

Comparison of Noise and Air Pollution at Recreational Places in Rajshahi, Pabna, Natore, and Sirajganj Districts

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Abstract

The present study aimed to assess and evaluate the noise and air pollution of the 17 selected recreational facilities, both public and privately managed, located in the Rajshahi, Natore, Shirajgong, and Pabna districts. The study measured selected key parameters of air and noise pollution levels in February-March 2023 to assess selected parks' air and noise pollution. The standard equipment for air and noise measurements, calibrated earlier, has been used. The data obtained from the field was analyzed to appraise pollution levels for recreational facilities. The study found that the noise level was comparatively low in Pabna district recreational facilities (53.42 dB), whereas high in Shirajgong (68.34 dB). The study also found that PM 2.5 and PM 10 concentrations were high in Pabna district recreational facilities, 251 $\mu\text{g}/\text{m}^3$, and 285 $\mu\text{g}/\text{m}^3$, respectively. The study's results might aid in adopting optimal management methods for poorly maintained parks or recreational areas for their patrons since they serve as the lungs of the environment in a cityscape.

Keywords: Noise pollution; PM 1; PM 2.5; PM 10; Air pollution.

1 Introduction

One of the fundamental purposes of living in a city is urban recreation, which is the process of a man's psycho-physical regeneration in an urban setting through recreational activities and the use of recreational spaces and content in the urban environment. Recreational areas are areas with green spaces and where leisure activities (both active and passive urban recreation) are carried out (Mitkovic & Bogdanovic, 2004). In addition to improving immune response, and psychological and spiritual benefits, such as reduced depression and improved subjective and spiritual well-being, resilience, and self-esteem, outdoor recreation can protect against heart disease and diabetes by lowering obesity, heart rate, blood pressure, and stress hormones such as adrenaline and cortisol; increasing heart rate variability; and reducing obesity, heart rate, and blood pressure (Ghimire et al., 2017; Gladwell et al., 2013; Heintzman, 2022; Laumann et al., 2003; Otsuka et al., 2011; Tsunetsugu et al., 2007). Recreationalists may be exposed to poor air quality associated with cardiovascular, respiratory, and neurological illnesses and stroke. The increased risk of heart attack, arrhythmia, heart failure, and stroke are particularly strongly correlated with particulate matter (McCann et al., 2021). According to EPA, land that has been developed, built, set aside, or used for recreational purposes would be considered a recreational area which also includes both public and private spaces that are often utilized for outdoor activities like biking, hiking, camping, bird viewing, and fishing ("Definition of recreational area for determining offsite impacts in RMP," 2019). Lack of proper upkeep and limitations on keeping a healthy environment reflect an unacceptably dangerous atmosphere, a typical situation in developing countries' recreational areas (Saha et al., 2022). Much research on noise pollution was carried out in Dhaka (Parvin, 2021), Sylhet (Amin et al., 2014; Farzana et al., 2014), Jessore (Jahan et al., 2016); Tangail (Alam et al., 2016; Hoque et al., 2013), Jamalpur (Ahsan et al., 2015), Rajshahi (Bari et al., 2016). Only a small number of research has been conducted for the assessment of air pollution in the cities of Dhaka, Rajshahi, and Chittagong (Rahman et al., 2016; Azad & Kitada, 1998; Hossen et al., 2018; Jahan, 2020; Nahian et al., 2023). However, it has been seen that no assessment of air and noise pollution has been taken so far to evaluate the present scenario of recreational places of Rajshahi, Pabna, Natore, and Shirajgong districts. Therefore, this study aims to assess the present noise and air pollution scenario of the Rajshahi, Pabna, Natore, and Shirajgong districts.

2 Methodology

Rajshahi division is one of the old divisions of Bangladesh, which have eight districts with an area of 18,154 sq. km ("www.rajshahidiv.gov.bd," n.d.). Four from the southern part of Rajshahi Division were selected as study areas among the eight districts. The selected districts were Pabna, Rajshahi, Shirajgong, and Natore, as shown in Figure 1. These four districts have many recreational places where people go to relax. A total of 17 recreational places were selected among the selected four districts (Table 1). A digital sound level meter (Decibel Meter RZ 1359) and air quality monitor meter (DM106A Air Quality Monitor) were used in the afternoon in the study area. From each recreational place, several sample points and at least three readings were taken for each sample point. Data collected from the field was processed and analyzed using Microsoft Office Excel 2021.

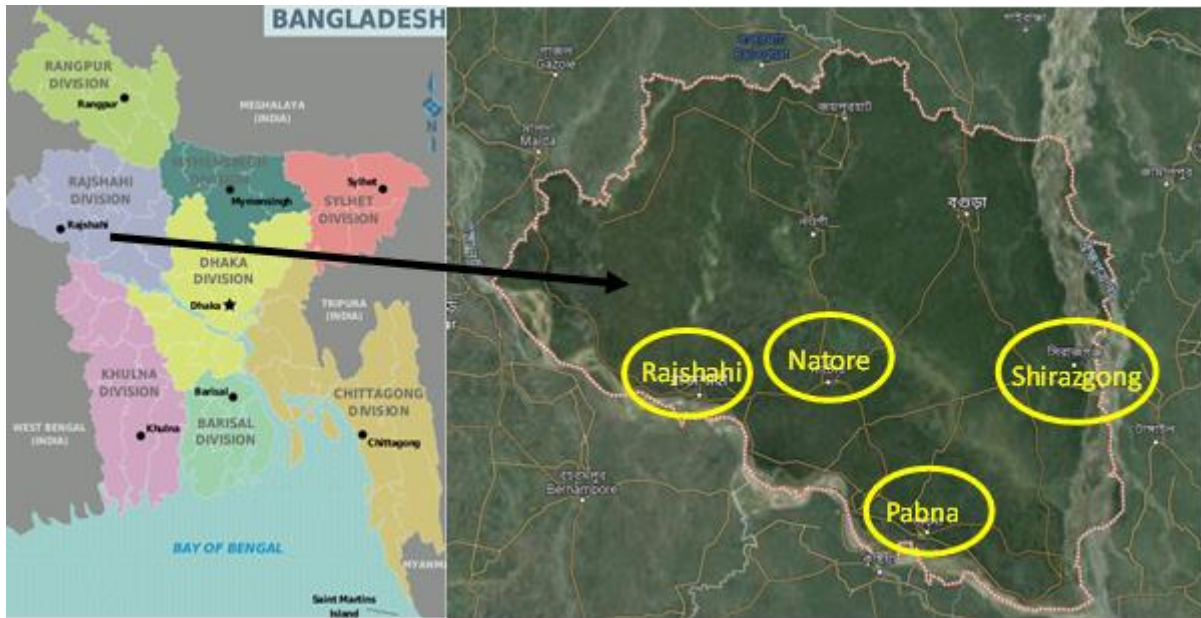


Figure 1. Selected study area (extracted from google earth)

Table 1: Details of sampling points

District Name	Recreational Place
Pabna	5
Rajshahi	5
Sirajganj	5
Natore	2
Total	17

3 Result and Discussion

From Figure 2, it was seen that the noise level of all districts was found to be exceeded the Bangladesh sound standard for the silent zone, which is 45 dB (ECR, 1997), as recreational places fall into the silent zone category. This may lead to loss of attention & performance, insomnia & sleep disturbance, as Razzaque et al. (2010) reported. Among the four districts, Rajshahi and Shirajgong have high (68 dB) noise levels compared to other districts. Particulate matters PM 2.5 was highest in Pabna district recreational places, 285 $\mu\text{g}/\text{m}^3$ and 251 $\mu\text{g}/\text{m}^3$, as shown in Figure 3. Particulate matter PM 1 was highest in the Natore district. The value of PM1 could not compare with the Bangladesh standard as no standard was found. However, PM1 concentration could result in cardiovascular mortality since PM1 was more closely related to it and had more significant impacts than PM2.5 or particulate matter with an aerodynamic diameter of less than 10 m. Smaller particles, notably PM1, have more excellent surface-to-volume ratios and are more likely to persist in the lung parenchyma, encouraging oxidative stress and inflammation. They can also more easily enter the acinar portion of the respiratory tract (Chen et al., 2017). According to a study by Yen et al. (2020) that examined PM1 levels in 65 Chinese cities, an individual's

risk of heart disease increased by 0.29 percent for every increase in PM1 of 10 $\mu\text{g}/\text{m}^3$. Researchers concluded that every 10 $\mu\text{g}/\text{m}^3$ rise in PM1 increased the risk of high blood pressure in children by 61%, particularly in those under 11 and those who were overweight or obese (Wu et al., 2020). All the recreational places of the Pabna, Rajshahi, Shirajgong and Natore districts' PM 2.5 exceeded the Bangladesh standard of 65 $\mu\text{g}/\text{m}^3$ (Hossen & Hoque, 2018). PM 10 was higher in Pabna district than Rajshahi district, which also exceeded the Bangladesh standard of 150 $\mu\text{g}/\text{m}^3$ (Hossen & Hoque, 2018). It was seen from Figure 4 that Natore district recreational place has the highest formaldehyde. However, the value of formaldehyde in all districts was within the standard limit (Health Canada, 2021). It was seen from Figure 5 that Natore district recreational place has the highest TVOC. However, the value of TVOC in all districts was within the standard limit (How TVOC affects indoor air quality, 2022).

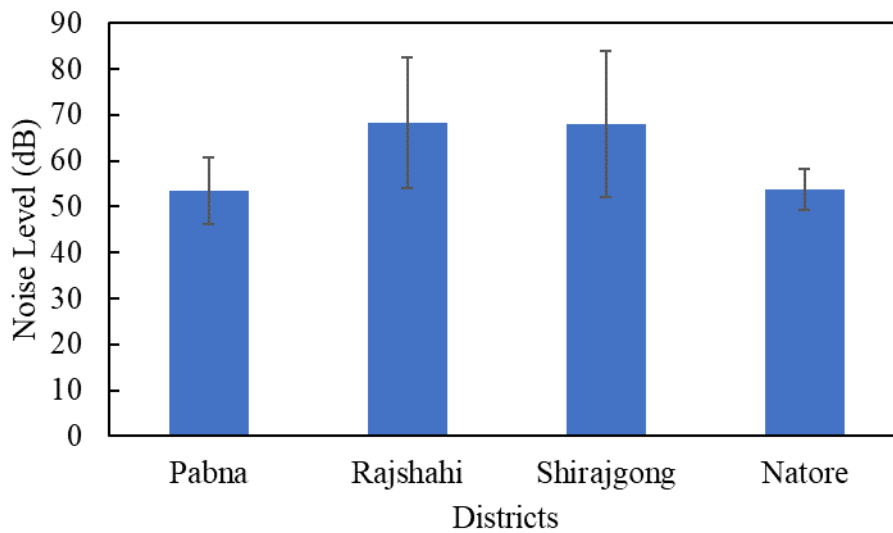


Figure 2. Noise level at selected districts' recreational places

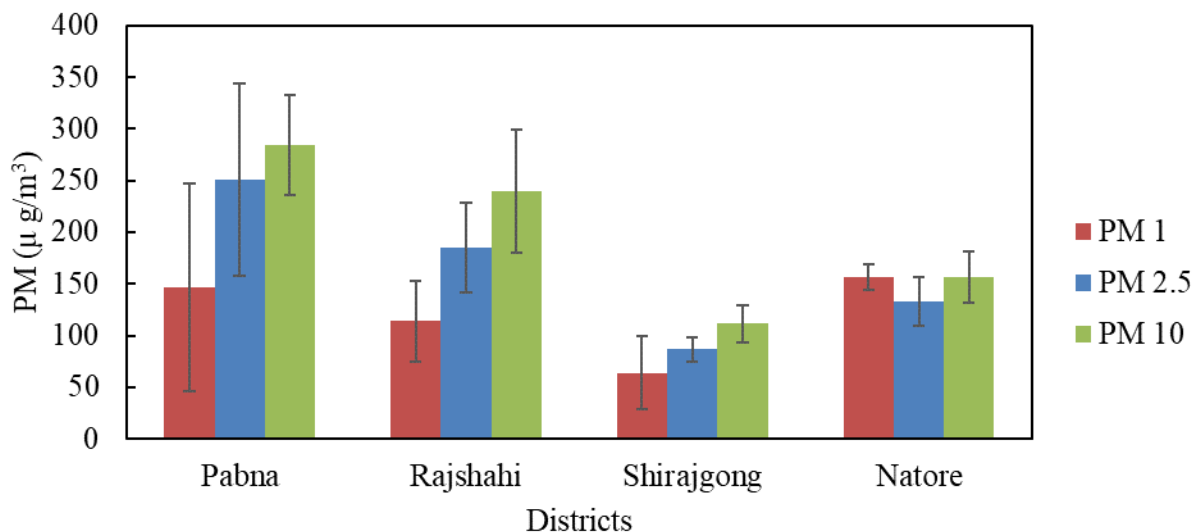


Figure 3. Particulate matters concentration at selected districts' recreational places

4 Conclusion

From the above discussion, it could be concluded that all the recreational places of Pabna, Rajshahi, Shirajgong, and Natore were highly polluted by noise and PM 2.5, which may lead to loss of attention, sleep disturbance, and cardiovascular mortality. Rajshahi and Natore districts were found to be polluted by PM 10. Immediate action needs to be taken to protect recreational places so that users can relax in recreational places safely.

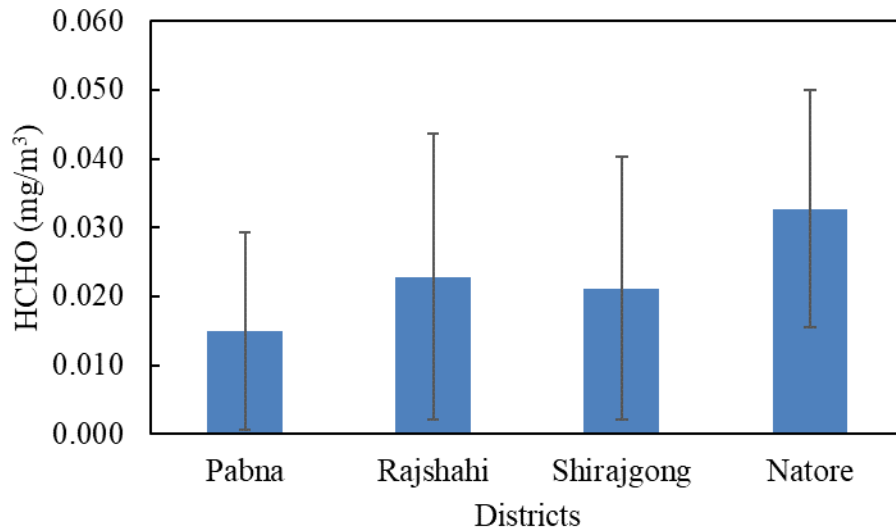


Figure 4. Formaldehyde concentration at selected districts' recreational places

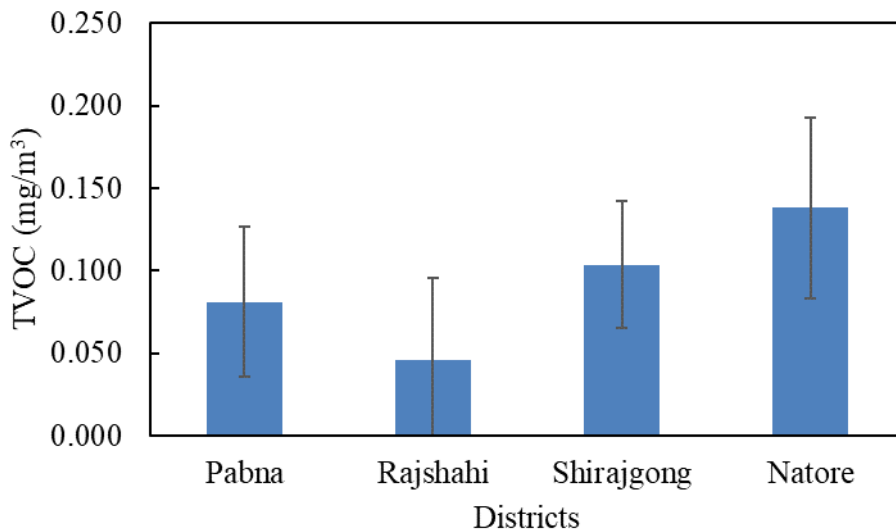


Figure 5. Total volatile organic compounds concentration at selected districts' recreational places

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