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Noise Measurements in the Community of Nablus in Palestine

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Summary
This paper presents the main results obtained in a general study of noise pollution in the city of Nablus in Palestine. The equivalent noise level values (Leq) were measured and tabulated for 50 locations spread over the area of the city. The obtained result of noise level of the 50 Leq values is in average 68.0 dB(A). It has been found that the Leq values for 35% of the selected locations are exceeding 73.0 dB(A). This result is obviously higher than the adopted international standards. Accordingly, the area of Nablus is considered an unacceptable living area. Hence, its buildings, streets and factories require severe reconstruction and modification plant. In addition, there should be adequate updated plans for setting up community noise surveys and ordinances.

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1. Introduction
Noise pollution is a hidden parameter having a great influence on the environment. Therefore, the life of human being through his direct and daily contact to it is affected. Accordingly, it is not surprising that the issue of noise pollution is a hot topic in scientific research [1, 2]. The necessity for noise pollution studies and its influences on the surrounding environment is increasing especially by increasing the number of noise sources as machines, machines, vehicles and factories. In the local society of Palestine of area 27,000 km² there are some specific issues affecting the noise level. These issues are the crowded living of our cities, the refugee camps that are not subjected to regulations and recommendations of safety and health laws, the shortage of open spaces, the heavy road traffic, as a consequence of narrow streets, and finally the military activities especially by using the aircrafts. Additionally, Palestine cities have no true boundaries between residential, commercial and industrial zones. The design of many buildings, factories and streets did not follow any kind of regulations in order to reduce noise pollution. All these factors and others contribute strongly to increase the noise level to which most of the people are exposed most of the time at homes, streets, factories and elsewhere. This in its turn affects the health and the quality of life of everybody in the region.

National standards frequently guarantee the availability of quiet new machines, automotive vehicles and other noise sources by legislating their maximum allowable noise hiring. Usually, noise enforcement legislation limits are set as the maximum dB(A) level generated during daylight time [3, 4, 5, 6, 7]. During the last twenty years, noise level measurements have been the topic of research of many groups in different countries [8, 9, 10, 11, 12, 13, 14, 15, 16]. Several of these studies have produced noise maps of some big cities for planning and designing new roads, buildings and factories. In an attempt to initiate similar study in Palestine where there is no real noise level measurements have been taken yet we started our experiments. This paper presents the main results obtained in all urban areas of the community of Nablus. The noise level was measured in 50 different selected locations then studied and compared to the international standards.

2. Experimental apparatus
The noise levels were measured by using the Quest model 2900 type 3 integrating and logging sound level meter. The accuracy of this meter is ±0.5 dB(A) at 29°C and its precision is 0.1 dB(A) [4, 17].

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3. Results and discussion

Noise level measurements were carried out in 50 locations spread through all urban areas in the community of Nablus (135,000 inhabitants). This means that the city of Nablus has been divided at a rate of one location for each 2,700 inhabitants. The mentioned criteria guaranteed that the results obtained from the measurements are statistically good representative of noise levels within the entire urban area of the city. All these measurements were carried out during working days of the week. The duration of each measurement in every location was 60 minutes and was done three times. The first time was during the early rush hour (8:00 to 9:00 o'clock), the second time was during the late rush hour (15:00 to 16:00 o'clock), and the third time was during the sleeping time (23:00 to 24:00 o'clock). For longer term trends in studying the environmental noise it is convenient to use a single number descriptor to define an entire day's noise history. The most common descriptor used in this field is the equivalent dB(A) level ($L_{eq}$) that is an excellent criterion for studying long term trends in ambient noise. However, it does not reveal complete information about the quality of the environment because human response is partially dependent upon the range of noise level variation. Consequently, the environmental noise pollution is best described by the $L_{eq}$ and $L_{max}$ values. For these two analyses the dB(A) sound pressure level exceeds 10% and 90% of the time, respectively, which reveals maximum and minimum noise levels. The average values of $L_{eq}$, $L_{max}$, and $L_{min}$ have been measured for each location. Table 1 shows the distribution of the measured equivalent sound level values ($L_{eq}$) across all the measurement locations. A plot of the percentage of the mean values in different locations is shown in Figure 1. The mean of the $L_{eq}$ values of the 50 locations obtained in these measurements is 68.0 dB(A) with a standard deviation of 9.8 dB(A). The minimum and maximum registered $L_{eq}$ values are 49.2 dB(A) and 95.0 dB(A), respectively.

In 15 measurement locations, i.e. 30% of the total locations considered in our samples, the results of noise level ranged between 55 and 65 dB(A). These are considered as acoustically undesirable for residential areas. In 29 measurement locations, about 58% of the total samples, the $L_{eq}$ sound level values exceeded 65 dB(A), therefore, they are considered unacceptable residential areas. It should be noted that in about 16% of locations the $L_{eq}$ values exceeded 75 dB(A), which is an extremely high value for residential areas. As mentioned before, the mean value of the $L_{eq}$ values obtained in the 50 locations is 68.0 dB(A), that is also unacceptable for residential areas. It should be noted that all the measured $L_{eq}$ values are compared to the report issued by the organization for economic cooperation and development [7].

The variation of hourly values of noise levels through 24 hours at one location with high traffic volume is typically represented in Figure 2. From such diagram, several important features can be understood. There exist two major peaks at 8.00 o'clock and 16.00 o'clock. These two peaks represent the early and late time rush hours, respectively. In addition, there is a little obvious peak at about 13.00 o'clock that reveals the lunch time. Another important point is that the figure can be divided into two major parts. The working day time (8:00–16:00 o'clock) during which we get extremely noise levels with average $L_{eq}$ values above 75 dB(A), and night time during which the $L_{eq}$ values drop down to an acceptable value around 55 dB(A).

The variation of the hourly values of noise levels was then measured during 24 hours in a low traffic volume urban area. The result of this experiment is shown in Figure 3 which reflects very similar features as Figure 2 but, in general, with lower noise levels. For comparison purposes of the low and high traffic volume areas, the $L_{eq}$ values for both regions are shown in Figure 4. In the high traffic street the average of $L_{eq}$ values is about 70 dB(A) compared to...
Figure 3. Variation of hourly values of noise levels through 24 hours at urban areas with low traffic volume.

Figure 4. Variation of hourly values of $L_{eq}$ for high and low traffic through 24 hours at urban areas.

63 dB(A) in the low traffic which means an increase of about 11% in the sound level.

At the end of this study, we can conclude that the city of Nablus as one of the most populated cities in Palestine is environmentally noise polluted. About 16% of the inhabitants of Nablus are exposed to diurnal extremely high value of equivalent sound levels over 75 dB(A). In addition, during the working hours the city in general is unacceptable for living purposes.

Many things can be done to relieve the environmental noise pollution problem in the city of Nablus. Some of these are: quieting the noise sources, putting barriers or allowing enough spaces between residential areas and noise sources, limiting the exposure time, following safety and health regulations, and setting up community noise surveys and ordinances. Moreover, there should be adequate plans for an early step in any noise control program for industrial or residential areas. The proposed legislation should be accompanied by favorable publicity programs so that the public will view it as a means to improve their lives and community not as an interference with their personal freedom.

Acknowledgement

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References


[17] Quest Technologies: Instructions for models 1900 and 2900 integrating and logging sound level meter.