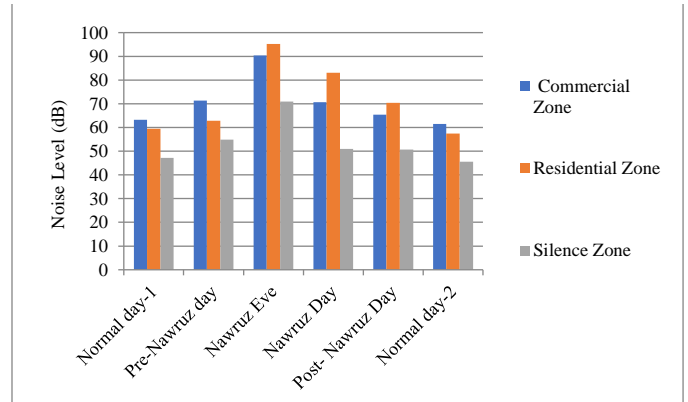


Fig. 5. Noise Level (dB) during Nawruz Day on 2017.

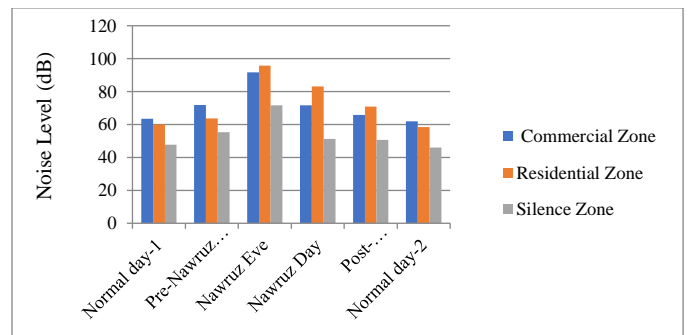


Fig. 6. Noise Level (dB) during Nawruz Day on 2018.

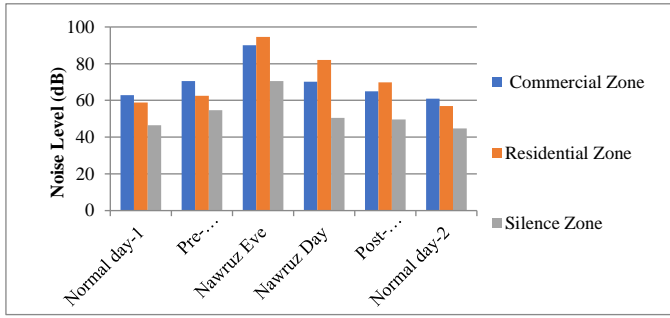


Fig. 7. Noise Level (dB) during Nawruz Day on 2019.

Fig. 8 represents the average noise in the Duhok city during the carnival or NZFS in Residential Zone (RNZ), for four consecutive years [2016 - 2019]. As one can see the noise levels are higher than pre and post festival days (i.e. normal day 1 & normal day 2). e.g. & the average noise level was about 94.6 dB (A) and 97.4 dB (A) in the Nawruz Eve, in 2016 & in 2019 respectively, where maximum crackers are burned. While the average noise level was about 69.9 dB (A) and 71.9 dB (A) in the Post- Nawruz Day, in 2016 & in 2019 respectively. In Commercial Zone (CRZ), maximum sound level of 92.6 dB is observed during 2019. In Silence Zone (SZ), maximum sound level was 70.2dB. during 2019, more NSP is observed as compared to 2016, 2017 & 2018. This value is truly much higher than the ones recorded in normal days. This can be attributed to the increase in human activities such as trumpeting, drumming, and yelling, or an increase in numbers of vehicles.

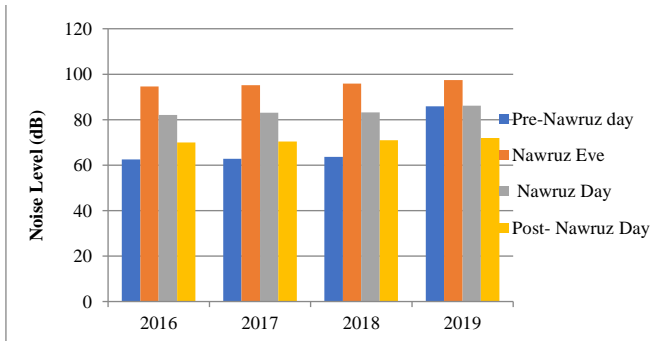


Fig. 8. Noise Level (dB) for four consecutive years during Nawruz festival in Residential Zone.

Our results indicate that, The Average noise level at all sites is over a standard admissible limit values. Though this is a time of merriment, people stand the risk of exposing their health. Therefore, the NSP above 70 dB should be avoided. People health status should not be jeopardized. It was noticed that noise has adverse effects on citizens; It has scientifically proven that high noise can cause hearing impairment [32]. Also, NSP has great effect on Patients in Hospitals and Health Clinics (silence zone) [33].

#### IV. CONCLUSIONS

Cities around the world face many environmental health challenges including contamination of noise, and poor housing conditions exacerbated by unsustainable urban development.

Achieving healthy environment requires sustainable urban planning. Hence, the level of noise pollution in Duhok city (DKC) can be affected significantly by a number of design and planning decisions including the location of different facilities in the city.

This work could be help to publicize awareness about NSP among the people, through which they will be able to take the required precautionary to save themselves from the harmful effects of the NSP and improve the quality of the environment.

The NSP constitutes a major challenge in Iraq. It needs more in-depth studies and needs more awareness and educational guidance. And it is necessary that it be at the top of the decision-makers' list of priorities, e.g. Decision makers must establish rules, regulations and provisions to conserve/protect the environment from the NSP at all times and places, or to find legislative solutions to reduce noise on the population in the short and long term.

Investigations and evaluations of the noise level throughout Nowruz festival (NZFS) in DKC for four consecutive years was achieved. The observed results indicated that the equivalent noise level recorded in all positions, exceeded the permissible standard which prescribed by WHO. The results from the digital SLM showed that the highest reading was in Nowruz Eve (March 20th) in Residential Zone during the night with ( $L_{max}=102. \text{dB (A)}$ , &  $L_{min}=62. \text{dB (A)}$ ). The NSP in residential area, Silence area and Commercial area are much higher than that of recommended, or acceptable noise limit. The detected mean  $LA_{eq}$  was high vehicles exceeded the recommended limits set by the WHO.

Several parameters contributed in creating a higher level of noise, further to NSP due to fireworks, human activities such as trumpeting, drumming, and yelling, as well as an increasing number of vehicles, using horn unnecessarily, microphones, etc. In Commercial Zone maximum sound level of 92.6 decibel is observed during 2019. In Silence Zone, the sound level reached 70.2 dB. During 2019, more noise pollution is observed as compared to 2016, 2017 & 2018. This value is truly much higher than the ones recorded in normal days. This can be attributed to the increase in human activities. Our findings indicate that the average level of noise at all sites is over a standard admissible limit values.

It was observed that most of the noise producers and noise influential people were unaware of the harmful effects of NSP. In addition, it is found that any visible or real initiatives against NSP are not yet taken.

This study also indicate that loud noise affects the citizens highly in many ways. It results in sleeplessness, weak communication, reduced efficiency, etc. Also, at the level of the universe, there are dangerous gases, and large amount of particulate matter that leak into the atmosphere due to use pyrotechnics, or fireworks. These gases include nitrogen oxide, sulfur, phosphorous, and carbon dioxide (causing global warming). Therefore, both, air and noise pollution caused by activities of celebrating the NZFS.

## V. RECOMMENDATIONS

For the health and safety of societies and individuals, noise must be reduced. Also gas emissions due to use pyrotechnics, or FRC must be reduced. The Law Enforcement (implementation) or execution of the law as regards environmental NSP is never implemented in Iraq. It is observed that the persistence of this problem could endanger, and could aggravate.

It is possible to benefit from the concept of “resilient cities”, which promote sustainable development, well-being and inclusive growth and absorb the impact of environmental & social hazards, and to use the solutions offered by these cities. Especially with regard to changing land uses, Organization and coordination for building hospitals and schools. To save our environment from NSP, It is recommended that:

1. The residents or peoples living in noisy area [especially noise-level higher than 70dB (A)] should take appropriate precautions to avoid health related problems.e.g. use of Ear-plugs. Noise must be reduced in buildings, by using & putting a sound-insulating materials, or sound-absorbing materials, and make the facade rough to weaken the reflected sound waves, or by reducing the size of windows in buildings, or making them double-glazed. Also the use of curtains with a thick cloth helps reduce the intensity of noise, or add somewhat thick floor coverings.
2. Attention and consciousness (i.e. raising awareness or alertness) must be considered, concerning the causes & effects of NSP among the noise producer and the citizens have been suffering from different health hazards.
3. Accounting for the noise pollution in planning the location of facilities, requires the availability of reliable methods for estimating the level of noise pollution generated at the source and the level of noise pollution at different noise-sensitive receivers.
4. The impact of bursting crackers, health risks or dangers related to NSP must publish in media (TV, newspapers, etc.) for public attention & awareness.
5. Since, little or no attention is paid to the control of NSP in Iraq. The Government of Iraq and the Government of Kurdistan should intervene or to boost the laws, or enhance in such a way that they can assist in strengthening & promote the good & ideal things to reduce the problem of NSP by issuing legal legislation, and legal procedures in this field, e.g. Ban (or prohibition) the use of FRC in silence or residential zones should be strictly followed throughout the time 10:00 pm to 07:00 am.
6. We should ban or discourage the use of FRC for attenuating or lightening the NZFS during the time 22:00 pm to 07:00 am. The Government of Iraq and the Government of Kurdistan should encourage the use of eco-friendly FRC which can produce colored lights. We must support the use of Safe, eco-friendly alternatives during NZFS, e.g. using The Lasers-Shows Spectacular (now, used in some countries, such as UAE, UK, and USA).

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