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# EVALUATION OF NOISE POLLUTION INDICATORS IN NAJAF CITY

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## ABSTRACT

This study sheds light on measuring and calculating the average of noises pollution indications in An Najaf. The city has recently got growth in commercial and industrial activities as well as a significant increase in the number of vehicles. In addition, the use of diesel generators is due to electricity shortage for long periods. Noise quality assessment was studied in An Najaf City for five areas, i.e., educational, industrial, commercial, residential and quiet. The study has been conducted for five months starting in November 2016.

Noise pollution indicators viz. L10, L50, L90, noise climate (N.C), equivalent continuous noise level (Leq) and noise pollution level (Lnp) were calculated for the above mentioned five areas. The results of this study showed that the highest value of (Leq), which is 108.44 dB, was in the industrial areas followed by 89.55 dB in the commercial areas, 87.1 dB in the educational areas, 80.4 dB in the quiet areas, and 69.05 dB in the residential areas. It has been noted that the highest values of Leq in all areas were higher than the permissible limit in the Iraqi standards, where the noise assessment study in this research revealed the disturbing situation of noise pollution in the city of Najaf.

**KEYWORDS:** Noise pollution indicators, Tolerance levels, Noise pollution, monitor of the noise, Iraqi noise standards.

## 1. INTRODUCTION

The term noise refers to unwanted or undesired sound. Noise can also be defined as when sound level is beyond the standard level and creates annoyance (Salhab Zudhi and Amro Husein, 2012). Noise pollution is always annoying, but in the recent times, it has been well recognized as one of the major trepidations that impact the quality of life in urban areas across the world (Pandey, 1992).

Noise pollution can also affect public health and environmental quality in an urban environment. There has been a considerable increase in noise from artificial sources during the last 100 years, which is now doubling after every ten years (Pandey, 1992).

Noise pollution has become the main feature of the busy cities. Most of the inhabitants in the urban areas consider excessive noise as one of the environmental problems that they suffer from. Noise pollution occupies the second stage after water pollution for the inhabitants. An Najaf, the Iraqi ancient city, has started facing noise pollution problems. It is located in the south central of Iraq, about 160 km south of Baghdad. After 2003, its population has increased remarkably due to security stability as well as increases in commercial and industrial activities. This has been accompanied by a significant increase in the number of vehicles and diesel and gasoline generators because of long hours of power cut-off during the day. In addition, An Najaf International Airport is close to the city center and residential neighborhoods. All of these have led to increasing the levels of noise and that is why the city was chosen to be the case of study of noise pollution levels.

## 2. NOISE SOURCES

There are numerous sources but may be broadly classified into two classes such as indoor and outdoor:

### 2.1. Outdoor:

Industries, factories, automobiles, airplanes construction work, and loudspeakers etc., (Essay on Noise Pollution, 2018) they all constitute an increasingly serious problem in big cities like An Najaf. An Najaf Airport is situated in the vicinity of population centers and the airplanes pass over the residential areas. Satellites are projected into space with the help of high explosive rockets also contributes to noise pollution.

### 2.2. Indoor:

Indoor noise is created from various domestic appliances, i.e., TVs, radios, music players, and other electronic gadgets (Essay on Noise Pollution, 2018).

## 3. EFFECTS OF NOISE ON HUMANS

(Kiernan, 1997) found that an even relatively low level of noise affects human health adversely. It may cause hypertension, disrupt sleep and/or hinder cognitive development in children. The effects of excessive noise can cause a permanent loss of memory or a psychiatric disorder (Bond, 1996). Thus, there are many a negative effects of excessive noise or sudden exposure to noise.

According to (Bhargawa, 2001), the noise may result in loss of hearing, stress, high-blood pressure, loss of sleep, distraction affecting productivity. Indiscriminate use of horn by the vehicles and wide spread use of loudspeakers in social and religious ceremonies caused several health hazards to the urban inhabitants. It may cause deafness, nervous breakdown, mental disorder, heart troubles, high blood pressure, dizziness and insomnia.

## 4. UNIT OF NOISE

Sound measurement unit is decibel (dB) it is a universal that measure with a meter which records sound pressure and to transfer these readings on a sound level scale (Bies and Hansen, 1996). Decibels are a logarithmic unit that means a sound of 20dB is 10 times more intense than a sound of 10dB and a 30dB sound is 100 times more intense. The logarithmic decibel scale goes up in powers of ten: every increase of 10dB on the scale is equivalent to a 10-fold increase in sound intensity.

## 5. PERMISSIBLE LIMITS IN IRAQ

The latest standards regulating and controlling noise in Iraq are mentioned in Law No. 41 of 2015. The Iraqi standards specify the daily exposure to continuous noise as shown in the Table 1 below (Al- waqai Iraqi Newapaper, 2015).

**Table 1. Continuous noise / in case the continuous noise not exceed 115 dB.**

| **Noise intensity level(dB)** | **80** | **85** | **90** | **95** | **100** | **105** | **110** | **115** |
|---|---|---|---|---|---|---|---|---|
| Daily exposure period(hr) | 16 | 8 | 4 | 2 | 1 | 1/2 | 1/4 | 1/8 |

The above-mentioned standards also set the permissible noise levels (Leq std.) outside the buildings as shown in the Table 2 (Al- waqai Iraqi Newapaper, 2015).

According to Iraqi standards, the allowable noise levels inside buildings are shown in Table 3 below (Al- waqai Iraqi Newapaper, 2015).

The findings of this study have compared with the permissible limits (Leq std.) set by the Iraqi standards mentioned in Table 2.

**Table 2. Iraqi standards of noise levels outside buildings (dB).**

| Sr. No. | Location | Day time | Night time |
|---|---|---|---|
| **1** | Hospitals | 50 | 40 |
| **2** | Residential areas | 60 | 50 |
| **3** | Residential areas (suburbs) | 55 | 45 |
| **4** | Hotels | 55 | 50 |
| **5** | Schools , kindergartens , universities and institutes | 55 | 45 |
| **6** | Industrials areas , governmental facilities | 70 | 65 |
| **7** | Utilities and commercial areas | 65 | 60 |
| **8** | Other areas: Airports, Railway stations, and Harbors | 70 | 60 |
| **9** | Cultural and protect urban area | 60 | 50 |
| **10** | Recreation areas | 60 | 50 |
| **11** | Mixed residential areas and industrial areas (vice- versa) | 60 | 45 |

**Table 3. Illustrates national standards of noise levels insides buildings (dB).**

| Sr. No. | Location | Day time | Night time |
|---|---|---|---|
| 1 | Hospitals, schools, kindergartens and nurseries | 50 - 55 | 35 |
| 2 | Hotels | 50 | 40 |
| 3 | Governmental department, commercial and service buildings | 60 | 55 |
| 4 | Dwellings | 50 | 45 |

## 6. MATERIALS AND METHODS

### 6.1. Study area and measurement of noise

The present investigation on evaluation and analysis of environmental noise pollution was conducted in the city of Najaf during the period of winter season for five months (from November, 2016 to March, 2017).Table 4 illustrates the information of Najaf city in context to demography, geographic locations and meteorological aspects during the period of study. Table 5 and Fig. 1 describe the five zones (regions) in Najaf city that were selected for noise pollution levels study. Noise pollution levels in (A) frequency weighting were measured using Digital Sound Level Meter (Model 407730). The microphone of device was held (120 to 150) cm above the ground surface and the distance of the microphone from noise sources within (7 m). For each zone in this study, noise measurements were implemented for the period of two weeks with eight hours of observation per day with a break one hour after every hour of reading. The method of work in this study during the day time was as follows: at morning (8.00 to 9.00) a.m., (10 to 11) a.m., at afternoon (12.00 to 1.00) p.m., (2.00 to 3.00) p.m., at evening (4.00 to 5.00) p.m., (6.00 to 7.00) p.m., (8.00 to 9.00) p.m., and at night (10.00 to 11.00) p.m. for each hour

30 reading were recorded. All noise levels reading were recorded under conditions as mentioned previously in Table 4.

**Table 4. Shows Demographic, geographic locations and meteorological aspects of Najaf city during the study time.**

| No. | Parameters | Documented values |
|---|---|---|
| **1** | Population (according to the statistics of 2017) | 1500522 |
| **2** | Geographical area | 28824 $km^2$ |
| **3** | Population density | 52 No. of persons/$km^2$ |
| **4** | Latitude | 31º59’ N |
| **5** | Longitude | 44º19’ E |
| **6** | Mean sea level | 70m |
| **7** | Average precipitation | 470.2 mm/year |
| **8** | Maximum temperature during winter season | 23 $C^{\circ}$ |
| **10** | Minimum temperature during winter season | 6 $C^{\circ}$ |
| **11** | Average dew point | 4 $C^{\circ}$ |
| **12** | Average evening relative humidity | 35% |
| **13** | Average morning relative humidity | 71.6% |
| **14** | Average wind speed | 12 km/h |

**Table 5. Shows type of selected zones for noise pollution monitoring in Najaf city.**

| No. | Zone name | Type of selected zone |
|---|---|---|
| **1** | Physical planning faculty | Educational zone |
| **2** | Al Sinay district | Industrial zone |
| **3** | Al-Sadiq street | Commercial zone |
| **4** | Al-Zahraa teaching hospital | Quit zone |
| **5** | Al-Salam district | Residential zone |

### 6.2. Noise pollution indicators

Various noise pollution indicators were computed using Gaussian percentile to get the noise pollution levels. Different percentile values like $L_{10}$, $L_{50}$ and $L_{90}$ were calculated from the sampled data and these parameters were used for the assessment of Noise Climate (N.C), Equivalent Continuous Noise Level (Leq) and Noise Pollution Level (Lnp) (Tripathi et al., 2006). The equations were used to calculate the noise pollution indicators as follows:

$$N.C = L_{10} - L_{90} \quad (1)$$

$$Leq = L_{50} + (L_{10} - L_{90})^2/60 \quad (2)$$

$$Lnp = Leq + N.C \quad (3)$$

Where:

N.C is Noise Climate

$L_{10}$ is the level of sound exceeding for 10% of total time of measurement or Peak Noise Level.

$L_{50}$ is the level of sound exceeding for 50% of total time of measurement or Mean Sound Level.

$L_{90}$ is the level of sound exceeding for 90% of total time of measurement or Background.

Leq is Equivalent continuous noise level.

Lnp is the Noise Pollution Level.

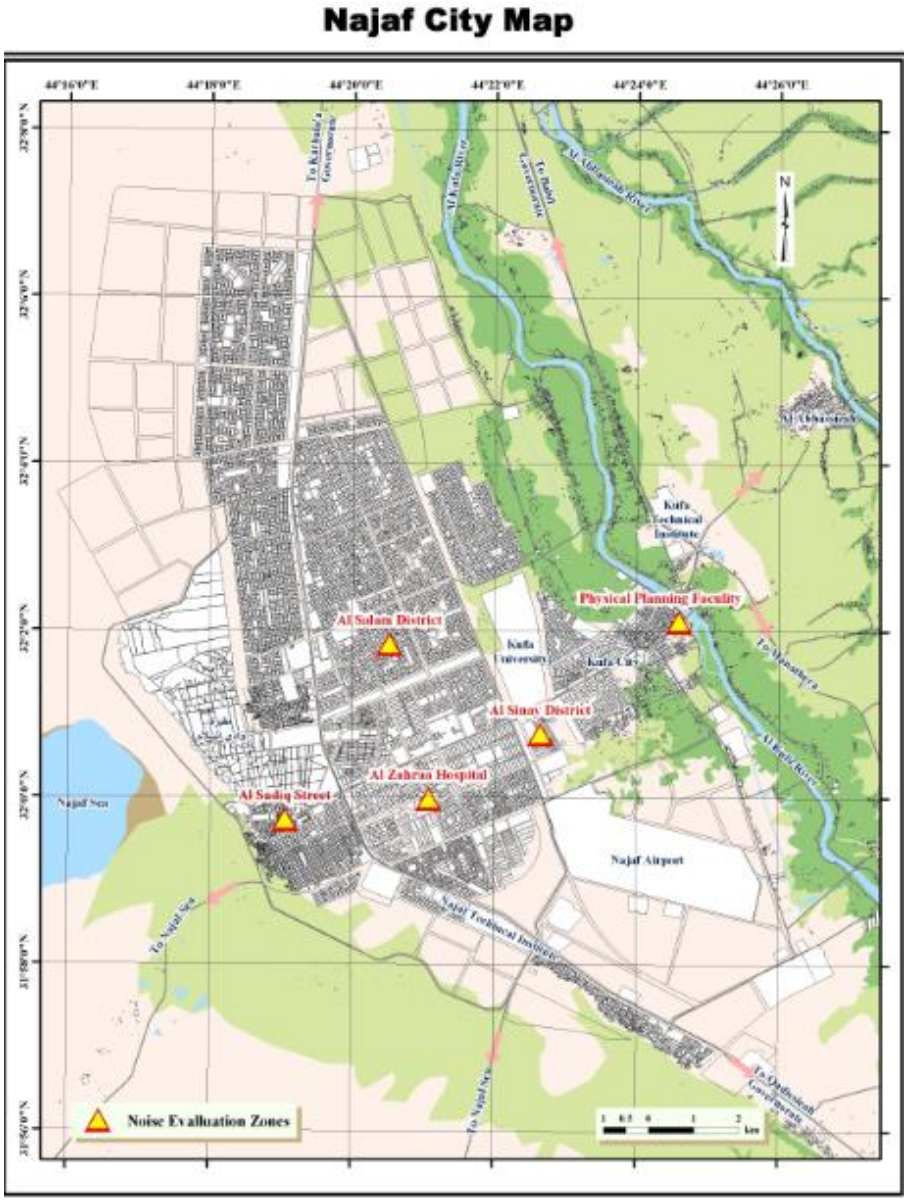


**Fig. 1. Map of Najaf city illustrating five noise evaluation zones**

## 7. RESULTS AND DISCUSSION

The data shown in Fig. 2 shows the average noise pollution indicators in the Physical Planning Faculty at the University of Kufa. These indicators are L10, L50, L90, Leq and Lnp, where the highest values of these indicators are (89.2, 81.8, 71.3, 87.1, 99.7) dB respectively in the period between (8.00-9.00) am, because this period represents the beginning of the official working hours. A large number of vehicles passing through the main street (Kufa - An Najaf Street), which the college is close to, may rise noises. In addition to the entry of students to the college in large numbers in the morning, the high sounds of traffic police whistles with excessive use of cars horns rise in the average noises pollution indicators in this period of time. It is also attributed to the raises the voices of street vendors and their use of loudspeakers in the local markets close to the college as well as the high noise of the diesel generators. All these sounds affect the environment of the campus. The average noises pollution indicators decrease for a while and rise slightly between 2.00-3.00 pm at this time is the end of the classes at college. Then decrease again to reach the lowest value in the period between 10-11 pm where the values of L10, L50, L90, Leq, and Lnp are (72.6, 63.7, 61.9, 65.6, 74.4) dB respectively. Although the educational regions is considered a quiet area, we noticed that the lowest level of( Leq) which equals 65 dB recorded between (10.00-11.00) pm is higher than (Leq std) which equals to 45 dB at night. Table 6 shows that the highest value of N.C is 17.9 dB and that is recorded between the period (8.00-9.00) am. This reflects the difference between L10 and L90 and the lowest value of N.C is 10.5 dB and which is recorded during (8.00-9.00) pm.

**Table 6. Noise levels computed during physical planning faculty (educational zone) at different times.**

| Time | $L_{10}$ | $L_{50}$ | $L_{90}$ | N.C | Leq | Lnp | Leq std. |
|---|---|---|---|---|---|---|---|
| **8-9 am** | 89.2 | 81.8 | 71.3 | 17.9 | 87.1 | 99.7 | 55 |
| **10-11 am** | 87.5 | 79.7 | 69.6 | 17.9 | 85.0 | 97.6 | 55 |
| **12-1 pm** | 86.2 | 79 | 68.5 | 17.7 | 84.2 | 96.7 | 55 |
| **2-3 pm** | 87.8 | 80.9 | 70.3 | 17.5 | 86.0 | 98.4 | 55 |
| **4-5 pm** | 83.1 | 73 | 67.7 | 15.4 | 77.0 | 88.4 | 55 |
| **6-7 pm** | 79.8 | 71 | 66.2 | 13.6 | 74.1 | 84.6 | 45 |
| **8-9 pm** | 75.3 | 68.8 | 64.8 | 10.5 | 70.6 | 79.3 | 45 |
| **10-11 pm** | 72.6 | 63.7 | 61.9 | 10.7 | 65.6 | 74.4 | 45 |

Note: these readings were recorded through November, one reading per week

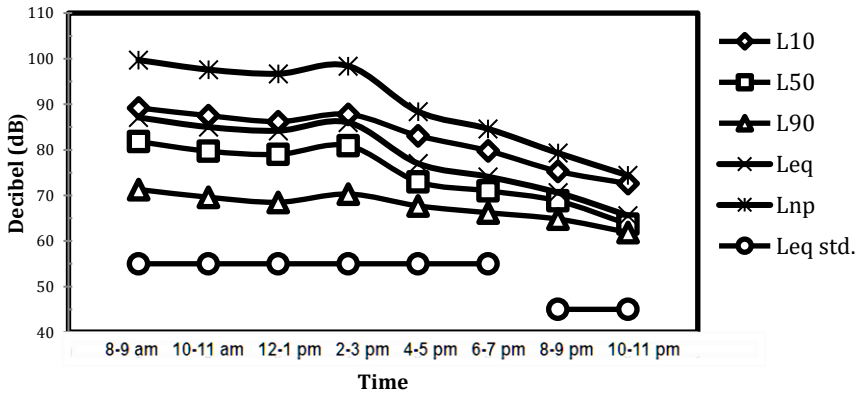


**Fig. 2. Noise pollution indices of physical planning faculty (educational zone)**

Fig. 3 shows the average noises pollution indicators in the industrial zone (Al Sinay district), where the highest recorded values of (L10, L50, L90, Leq and Lnp) are (113.8, 94.9, 85.3, 108.44, 136.94) respectively during (10.00-11.00) am. It is noted that the value of (Leq) is higher than the (Leq std) as it is mentioned in the Iraqi standards. The value is 70 dB at daytime because this period represents the peak hours of cars maintenance, workshops, and steel factories .After that period, all average noise pollution indices start to decline including the (Leq), with value 68.7 dB in the period between (6.00-7.00) pm. However, it remains higher than (Leq std) which is equal to 65 dB at night. Then it reaches the minimum and corresponds to the allowed value of (Leq std) which is equal to 65dB between (8.00-9.00) pm. The value of the Leq during this time is 64.97 dB. Its value during (10.00-11.00) pm equals 62.45 dB due to the end of the working hours. Table 7 shows that the highest value of N.C is 28.5 dB and that is recorded between the times period (10.00-11.00) am. This is the lowest value of N.C (1.7 dB), which is recorded during (10.00-11.00) pm.

**Table 7. Noise levels computed during Al Sinay district (industrial zone) at different times.**

| Time | $L_{10}$ | $L_{50}$ | $L_{90}$ | N.C | Leq | Lnp | Leq std. |
|---|---|---|---|---|---|---|---|
| **8-9 a.m.** | 108.4 | 91.4 | 82.5 | 25.9 | 102.58 | 128.48 | 70 |
| **10-11 a.m.** | 113.8 | 94.9 | 85.3 | 28.5 | 108.44 | 136.94 | 70 |
| **12-1 p.m.** | 111.7 | 93.2 | 84.1 | 27.6 | 105.90 | 133.50 | 70 |
| **2-3 p.m.** | 106.9 | 91.8 | 83.7 | 23.2 | 100.77 | 123.97 | 70 |
| **4-5 p.m.** | 90.8 | 80.8 | 77.1 | 13.7 | 83.93 | 97.63 | 70 |
| **6-7 p.m.** | 71.7 | 68.3 | 66.8 | 4.9 | 68.70 | 73.60 | 65 |
| **8-9 p.m.** | 66.6 | 64.9 | 64.6 | 2.0 | 64.97 | 66.97 | 65 |
| **10-11 p.m.** | 63.3 | 62.4 | 61.6 | 1.7 | 62.45 | 64.15 | 65 |

Note: these readings were recorded through December, one reading per week

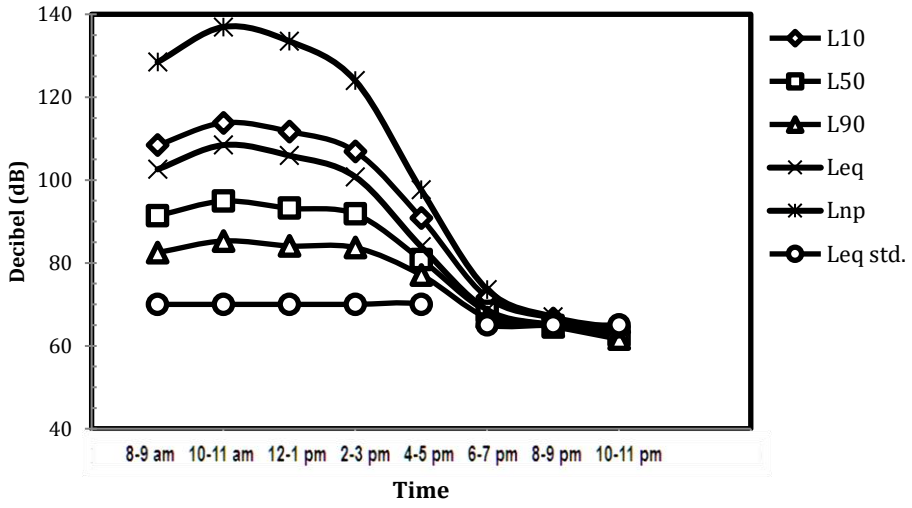


**Fig. 3. Noise pollution indices of Al Sinay district (industrial zone).**

Fig. 4 shows the average noises of pollution indicators in Al-Sadiq Street. The highest values of (L10, L50, L90, and Leq) are (91.9, 85.6, 76.5, 89.55) dB respectively that have been noticed in the period between (6.00-7.00) pm. whereas at this time, the number of visitors and buyers from inside and outside the city increases. The street is located in the center of the ancient city of Najaf and it is the main street to reach the Shrine of Imam Ali (A.S). In that commercial street, there are many shops, restaurants and hotels, as well as hawkers who use loudspeakers, which are also used extensively in religious events. The highest value of (Lnp) is 105.9 dB which is recorded between (4.00-5.00) pm. This is an indicator to give an idea of noises pollution and the extent of fluctuation in levels. It is the best indicator of the psychological and physiological impact of noise. Table 8 shows that the highest (N.C) value is 19.6 dB in the period between (12.00-1.00) pm and its lowest value was 12 dB in the period between (10.00 - 11.00) am, whereas the lowest value of noises pollution indicators of (L10, L50, L90, Leq and Lnp) which their value are (82.2, 72.4, 70.2, 74.80, 86.80) dB respectively. This is between (10.00-11.00) pm due to the closure of shops and the lack of numbers of pedestrians and the people in Al-Sadiq Street. We noticed that the minimum value of (Leq) is 74.8 dB and it is higher than the allowed (Leq std) value which is equal to 60 dB at night.

**Table 8. Noise levels computed during Al-Sadiq street (commercial zone) at different times.**

| Time | $L_{10}$ | $L_{50}$ | $L_{90}$ | N.C | Leq | Lnp | Leq std. |
|---|---|---|---|---|---|---|---|
| **8-9 a.m.** | 88.7 | 76.5 | 72.9 | 15.8 | 80.66 | 96.46 | 65 |
| **10-11a.m.** | 89.1 | 78.8 | 70.3 | 18.8 | 84.69 | 103.49 | 65 |
| **12-1 p.m.** | 90.6 | 79.5 | 71 | 19.6 | 85.90 | 105.50 | 65 |
| **2-3 p.m.** | 87.2 | 76.1 | 70.7 | 16.5 | 80.64 | 97.14 | 65 |
| **4-5 p.m.** | 91.4 | 83.3 | 73.9 | 17.5 | 88.40 | 105.90 | 65 |
| **6-7 p.m.** | 91.9 | 85.6 | 76.5 | 15.4 | 89.55 | 104.95 | 60 |
| **8-9 p.m.** | 91.3 | 81.6 | 74.1 | 17.2 | 86.53 | 103.73 | 60 |
| **10-11p.m.** | 82.2 | 72.4 | 70.2 | 12 | 74.80 | 86.80 | 60 |

Note: these readings were recorded through January, one reading per week

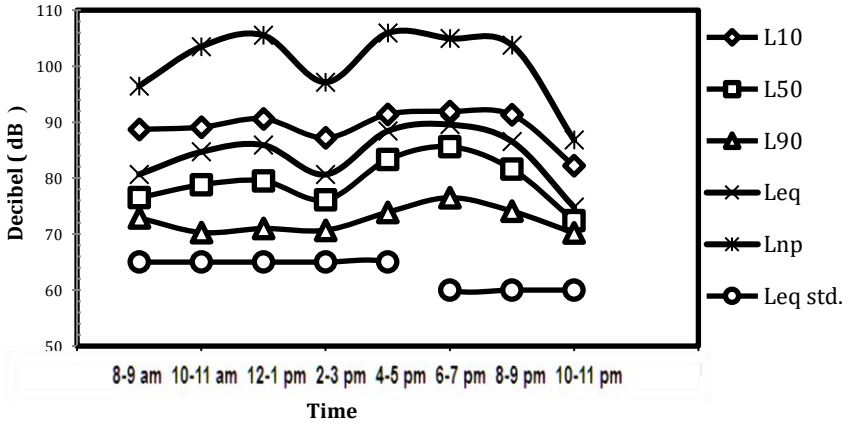


**Fig. 4. Noise pollution indices of Al-Sadiq street (commercial zone).**

Fig. 5 shows the average of pollution indicators in Al-Zahra'a hospital where the highest value of (L10, L50, L90, Leq and Lnp) are (84.5,76.7,69.6,80.4,91.6) dB respectively during (10.00-11.00) am because this period is the most crowded time with patients, women, children and their companions in addition to the sounds of ambulances and sounds of electric generators. The highest value of the L90 is 71.3 dB that is recorded in the period (8.00-9.00) am. This reflects the increase in noises produced from the vehicles that are passing by the main streets which surround Al-Zahra'a Hospital. In subsequent periods, the noises pollution indicators start to decline until they reach the lowest value in the period between (10.00-11.00) pm. However, the lowest value of Leq which equals 61.7 dB is higher than (Leq std) that mentioned in the Iraqi standards, with a value of 40 dB at night. Table 9 shows the highest value for N.C is 14.9 dB in the period between (10.00-11.00) pm, this reflects the difference between L10 and L90 and its lowest value is 7.5 dB during (8.00-9.00) pm.

**Table 9. Noise levels computed during Al-Zahraa teaching hospital (quit zone) at different times.**

| Time | $L_{10}$ | $L_{50}$ | $L_{90}$ | N.C | Leq | Lnp | Leq std. |
|---|---|---|---|---|---|---|---|
| **8-9 am** | 83.2 | 75.8 | 71.3 | 11.9 | 78.2 | 87.7 | 50 |
| **10-11 am** | 84.5 | 76.7 | 69.6 | 14.9 | 80.4 | 91.6 | 50 |
| **12-1 pm** | 83.2 | 76.1 | 68.5 | 14.7 | 79.7 | 90.8 | 50 |
| **2-3 pm** | 82.8 | 75.9 | 70.3 | 12.5 | 78.5 | 88.4 | 50 |
| **4-5 pm** | 80.1 | 70.2 | 67.7 | 12.4 | 72.8 | 82.6 | 50 |
| **6-7 pm** | 76.8 | 68.3 | 66.2 | 10.6 | 70.2 | 78.9 | 40 |
| **8-9 pm** | 72.3 | 65.8 | 64.8 | 7.5 | 66.7 | 73.3 | 40 |
| **10-11 pm** | 69.6 | 60.7 | 61.9 | 7.7 | 61.7 | 68.4 | 40 |

Note: these readings were recorded through February, one reading per week

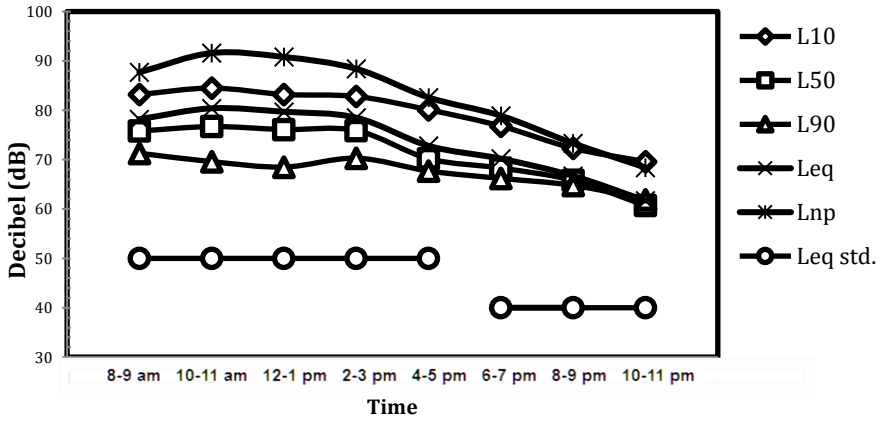


**Fig. 5. Noise pollution indices of Al-Zahraa teaching hospital (quit zone).**

Fig. 6 shows the rate of indicators of pollution in the residential area which is represented by Al-Salam district, where the highest rate of pollution indicators (L10,L50,L90 and Leq) value are (73.6, 67.9, 65.3, 69.05) dB between (12.00-1.00) pm due to the enormous number of private and governmental schools, which contains a lot of students in that province. The end of classes at this time with a large number of private vehicles nearby the schools leads to raising the mentioned noises levels. The highest value of (Lnp) is 98.9 dB that is recorded in the period from (10.00-11.00) am. This shows the effect of noises from loudspeakers by hawkers as well as the sounds of electric generators that used in homes and the sounds of aircraft passing over this residential area, which take off and land from Najaf International Airport. That residential area of the city center contains a huge numbers of small houses, which their average area does not exceed 50 $m^2$ that consists as around more than three

people per house. The noise produced in a house can be heard in the neighboring one, i.e., an electric water pump. In comparing to the highest value of (Leq) which is 69.05 dB in the period between (12.00-1.00) pm, we notice that it is higher than (Leq std) that mentioned in the Iraqi standards, which is equal to 60 dB at the day time. Table 10 shows the highest value for N.C is 11.6 dB in the period between (4.00-5.00) pm while lowest value is 8.3 dB during (12.00-1.00) pm.

**Table 10. Noise levels computed during Al-Salam district (residential zone) at different times.**

| Time | $L_{10}$ | $L_{50}$ | $L_{90}$ | N.C | Leq | Lnp | Leq std. |
|---|---|---|---|---|---|---|---|
| **8-9 am** | 70.3 | 63.5 | 58.9 | 11.4 | 65.67 | 77.07 | 60 |
| **10-11 am** | 72.8 | 66.7 | 62.4 | 10.4 | 68.50 | 78.90 | 60 |
| **12-1 pm** | 73.6 | 67.9 | 65.3 | 8.3 | 69.05 | 77.35 | 60 |
| **2-3 pm** | 68.5 | 61.2 | 58.1 | 10.4 | 63.00 | 73.40 | 60 |
| **4-5 pm** | 70.7 | 64.5 | 59.1 | 11.6 | 66.74 | 78.34 | 60 |
| **6-7 pm** | 71.1 | 63.5 | 59.8 | 11.3 | 65.63 | 76.93 | 50 |
| **8-9 pm** | 53.9 | 45 | 42.8 | 11.1 | 47.05 | 58.15 | 50 |
| **10-11 pm** | 51.6 | 43.7 | 41.9 | 9.7 | 45.27 | 54.97 | 50 |

Note: these readings were recorded through March, one reading per week

To give a clear view of high level of noise pollution, a percentage override of (Leq) over (Leq std) has been calculated for five selected zones and is shown in Fig. 7 below.

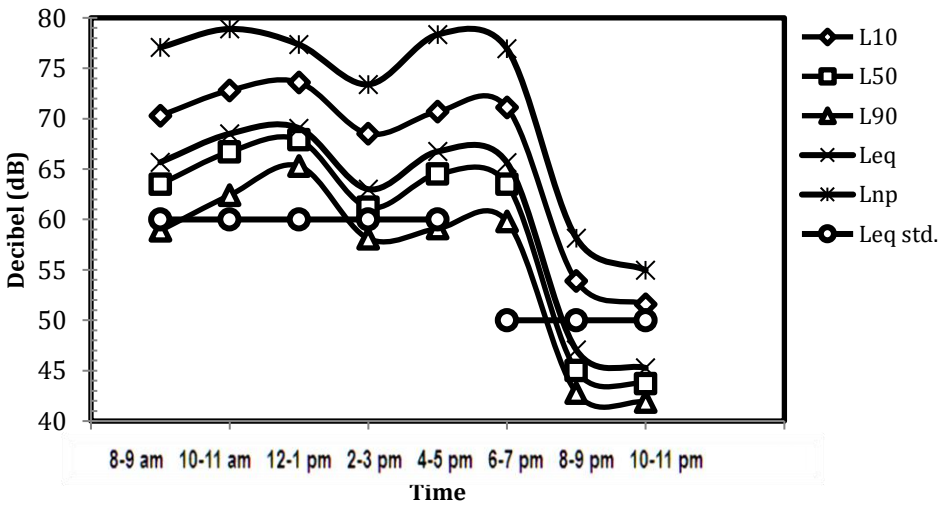


**Fig. 6. Noise pollution indices of Al-Salam district (residential zone)**

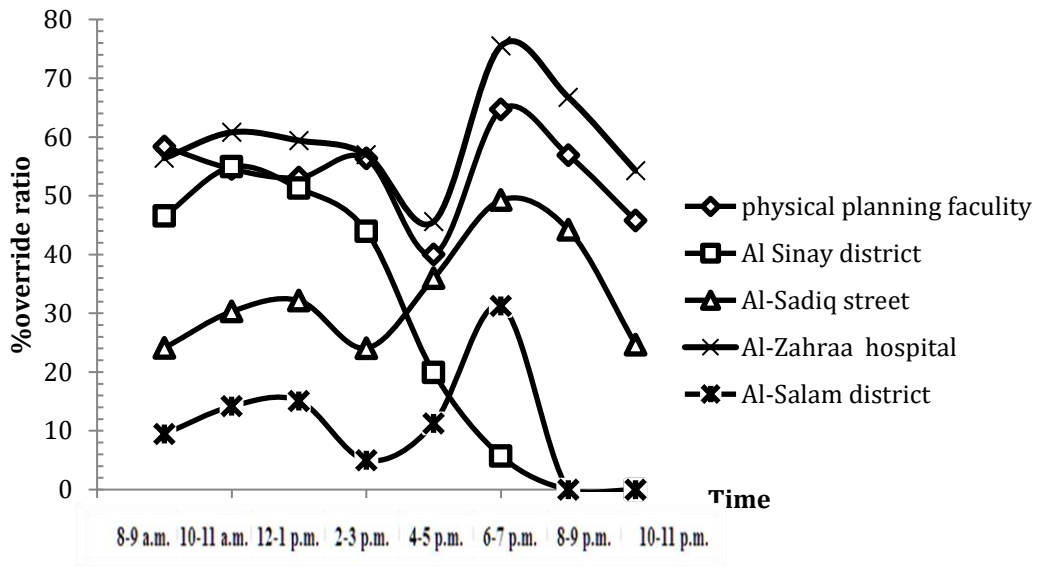


**Fig. 7. Shows the percentage override of (Leq) over (Leq std) .**

## 8. RECOMMENDATION

In this study, we recommend that to take the following preventive measures into considerations:

1. Prevent heavy load vehicles and big trucks from passing through the centers of the city, hospitals, and educational places. Also, construct other external roads for those kinds of vehicles.

2. Produce and use a specific type of asphalt which can absorb and reduce noises.

3. Increase cultural awareness about the use of the devices which produce noises like vehicle horns and loudspeakers. Loudspeakers are nowadays widely used intensively by vendors and gas cylinder vehicles, especially in quiet neighborhoods. The researcher recommends imposing fines of any violations.

4. An Najaf Airport is supposed to be constructed outside the city center and residential areas by a distance not less than 25 km, as well as coordination with Ministry of Transport & Communication to build stations to monitor the noise of airplanes during landing and taking off.

5. Minimize the noise of industrial area. Make sure that there is no annoying noises can be heard outside the factories and workshops. This can be achieved by placing soundproof materials or replacing old machine parts with new electronic parts.

6. Transfer any workshops and factories away from residential areas.

7. Use noises protection equipment to protect the workers in the factories and workshops, including ear plugs or ear covers to reduce the level of sounds and thus prevent the hearing loss.

8. The green belt reduces the intensity of the sound. So, it is better to plant the main streets with trees and increase the green areas and parks to reduce the intensity of the noise.

9. Use insulation of walls and ceilings such as acoustic insulation materials in residential premises and the use of double glazing which can be considered as a proper insulation between buildings.

## 9. CONCLUSIONS

This study showed:

1. The average noise pollution indicators have risen up in the five selected areas (Educational, Industrial, Commercial, Residential, and Quiet) in comparison with the Iraqi standards. On the other hand, the highest rate of noise pollution was recorded in the Industrial Area in the morning.

2. Poor urban planning of some building sites in An Najaf city has led to exposure to high levels of noise pollution, which is inconsistent with the functional performance of those areas. For example, in the Educational area such as (Faculty of Physical Planning), it is supposed to be located in a quiet area. But there were high levels of noise recorded in comparison to the Iraqi standards in the Educational zones. The main reason behind this pollution is that the building premises are close to a main street and to the highly crowded market area.

3. Efforts by official authorities to reduce noise pollution are almost missing and not consistent with the increasing level of noise pollution sources. In the residential area (As-Salam Neighborhood), the prevalence of loose dogs, street vendors and diesel generators were remarkably noted.

4. The high levels of noise pollution recorded in the quiet area (Zahraa Pediatric Teaching Hospital) reflect the large numbers of the sick compared with the limited capacity of the hospital. The lack of sound insulation of the buildings, as well as the lack of green areas that reduce noise, were noted.

5. Multiple sources of noise pollution in the commercial area (Al-Sadiq Street) can be well noticed. The reason behind this is that the street is overcrowded with visitors and buyers as well as the intensive spread of loudspeakers, especially in religious occasions. In addition, the lack of urban expansion of this commercial street has led to a high rate of noise pollution indicators.

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