

# Assessment of Noise Pollution in the City of Biskra, Algeria

Tallal Abdel Karim Bouzir, Nourinne Zemmouri, Djihed Berkouk

**Abstract**—In this research, a quantitative assessment of the urban sound environment of the city of Biskra, Algeria, was conducted. To determine the quality of the soundscape based on in-situ measurement, using a Landtek SL5868P sound level meter in 47 points, which have been identified to represent the whole city. The result shows that the urban noise level varies from 55.3 dB to 75.8 dB during the weekdays and from 51.7 dB to 74.3 dB during the weekend. On the other hand, we can also note that 70.20% of the results of the weekday measurements and 55.30% of the results of the weekend measurements have levels of sound intensity that exceed the levels allowed by Algerian law and the recommendations of the World Health Organization. These very high urban noise levels affect the quality of life, the acoustic comfort and may even pose multiple risks to people's health.

**Keywords**—Noise pollution, road traffic, sound intensity, public health, noise monitoring.

## I. INTRODUCTION

BISKRA is considered as one of the biggest cities of the Algerian South. The rapid, massive and poorly planned urbanization that has been experienced in recent years, as well as significant growth in industrial and service sector [1], has negatively affected quality of life and increased pollution rates of urban ambiances.

This research focuses on the third most environmentally hazardous type of pollution for human health, which is noise pollution [2], [3]. It is mainly caused by traffic noise [4]-[6], classified by the US Environmental Protection Agency as one of the main pollutants of the urban environment since the 1970s [7]. An excess of the urban noise level can cause discomfort and stress as well as hearing loss [8], sleep disturbances [9]-[11], cardiovascular and even mental pathologies [12]-[15], (see Fig. 1).

This study is based on an evaluation and a comparative analysis of the real sound levels existing throughout the city of Biskra, confronted with the recommendations of the Algerian law concerning noise pollution and the standards of WHO.

## II. RECOMMENDED SOUND LEVELS

In Algeria, the recommended limit noise level in urban areas is 70 dB [17]. This value meets the international standards given by WHO [12] with the exception of residential areas, where this level far exceeds the recommended value [18]. See Table 1.

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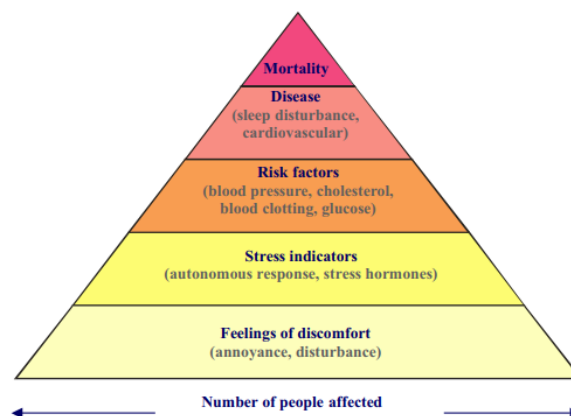


Fig. 1 The effect of noise on human health [16]

TABLE I  
 PERMITTED NOISE LIMIT VALUES IN URBAN AREAS [18]

Country	Industrial Zone	Commercial, residential (mixed)	Residential
Algeria [16]	-	70	70
India [19]	75	65	55
Saudi Arabia [20]	70	65-60	55
Bangladesh [21]	75	65	55
WHO [12]	-	70	55
Brazil [22]	70	60	55

## III. METHODOLOGY

### A. Selection of Measurement Stations

Forty-seven points were selected to represent the different urban landscapes and cover the entire city of Biskra. Fig. 2 shows the positioning of the measurement stations.

### B. Measurement Protocol

A measurement campaign was carried out using a Landtek SL5868P sound level meter with a time (Fast) and frequency (A) weighting. The equivalent sound level ( $Leq_{1min}$ ) is measured for one minute. In accordance with the standards proposed by the French Association for Standardization [23], the sound level meter was placed at a minimum distance of 2 m from all walls and reflective obstacles and at a height of 1.5 m. Measurements are made during weekdays and weekends and out of peak hours, as they do not represent the sound environment of the city, but only extreme situations for short periods of time. The climatic and temporal data during the acquisition of the data are in Table II.

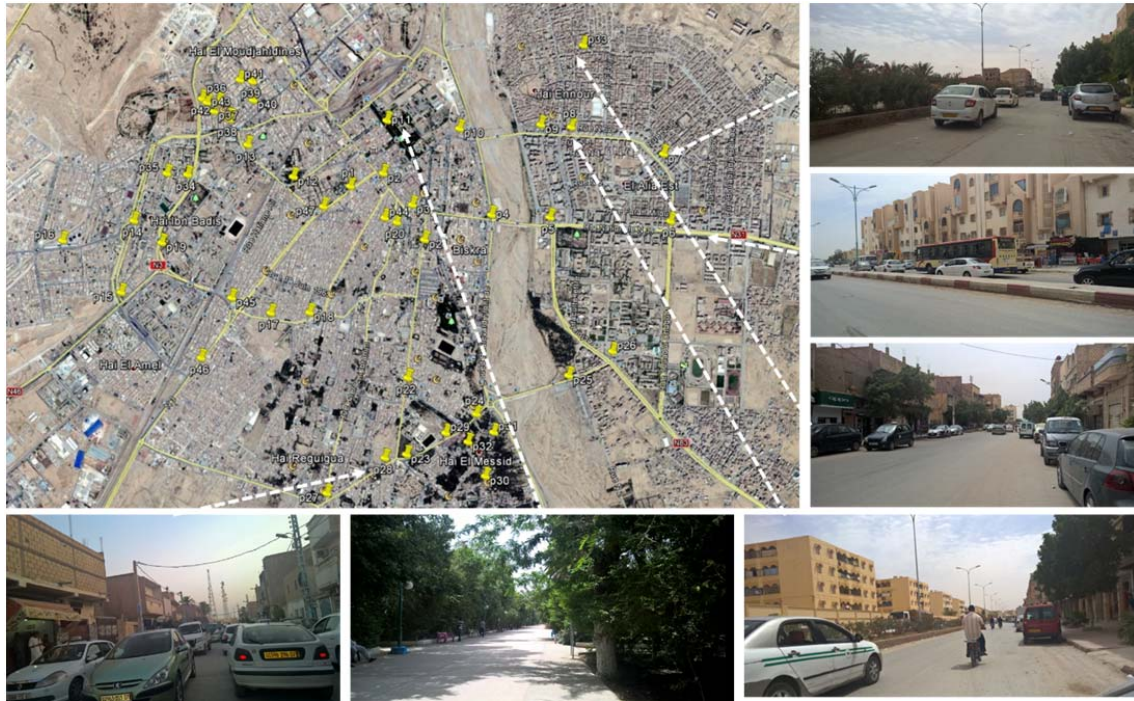


Fig. 2 Identification of measurement stations

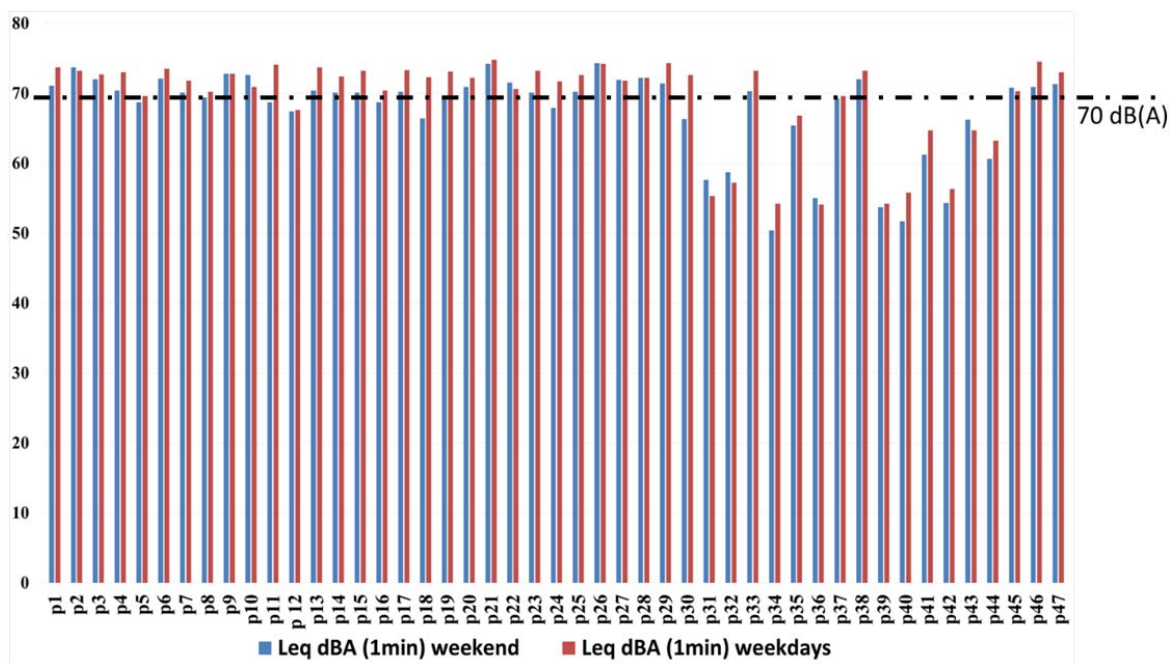


Fig. 3 Fluctuations of loudness throughout the urban landscapes

#### IV. ANALYSES OF THE RESULTS

According to Table III, which summarizes the overall results of our measurement campaigns, it is clear that the level of noise in the city of Biskra during the weekdays varies between 55.3 dB measured in Hai El Mojahidine and 75.8 dB in the boulevard of EL Azilat. While the noise intensity measured during the weekend is slightly lower compared to weekdays, it varied between 51.7 dB in Hai El Mojahidine city and 74.3 dB in the old city of Biskra

TABLE II  
 CLIMATIC CONDITIONS DURING DATA ACQUISITION

	The date	Hour (a.m.)	Temperature (°C)	Humidity (%)	Wind
Weekend	04/11/16	9-11	26	27	weak
	05/11/16	9-11	25	35	weak
Weekdays	09/11/16	9-11	17	50	weak
	10/11/16	9-11	19	47	weak

TABLE III  
SOUND LEVELS MEASURED IN THE CITY OF BISKRA

N point	Leq <sub>1min</sub> week-end dB(A)	Leq <sub>1min</sub> Weekdays dB(A)	GPS coordinates	
p1	71.1	73.7	34°51'5.67"N	5°43'19.80"E
p2	73.7	73.2	34°50'53.41"N	5°43'7.47"E
p3	72.0	72.7	34°50'42.55"N	5°42'54.78"E
p4	70.4	73.0	34°50'27.45"N	5°42'46.81"E
p5	68.7	69.6	34°51'11.53"N	5°43'27.90"E
p6	72.1	73.5	34°51'15.16"N	5°43'37.39"E
p7	70.1	71.8	34°51'7.98"N	5°43'46.63"E
p8	69.4	70.2	34°51'6.79"N	5°44'10.26"E
p9	72.8	72.8	34°51'7.18"N	5°44'26.83"E
p10	72.6	70.9	34°51'8.06"N	5°45'3.58"E
p11	68.7	74.1	34°51'24.30"N	5°45'0.19"E
p12	67.4	67.6	34°51'29.32"N	5°44'32.23"E
p13	70.4	73.7	34°51'29.44"N	5°44'23.12"E
p14	70.1	69.4	34°51'27.21"N	5°43'59.14"E
p15	70.1	73.2	34°51'28.01"N	5°43'37.51"E
p16	68.7	70.4	34°51'12.93"N	5°43'10.81"E
p17	70.2	73.3	34°51'19.97"N	5°42'56.63"E
p18	66.4	72.3	34°50'59.77"N	5°42'24.28"E
p19	69.2	73.1	34°50'53.85"N	5°42'3.30"E
p20	70.9	72.2	34°50'42.15"N	5°42'21.83"E
p21	74.2	74.8	34°50'39.49"N	5°43'6.65"E
p22	71.5	70.6	34°50'40.22"N	5°43'18.19"E
p23	70.1	73.2	34°50'54.86"N	5°42'32.93"E
p24	67.9	69.7	34°51'3.49"N	5°43'42.36"E
p25	70.2	72.6	34°50'59.68"N	5°43'50.87"E
p26	74.3	74.2	34°50'25.88"N	5°43'48.54"E
p27	71.9	69.9	34°50'7.18"N	5°43'49.63"E
p28	72.2	72.2	34°50'18.12"N	5°44'9.58"E
p29	71.4	74.3	34°50'28.92"N	5°44'36.30"E
p30	66.3	72.6	34°50'35.49"N	5°44'48.82"E
p31	57.6	55.3	34°51'29.99"N	5°42'47.18"E
p32	58.7	57.2	34°51'27.57"N	5°42'46.07"E
p33	70.3	73.2	34°51'25.63"N	5°42'50.67"E
p34	50.4	54.2	34°51'35.36"N	5°42'56.97"E
p35	65.4	66.8	34°51'30.91"N	5°42'57.47"E
p36	55.0	54.1	34°51'35.54"N	5°42'53.24"E
p37	69.2	69.6	34°51'29.57"N	5°42'43.86"E
p38	70.0	71.2	34°51'30.39"N	5°42'42.37"E
p39	53.7	54.2	34°51'11.80"N	5°42'39.37"E
p40	51.7	55.8	34°51'11.77"N	5°42'33.23"E
p41	61.2	64.7	34°51'49.30"N	5°44'34.17"E
p42	54.3	56.3	34°50'11.21"N	5°44'7.65"E
p43	66.2	64.7	34°50'13.97"N	5°44'15.12"E
p44	60.6	63.2	34°50'3.13"N	5°44'13.44"E
p45	70.8	70.3	34°49'56.48"N	5°43'26.69"E
p46	70.9	74.5	34°50'6.00"N	5°43'43.26"E
p47	71.3	73.0	34°50'13.02"N	5°44'0.88"E

By comparing the results of the measurements with the limit

values of Decree 93-184, it can be noted that 70% of the points measured in weekdays and more than 55% of the points measured during the weekend have sound intensity values higher than the limit value of sound intensity accepted by the Algerian law (see Fig. 3 and Fig. 4). Moreover, noise pollution in this city is mainly caused by traffic noise.

As we can see in Fig. 5, the difference between the level of noise measured during the weekdays and at the weekend does not exceed 4 dB in 91.48% of the measured points. These converging values can be explained, on the one hand, by the increase in the sound intensity due to the increase in the speed of the vehicles during the weekends due to the low traffic flow and, on the other, by weekend special events like markets that are located in several locations in the city affecting the sound environment.

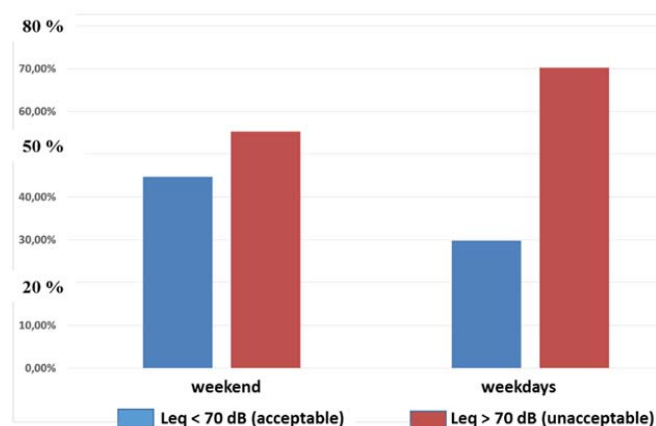


Fig. 4 Excess of the noise level in relation to the permissible level in the Algerian law (weekdays, weekend)

## V. CONCLUSION

It is clear that the problem of noise pollution in the city of Biskra is very obvious. More than 70% of the results obtained in weekdays and 55.30% of those on weekends have excessive levels of sound intensity that exceed international standards. This state affects the quality of life as well as the health of the inhabitants as it can also disrupt the natural system [24]-[26] of the city.

Rapid action must be taken in the immediate to guarantee a healthy and comfortable environment for the city's inhabitants.

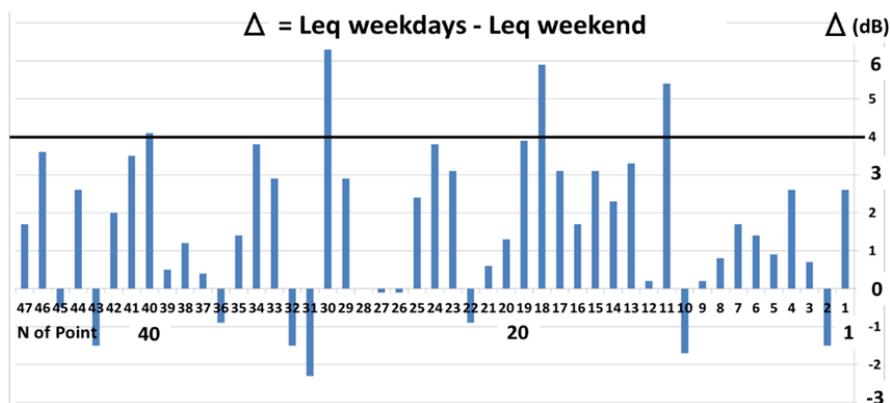


Fig. 5 Difference between the levels of noise in each measurement station measured during weekdays and weekends

#### REFERENCES

- [1] Farhi, A. (2002). Biskra : de l'oasis à la ville saharienne (Note). Méditerranée, 99(3), 77-82.
- [2] Zannin, P. H. T., Ferreira, A. M. C., & Szeremetta, B. (2006). Evaluation of noise pollution in urban parks. Environmental Monitoring and Assessment, 118(1-3), 423-433.
- [3] Onder, S., & Kocbeker, Z. (2012). Importance of the green belts to reduce noise pollution and determination of roadside noise reduction effectiveness of bushes in Konya, Turkey. Turkey. World Academy of Science, Engineering and Technology, 66, 639-642.
- [4] Kumar, S. (2011). Assessment of Urban Noise Pollution in Vijayawada City, AP, India. International Journal of Earth Sciences and Engineering, 4(6), 459-463.
- [5] Morillas, J. B., Escobar, V. G., Sierra, J. M., Gómez, R. V., & Carmona, J. T. (2002). An environmental noise study in the city of Cáceres, Spain. Applied acoustics, 63(10), 1061-1070.
- [6] Bouzir, T. A. K., & Zemmouri, N. (2017). Effect of urban morphology on road noise distribution. Energy Procedia, 119, 376-385.
- [7] [7] United States Environmental Protection Agency. Our built and natural environments: a technical review of the interactions between land use, transportation and environmental quality (EPA 231-R-01e002). Washington DC, US: US EPA; 2001.
- [8] Dalton DS, Cruickshanks KJ, Wiley TL, Klein BE, Klein R, Tweed TS. Association of leisure-time noise exposure and hearing loss. Audiology 2001; 40: 1-9.
- [9] Muzet, A. (2002). Les effets du bruit sur le sommeil. Acoustique & techniques, 28, 13-9.
- [10] Halperin, D. (2014). Environmental noise and sleep disturbances: A threat to health?. Sleep science, 7(4), 209-212.
- [11] Lévy-Leboyer, G., Vedrenne, B., & Veyssière, M. (1976). Psychologie différentielle des genes dues au bruit. L'année psychologique, 76(1), 245-256.
- [12] Lercher, P., Widmann, U., & Kofler, W. (2000, August). Transportation noise and blood pressure: the importance of modifying factors. In Proceedings of the 29th International Congress and Exhibition on Noise Control Engineering (Cassereau D, ed). InterNoise (Vol. 4, pp. 2071-2075).
- [13] Yuen, F. K. (2014). A vision of the environmental and occupational noise pollution in Malaysia. Noise and Health, 16(73), 427.
- [14] Berglund, B., Lindvall, T., & Schwela, D. H. (1999). Guidelines for community noise. In Guidelines for community noise. OMS.
- [15] Bruno Vincent, Vincent Gissingier. Mai 2011. Les effets du bruit sur la santé, Synthèse documentaire acouité.
- [16] Fritsch, L., Brown, L., Kim, R., Schwela, D., & Kephelopoulous, S. (2011). Conclusions (Burden of disease from environmental noise: Quantification of healthy years life lost in Europe). World Health Organisation.
- [17] Décret exécutif n°93-184 du 27 juillet 1993 réglementant l'émission des bruits, journal officiel de la République algérienne N 50,28 juillet 1993.
- [18] Bouzir, T. A. K., & Zemmouri, N. (in press). Évaluation de l'environnement sonore de la ville de Biskra (Algérie). Journal of Applied Engineering Science and Technology.
- [19] Kumar, S. (2011). Assessment of Urban Noise Pollution in Vijayawada City, AP, India. International Journal of Earth Sciences and Engineering, 4(6), 459-463.
- [20] Al-Ghonamy, A. I. (2010). Analysis and evaluation of road traffic noise in Al-Dammam: A business city of the eastern province of KSA. Journal of Environmental Science and Technology, 3(1), 47-55.
- [21] Amin, N., Sikder, I., Zafor, M. A., & Chowdhury, M. A. I. (2014). Assessment of noise pollution of two vulnerable sites of Sylhet city, Bangladesh. International Journal of Water Resources and Environmental Engineering, 6(3), 112-120.
- [22] Zannin, P. H. T., Diniz, F. B., & Barbosa, W. A. (2002). Environmental noise pollution in the city of Curitiba, Brazil. Applied Acoustics, 63(4), 351-358.
- [23] Agence Française De Normalisation. Acoustique: Caractérisation et mesurage des bruits de l'environnement. NF S 31-010. Paris: AFNOR, 1996, p15.
- [24] Halfwerk, W., Holleman, L. J., Lessells, C. K., & Slabbekoorn, H. (2011). Negative impact of traffic noise on avian reproductive success. Journal of applied Ecology, 48(1), 210-219.
- [25] Slabbekoorn H, Ripmeester EAP (2008) Birdsong and anthropogenic noise: implications and applications for conservation. Mol Ecol 17(1):72-83.
- [26] Parris, K., & Schneider, A. (2009). Impacts of traffic noise and traffic volume on birds of roadside habitats. Ecology and society, 14(1).