

Noise Pollution Modeling in Regions 5 and 6 of Isfahan City

Extended Abstract

Introduction: Noise pollution, a critical environmental issue in urban settings, significantly impacts the health and quality of life of city residents. This study focuses on assessing noise pollution and its correlation with vehicular traffic in municipal regions 5 and 6 of Isfahan, Iran, located in the southern part of the city. Isfahan, a major metropolitan area with a population exceeding 2 million and a strategic position in Iran's transportation network, faces increasing noise pollution due to rapid urbanization, dense traffic, and commercial activities. The research aims to map the spatial distribution of noise pollution, identify critical hotspots and coldspots, and provide insights for urban planning to mitigate its adverse effects.

Material and Methods: The study collected sound level data, measured in decibels A (dBA), from 23 sampling points—12 in region 5 and 11 in region 6—during the peak traffic hours of 16:00 to 18:00 on weekdays. These points were strategically selected to ensure homogeneous geographical coverage and to represent areas with varying traffic intensities, from low to high. Region 5, with an area of 1,702 hectares and a population of 171,182, is characterized by high traffic density due to its proximity to major roads and commercial zones. Region 6, spanning 6,600 hectares with a population of 104,737, includes residential areas and is adjacent to the Zayandehroud River, influencing its acoustic environment. Sound measurements were conducted using a portable sound level meter, with data averaged over 30-minute intervals to capture real-time noise levels during peak activity. The Inverse Distance Weighted (IDW) interpolation method, implemented in ArcGIS 10.8, was used to analyze the spatial distribution of noise pollution, generating continuous noise maps. The IDW method, based on the principle that closer points have greater influence, effectively highlighted areas with elevated noise levels, particularly in southern and southwestern parts of region 5, where levels exceeded 78 dBA. Additionally, the Getis-Ord Gi* statistical method was employed to identify noise pollution hotspots and coldspots, confirming four hotspots in region 5 (e.g., Sofeh and Artesh at 80.5 dBA) and two coldspots in region 6 (e.g., Sheikh Sadough at 61.2 dBA and Azadegan at 62.11 dBA).

Results: A one-way ANOVA test, assuming data normality (verified by Shapiro-Wilk) and homogeneity of variances (confirmed by Levene's test), was conducted to compare sound levels between regions. The results, with a p-value of 0.020, indicated a statistically significant difference, with region 5 (mean: 73.39 dBA) experiencing higher noise levels than region 6 (mean: 69.31 dBA), attributed to denser traffic and commercial activities. All measured points exceeded the World Health Organization's thresholds (55 dBA for residential areas and 65–70 dBA for commercial zones) and Iran's national standards, highlighting a pervasive noise pollution issue. Hotspots like Sofeh, Artesh, and Chahar Bagh Nazar (78.8 dBA) pose significant health risks, including stress, sleep disturbances, and potential hearing loss, particularly for vulnerable groups. The spatial analysis revealed that urban structure, high building density, and lack of sound barriers exacerbate noise in region 5, while open spaces and proximity to the Zayandehroud River mitigate it in region 6.

Conclusion: Comparative studies in cities like London and Seoul corroborate these findings, emphasizing the role of traffic and urban design in noise pollution. The results underscore the need for targeted interventions, such as installing sound barriers, expanding green spaces, and optimizing traffic management, particularly in region 5's hotspots. These findings provide a robust framework for urban planners to enhance the acoustic environment and public health in Isfahan, contributing to sustainable urban development.

Keywords: Noise pollution, Traffic, Inverse Distance Weighted, Getis-Ord Gi*, Isfahan.