

The Assessment and Analysis of Traffic Noise Pollution in the City of Amman

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Abstract- This investigation analysed the traffic noise pollution in the city of Amman in the Hashemite kingdom of Jordan. Twenty-two major locations, which are important streets and intersections in Amman connecting Amman with the south, the north and the airport of Jordan, were monitored. Monitoring of these selected locations has been conducted for three months. An equivalent A-weighted sound pressure level (LAeq) index was used, and the effect of workday and weekend traffic was conducted. The recorded results indicate that traffic noise levels are exceeding the accepted limits, which is 60 dBA for the day-time, at most of the locations. The reported results of the investigation showed that the minimum and the maximum noise levels are 51 dBA and 75.7 dBA during daytime. The Sweileh roundabout and the Alsenah traffic lights were found to be subjected to maximum noise levels of 75.7 and 72.63 dBA, respectively, because these sites are subjected to heavy traffic from the south. This study confirms the urgent need to establish a centre in Jordan for noise pollution monitoring and to develop local traffic noise standards. It is noted that people who live near the most polluted places suffer from some behavioural disorders and poor work performance.

Keywords- Noise Pollution; Traffic; Environment; Assessment; Survey

I. INTRODUCTION

In Jordan, traffic noise witnessed a serious global concern because of its negative impact on the quality of life in the community. Large cities like Amman face growing problems with noise pollution [1], which is a significant environmental problem in many developing areas. Fig. 1 shows the number of vehicles registered in Jordan between the years 1950-2010, and Fig. 2 shows that of foreign vehicles entering Jordan during 2001-2011 [2]. From these figures, it can be seen that the high percentage of vehicles, the continuously increasing rate of growth in vehicle ownership due to fast development, the expansion of the economy, travel and tourism, and the fast growth of the industrial and commercial sectors all contribute to noise pollution. In addition to the relatively large population growth of approximately 2.5 million, the city has been expanding continuously in all directions during the past two decades. This high percentage of vehicles, along with the continuously increasing rate of growth in vehicle ownership, contributed to the high noise level recorded in this city. It is well established now that noise is a potential hazard to health, communication and the enjoyment of social life. Predictions and measurements of road traffic noise levels are essential for roadway planning and noise control [3].

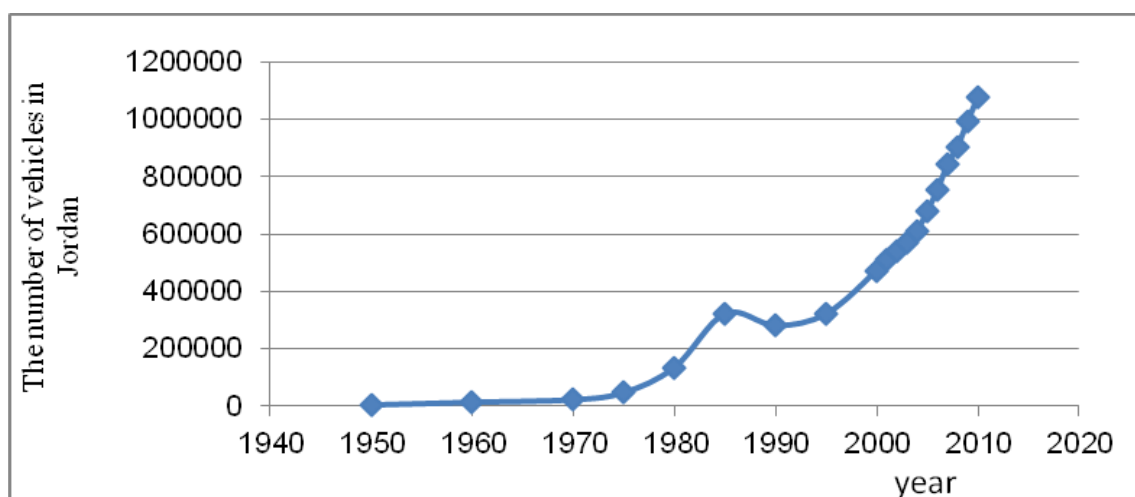


Fig. 1 Number of vehicles in Jordan from (1950-2010)

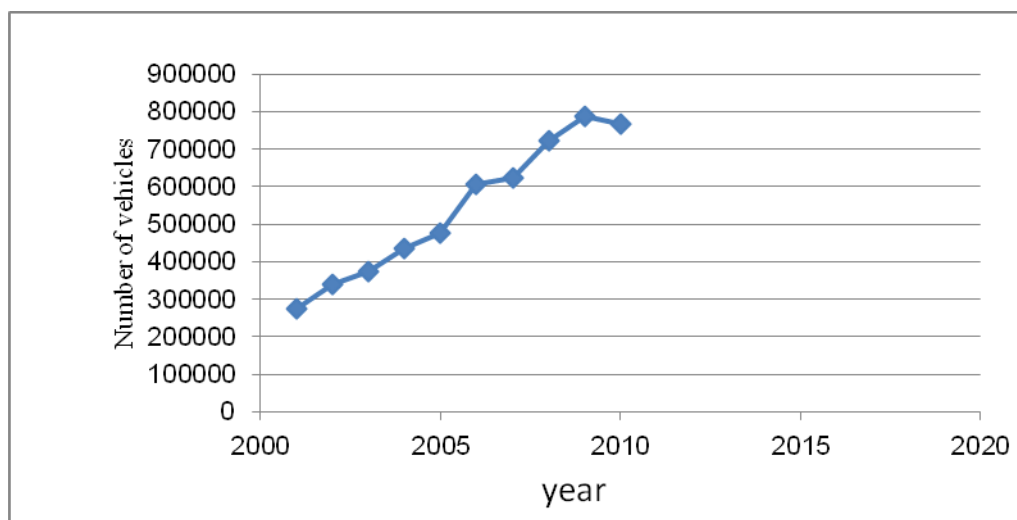


Fig. 2 The number of foreign vehicles entering Jordan

The seriousness of traffic noise as the major source of environmental pollution was exposed by a number of previous studies, but unfortunately, few studies have been carried out to investigate and assess noise pollution in Jordan. One of the most available studies is by Hammad and Abdelazeez [4] who studied traffic noise and related annoyances in the city of Amman. These authors showed that the national vehicle registration jumped from 310,000 to 575,000, which represents an average annual increase of approximately 11%. This increase is somewhat comparable to the percentages reported for many European and Asian countries. Serkan et al. [5] carried out a study to determine motorway noise levels in the Tokat city center located in the northern part of Turkey. Khan et al. [6] determined the level of traffic noise in the city of Karachi. Maximum noise was observed during the peak rush hours between 01:00 p.m. and 03:00 p.m. and between 05:00 p.m. and 07:00 p.m. and was in the range of 110 dBA. Supplementary col 2 3 4 5 I am the caption Waters [7] studied the characteristics of the noise emitted by commercial vehicles. Suresh et al. [8] examined the effect of traffic, vehicle and road characteristics on vehicular emissions and reviewed traffic flow and emission models. Cannelli and Corbino [9], in 1974, surveyed the rush-hour traffic noise in Rome. Hai Yen et al. [10], in 2010, conducted extensive noise measurements in Hanoi and Ho Chi Minh City, and a comprehensive dataset of noise was obtained that included 24 h noise measurements as well as short-term noise recordings. Bogoy et al. [11], in 2001, analysed the dependence of the measured primary pollutants, CO and a mixture of nitrogen oxides (NO_x), on meteorological conditions, traffic emissions and monitoring location. King et al. [12], in 2011, quantified the impact on noise levels from a ban on private cars in the Dublin city center. Paulo et al. [13] presented the results obtained in a study on environmental noise pollution in the city of Curitiba, Brazil. Paulo [14], in 2011, presented the results of an acoustic evaluation conducted in areas adjacent to the federal highway BR-116, part of which lies within the urban limits of the city of Curitiba in southern Brazil. Zissis et al. [15], in 1993, analysed the results of a study carried out for the Commission of the European Communities regarding the expected evolution of traffic-produced emissions. Different scenarios were developed, including a baseline approach, an accelerated best technology implementation and a car use intervention. Jaddan et al. [16, 17] evaluated using British Calculation of Road Traffic Noise (CRTN) method. The impact of the problem on the exposed residents is also evaluated through a social attitudinal survey. The results confirm that the present and predicted noise level are high and exceed the maximum allowable limits. And from the previous studies, it is essential to investigate the extent of traffic noise problems, to highlight the danger of the ensuing environmental deteriorations and to explore the effect of noise pollution on the environment due to vehicles in Amman by comparing the measured noise level with the standard noise levels allowed by international standards. It is also essential to identify the main sources of noise in vehicles.

II. METHODOLOGY

Amman, located in the middle of Jordan, was selected as a typical modern city to perform this study. This city has witnessed extensive urban development over recent decades and has become a point for industrial and commercial activities because of its location and climate. Measurements were performed at the selected sites shown in Fig. 3 at the traffic peak time and also when traffic was at its minimum.

The noise levels were measured with the help of a portable precision digital sound level meter (BK Model- type 2235). This instrument is shown in Fig. 4 and was designed for community noise surveys. A large digital display gives a single value indication of the maximum 'A'-weighted RMS (root mean square) sound pressure level measured during the previous second. The investigation was conducted during three consecutive months in 2012 in 22 locations, which are known for their heavy traffic and population flow. The results indicate the LAeq averages during peak and minimum traffic load hours. Measurements were made during rush hours at 07:30 am, 10:30 am, 03:00 pm, 05:00 pm, 08:00 pm and 11:00 pm. At each site and at each recording, the sound level meter was mounted at a uniform height of 1 meter. Six consecutive days were spent at

the twenty-two selected sites, and one whole day was spent at one of the sites. Three measurements were made at intervals of five minutes, and a mean value was recorded. Microsoft Excel was used to record and analyze the noise levels.

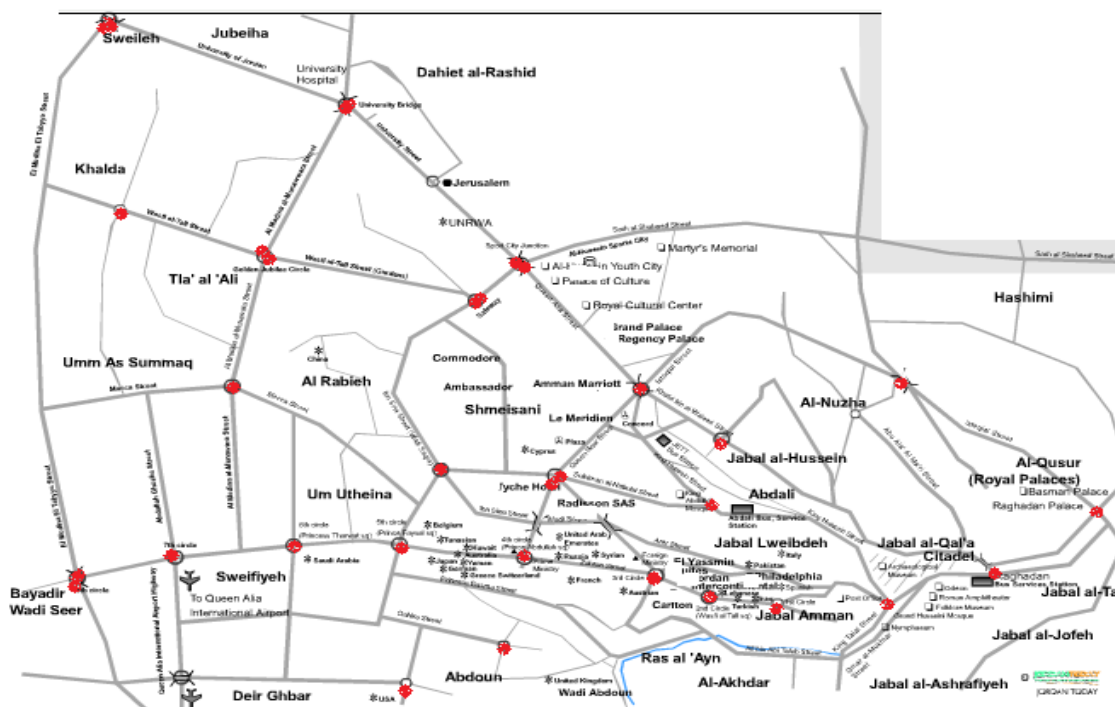


Fig. 3 Selected sites locations on Amman city map



Fig. 4 Portable digital sound level meter

III. RESULTS AND DISCUSSION

The traffic noise characteristics are explained by sets of measurements that dealt with the traffic noise profile of the LAeq index. Moreover, the statistical results showed significant differences between light and heavy traffic conditions and the direct effect of heavy traffic on noise pollution. These results also showed that vehicle traffic is the main source of the produced noise pollution [19].

Noise sources associated with transportation include passenger vehicles, medium trucks, heavy trucks and buses. Each of these vehicles produces noise, however, the source and the magnitude of the noise can vary greatly depending on the vehicle type. For example, while the noise from passenger vehicles occurs mainly from the tire-roadway interface and is therefore

located at ground level, it was found that noise from heavy trucks is produced by a combination of noise from the tires, the engine, and the exhaust, resulting in a noise source that is approximately 2 m above the ground [20]. Table 1 shows the maximum limit or the acceptable limits allowed according to the Jordanian legislation noise control regulation for environment protection [18].

TABLE1 MAXIMUM LIMITS FOR NOISE LEVEL POLLUTION ACCEPTED ACCORDING JORDANIAN REGULATION

Site	Standard Noise level dBA
Residential areas in cities	60
Residential areas in the suburbs	55
Residential areas in villages	50
Residential areas that have some of the workshops or Simple character or business areas Commercial a administrative center of the city	65
Industrial areas	75
Education and places of worship, hospitals and treatment	45

The noise levels of several areas of the city of Amman were measured, as shown in Fig. 5. From this figure, it can be seen that most of the measurements exceeded the allowed values determined by the Jordanian Environmental law. The highest noise levels were recorded at the Sweileh roundabout and the Alsenaah traffic light because these two locations connect the capital Amman with the southern and northern parts of Jordan and with the airport 30 km south of Amman. As Figs. 1 and 2 indicate, the Kingdom experienced fast development, with rapid growth of cities, extensive urban extensions and a high population growth. This rapid development accelerated the demands for increased transportation facilities, i.e., cars, buses and airplanes.

It is evident that the control of noise emission from road vehicles is of paramount importance to reduce environmental noise. The measurements of the environmental noise pollution showed a correlation between the data obtained and evaluated for the different indicators. A questionnaire given to the people who were exposed to the two highest noise levels in this investigation showed that the noise levels have a negative impact on the behaviour and the work of these people. The questionnaire was constructed to measure the effect of noise impact on the people exposed to traffic noise and living in these areas, and it consisted of statements, specifically about noise sources, how they feel suffering from any disease and the degree of noise levels and its impact on their life and how to solve this issue. Moreover, the outcomes analysed will be submitted to the ministry of environment and health.

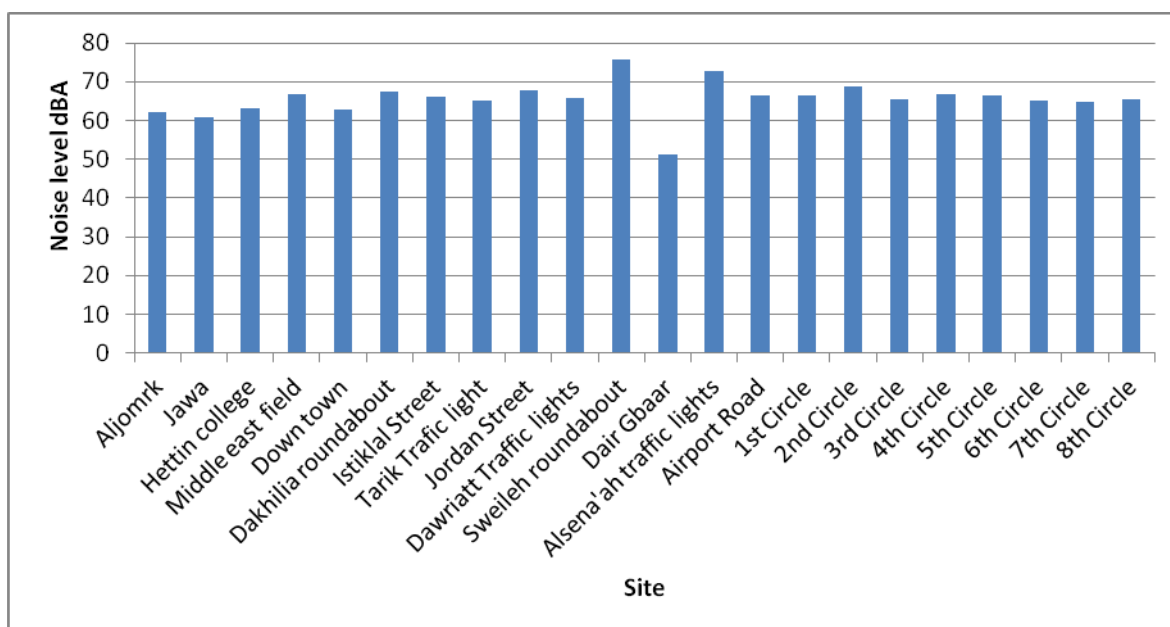


Fig. 5 Traffic noise level at different sites in Amman

Additionally, it was found through this investigation that all imported vehicles are not subjected to tests or acceptable noise level limit certification before registration. The absence of strict legislation to prevent the import of cars that exceed the noise level limit contributed to an increase in the noise pollution level. The survey also shows that there is a lack of awareness of the consequences for the owners of the vehicles and the impact of traffic noise on the environment and society.

IV. CONCLUSIONS

High noise levels due to vehicular traffic were observed during the study, as well as cause disturbance and even some health problems. Based on the study findings, it can be inferred that there is an urgent need to establish a noise monitoring system in the country to control the noise pollution. The Alsenaa traffic and the Sweileh bound circle were found to have higher noise levels because of heavy traffic from the south, the north and the airport. It was found that the noise level in most areas in Amman exceeded the allowed values. These levels were generally higher than the accepted standard criteria of a maximum permissible level of 60 dBA. The findings of noise pollution in Amman were submitted to the Ministry of Environment in addition to suggestions such as the improvement and encouragement of public transportation, the reduction of the number of private cars on roads, the revision of driving license regulation and the application of national noise level standard specifications for imported cars. These recommendations, in addition to traffic planning, reviewed policies and the establishment of a centre for noise pollution monitoring, can contribute significantly to overcoming limitations and diminishing the number of people exposed to the high noise levels in the main cities. Because of time and finance limitations, this study was limited to one city. Further investigations covering the main cities of the kingdom should be conducted.

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