THE STATUS OF NOISE POLLUTION OF SUST CAMPUS, SYLHET, BANGLADESH: A GIS-BASED NOISE MAPPING

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Abstract

This study investigates the status of noise pollution at Shahjalal University of Science and Technology (SUST) campus in Sylhet, Bangladesh, employing a GIS-based approach to map and analyze noise levels across different areas of the campus. The research was motivated by the growing concern over environmental noise as a public health issue, particularly in educational settings, where it can significantly impact the well-being and academic performance of students and staff. Utilizing digital sound level meters and GIS technology, noise levels were measured at ten major locations within the campus on both working and non-working days. The findings reveal that noise levels exceeded the permissible limits set by the Department of Environment (DoE) for Bangladesh in several campus areas, particularly in commercial and mixed-use zones. This indicates substantial environmental stressors that could adversely affect the campus community. The study highlights the utility of GIS technology in identifying noise hotspots and suggests the need for targeted interventions to mitigate noise pollution, such as the implementation of noise-reducing infrastructure and the regulation of noise sources. It contributes to the broader discourse on environmental quality in educational settings and underscores the importance of integrating environmental health considerations into campus planning and management practices.

Introduction

Noise pollution means the unpleasant loud sounds that exceed the permissible limits and adversely affect human health(Sojib et al., 2021) . But this pollution is often considered as overlooked though the consequences are severe for living organisms. The initiation of this pollution mainly started from the mid of the last century due to speedy urbanization. This urbanization acts as an environmental stressor with a high degree of exposers such as noise and air pollution (Sojib et al., 2021).

Noise is a pleasantly and momentarily undesired sound that causes aggravation, interferes with dialogue, and disrupts sleep and the teaching learning process (Gour, 2013). The Department of Environment (DoE) of Bangladesh recommended a verge of the admissible noise level for different decibel (dB) units, which is thoroughly known as Noise pollution (Control) Rules, 2006. The admissible verge limits for Sensitive areas, residential areas, mixed areas, commercial areas and industrial areas are 45 dB, 50 dB, 60 dB, 70 dB, and 75 dB (DoE, 2006).

1.1 Background of the study

The exploration of noise pollution within the context of educational campuses has gained significant attention, acknowledging its potential impact on academic performance, concentration, and overall well-being of students and staff. Shahjalal University of Science and Technology (SUST), being one of the leading institutions in Bangladesh, provides a unique case for studying noise pollution due to its urban location and the rapid urbanization of surrounding areas. Although specific studies directly focusing on noise pollution within SUST are limited, the broader literature on urban noise pollution and its effects on educational environments offers a pertinent backdrop.

Research in various geographic contexts has consistently highlighted that elevated noise levels in and around educational institutions can adversely affect learning by disrupting concentration, increasing stress, and impairing memory (Clark & Stansfeld, 2007; Shield & Dockrell, 2008). These findings suggest a pressing need for investigating the noise environment at SUST to assess its impact on the academic community.

Moreover, studies conducted in similar contexts within Bangladesh, such as those by Hasan, Miah, and Hasan (Sojib.,2023) on traffic noise pollution in urban areas, provide a foundational understanding of the sources and scales of noise pollution that might be mirrored in the SUST campus environment. The emphasis on traffic as a primary noise source in urban Bangladeshi contexts is

particularly relevant to SUST, considering the university's accessibility to main roads and the resultant exposure to traffic noise.

Given the established body of knowledge surrounding the implications of noise pollution on health and cognitive functions (Basner et al., 2014; Clark & Stansfeld, 2007; Shield & Dockrell, 2008), coupled with the specific urban dynamics of Sylhet, the study of noise pollution in the SUST campus is both timely and necessary. It not only contributes to the global discourse on the environmental quality of educational settings but also addresses a significant gap in the local context of Bangladesh, where empirical data on noise pollution in university campuses remain sparse.

1.2 Rationale

The rationale for investigating noise pollution within the Shahjalal University of Science and Technology (SUST) campus is underpinned by the growing recognition of environmental noise as a significant public health issue, particularly in educational settings. Noise pollution, characterized by unwanted or harmful outdoor sound created by human activities, has been linked to a range of adverse health effects, including stress, sleep disturbance, and cardiovascular disease, as well as negative impacts on academic performance, concentration, and learning outcomes (Basner et al., 2014; Clark & Stansfeld, 2007).

Given SUST's urban location and the associated challenges of urban noise from construction, academic and various campus activities, there is a pressing need to assess the acoustic environment on campus to identify potential risks and areas for intervention. The campus serves as an ideal setting for such a study due to its dynamic population of students, faculty, and staff, who are potentially exposed to varying levels of noise pollution across different times and locations within the university grounds.

1.3 Aim and objective of the study

The aim of the study is to find out the status of noise pollution of SUST campus and the specific objectives are-

- To Measure Noise Levels.
- To utilize GIS technology for the creation of a detailed noise map of the SUST campus.
- To Determine the Sources of Noise Pollution.

Literature Review

In addressing the pervasive issue of noise pollution across various regions in Bangladesh, a comprehensive literature survey reveals a concerted effort by researchers to map, assess, and understand the impacts and dynamics of noise pollution within urban and semi-urban settings. These studies, while diverse in geographic focus and methodological approach, collectively underscore the rising concern of noise pollution as an environmental and public health issue in Bangladesh.

The study by (Hasan et al., 2023a) on traffic noise pollution in Jamalpur Sadar, Mymensingh, presents a detailed assessment, identifying significant levels of noise pollution and advocating for strategic interventions to mitigate its adverse effects on the local population. Similarly, (Hoque et al., 2013) provide an early examination of noise pollution at different locations in the Tangail Municipal Area, establishing a baseline for understanding the spatial variations and potential health implications of urban noise pollution.

In the capital city of Dhaka, (Hoque & Kabir, n.d.) focus on traffic-induced noise levels, highlighting the critical role of vehicular traffic in exacerbating urban noise levels. This finding is echoed in the work of (Manirul Islam et al., 2012) who employ a GIS approach to delineate the status of noise pollution in mixed areas of Dhaka City, revealing the intersection of urban planning and noise pollution management.

Expanding the geographic scope of research, (Hossain, n.d.) explores the noise pollution status in Naogaon using GIS and statistical methods, while (Kumar Das et al., 2018) and (Mahmud & Basak, 2019) assess noise levels in Magura Municipality and Sylhet City Corporation, respectively. These studies not only quantify noise levels but also emphasize the need for comprehensive urban noise management strategies.

The innovative work of (Puyana-Romero et al., 2020) introduces a 3D GIS tool for detecting noise hot-spots from major roads, offering a novel approach to identifying and addressing critical areas of noise pollution. This technological advancement is complemented by the GIS-based noise mapping efforts of (Hasan et al., 2023b) in Mymensingh City and (RAHMAN & BIN Alam, 2022) in Sylhet City Corporation, which provide detailed spatial analyses of noise pollution, enhancing the ability to target interventions effectively.

(Sultana et al., 2020) investigate the status of noise pollution at major traffic intersections in Khulna Metropolitan City, shedding light on the potential effects of noise exposure on people, a crucial aspect of public health research in the context of urban environmental hazards.

Collectively, these studies reveal a common set of findings and problems associated with noise pollution in Bangladesh: the significant impact of traffic on urban noise levels, the need for improved urban planning and policy interventions to manage noise pollution, and the importance of employing advanced technological tools for effective noise pollution assessment and mitigation. The consistent identification of high noise levels across various urban settings indicates a widespread environmental health issue, necessitating concerted efforts for mitigation and management to safeguard public health and enhance the quality of urban life in Bangladesh.

Methodology

3.1 Study Area

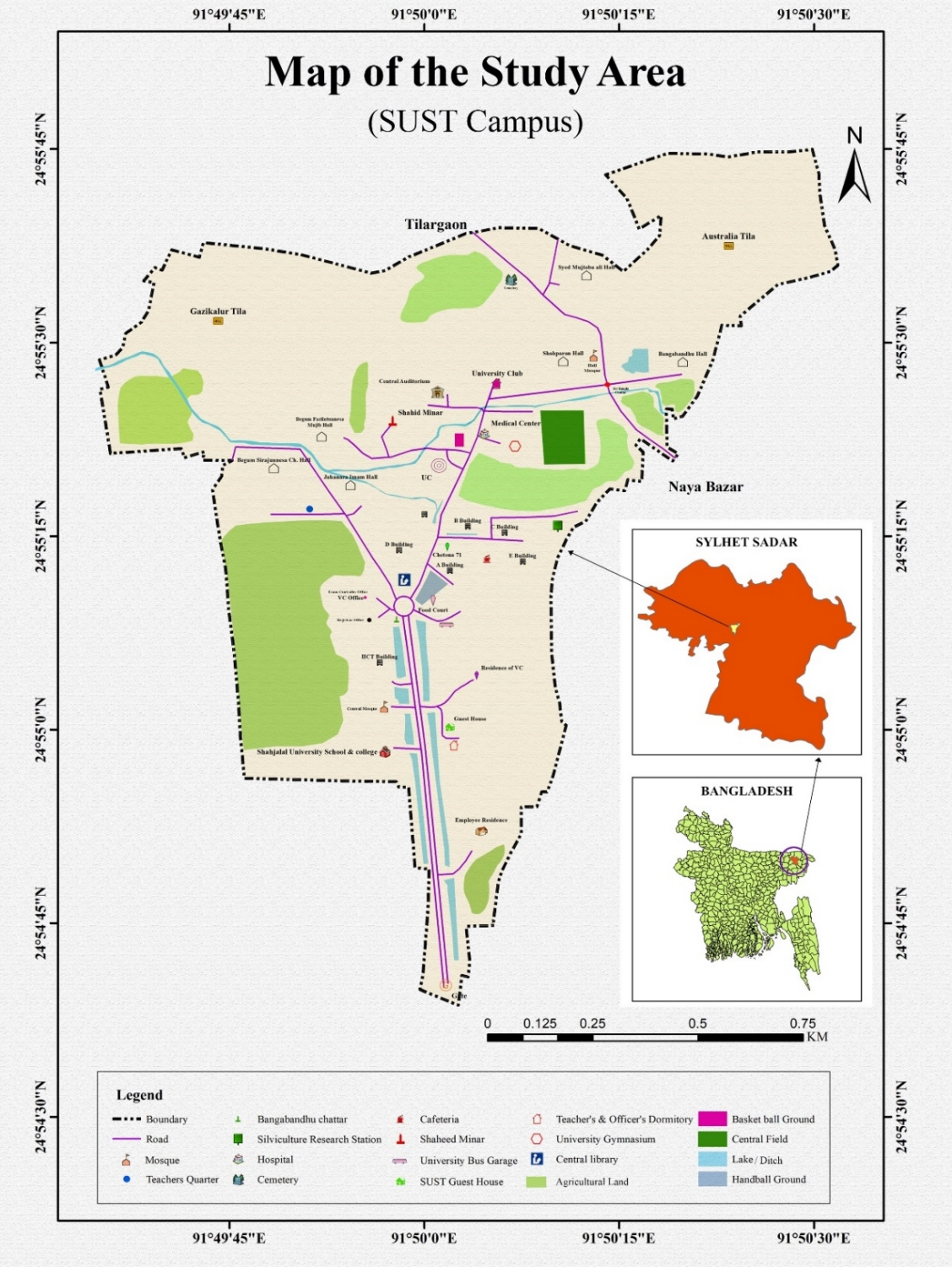

Figure 1: *Map of the Study Area*

Shahjalal University of Science and Technology, commonly known as SUST, is a public research university located in Kumargaon, Sylhet, Bangladesh. Established in 1986, it is one of the leading universities in pioneering research and education in the physical sciences and engineering in the country. Shahjalal University of Science and Technology's mission is to be a leading university of excellence in science and technology with a strong national commitment and international impact. The university operates from a 320-hectare campus located approximately four miles from Sylhet city centre.

3.2 Sampling Locations

Noise levels were determined in 10 major places of SUST campus. We were take two different day's data, On day and Off day.

Table 1: *Sampling Location*

Study point	Name	Latitude	Longitude
1	Foodcourt	24.9231013	91.83255
2	Gol Chattar	24.9192333	91.83181
3	2nd Ladies Hall	24.9228205	91.82939
4	UC	24.9224911	91.83259
5	Central Field	24.9231013	91.83461
6	1st Hall Mosque	24.9247317	91.83581
7	E Boulding tong	24.9208142	91.83429
8	Arjuntola	24.9202075	91.83215
9	university school	24.9163386	91.83121
10	Varsity Gate	24.9115165	91.8323

3.3 Instruments Used

i. **Sound level meter:** A sound meter is an instrument that measures sound pressure levels. Levels of noise intensity were measured by digital sound level meter 'Lutron SL-4033SD'. Measurement range of 30 to 130 dB(A) figure 2 with an accuracy of ±1.5 dB (A and C) and resolution 0.1 dB. It is mainly used in noise pollution studies for the measurement of different kinds of sound levels, especially for industrial, environmental, and commercial.

ii. **GPS:** Utilizing the "MGRS UTM GPS" android application, coordinates for each site where noise levels were measured were acquired.

iii. **ArcGIS Pro:** ArcGIS Pro 3.2.2 software was employed in this research to conduct spatial analysis within the boundaries of SUST Campus. The software applied the Inverse Distance Weighting (IDW) interpolation technique for the analysis. By utilizing available data within the specified area, the software extrapolates values for locations without recorded measurements.

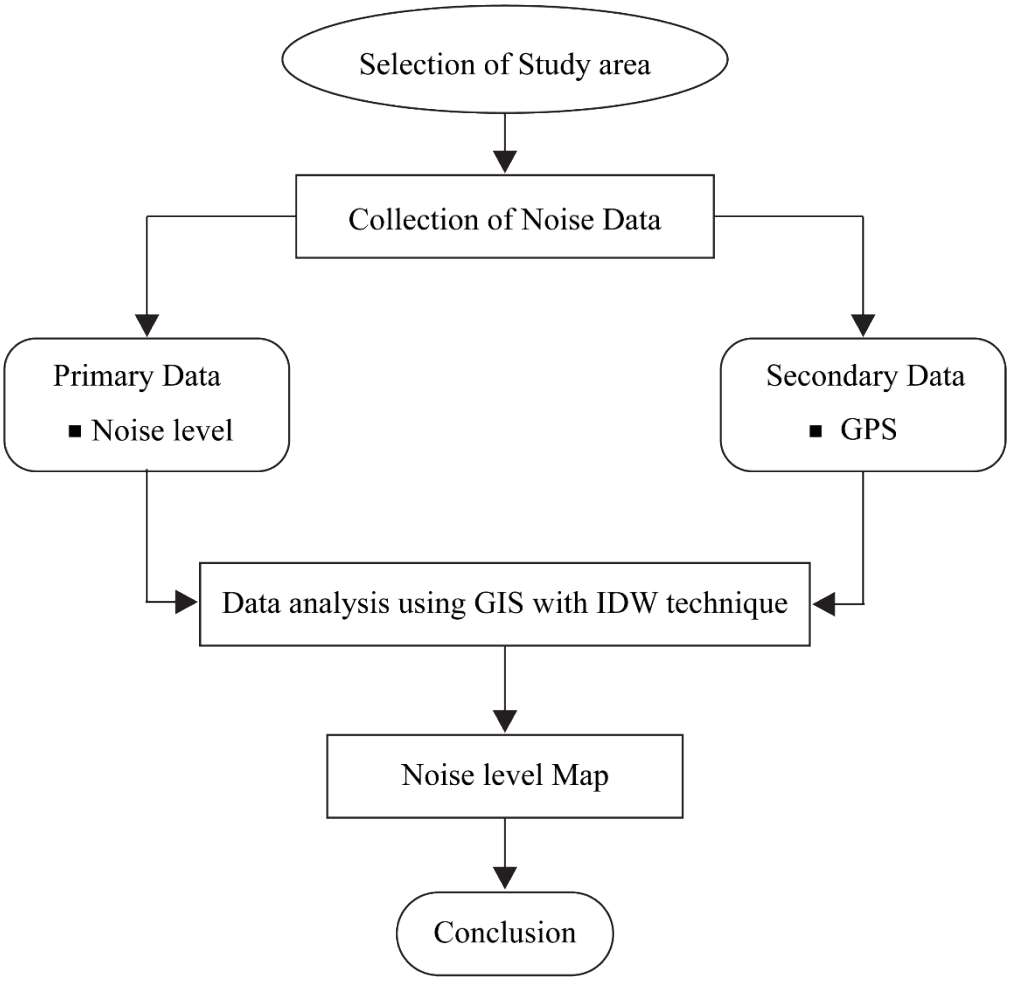

***Figure 2**: Methodology of the Study*

Result and Discussion

Table 2: *Noise levels (dB) at different locations of SUST Campus*

Sl. No	Location Name	On Day (dBA)			Off Day (dBA)			Category of the Area	Noise level Standard (Day) [(WHO 2002), And (DoE 1997)]
		Max	Min	Avg	Max	Min	Avg		
1	New Foodcourt	84.2	68.9	76.6	80.9	50.1	65.5	Commercial	75
2	Gol Chattar	79.8	54	66.9	72.2	53.8	63	Mixed	60
3	2nd Ladies Hall	77.3	51.8	64.6	75.9	49.8	62.9	Residential	50
4	UC	67.5	49.3	58.4	67.1	51	59.1	Mixed	60
5	Central Field	74.3	48.4	61.4	79.1	44	61.6	Mixed	60
6	1st Hall Mosque	67.3	45.9	56.6	65.0	60.7	62.9	Silence Area	45
7	E Boulding tong	91.5	69.9	80.7	61.3	56.6	59.0	Commercial	75
8	Arjuntola	77.3	65.2	71.3	68	50.7	59.4	Mixed	60
9	University school	78.4	63.4	70.9	71.9	47.3	59.6	Mixed	60
10	Varsity Gate	82.2	61.4	71.8	80.3	60.9	70.6	Mixed	60

[Note: DoE = Department of Environment (Bangladesh), W.H.O = World Health Organization]

The analyses of 10 stations of different locations are presented in Table 2. This study found that the high noise level occurs during On day at Food Court area. From Table-2, the highest (91.5 dB) level of sound was observed from the E Boulding tong in On day (working day). In Off day, it was also observed that this low level of noise pollution. The lowest average noise level (56.6 dB) was found in off day at the 1st Hall Mosque.

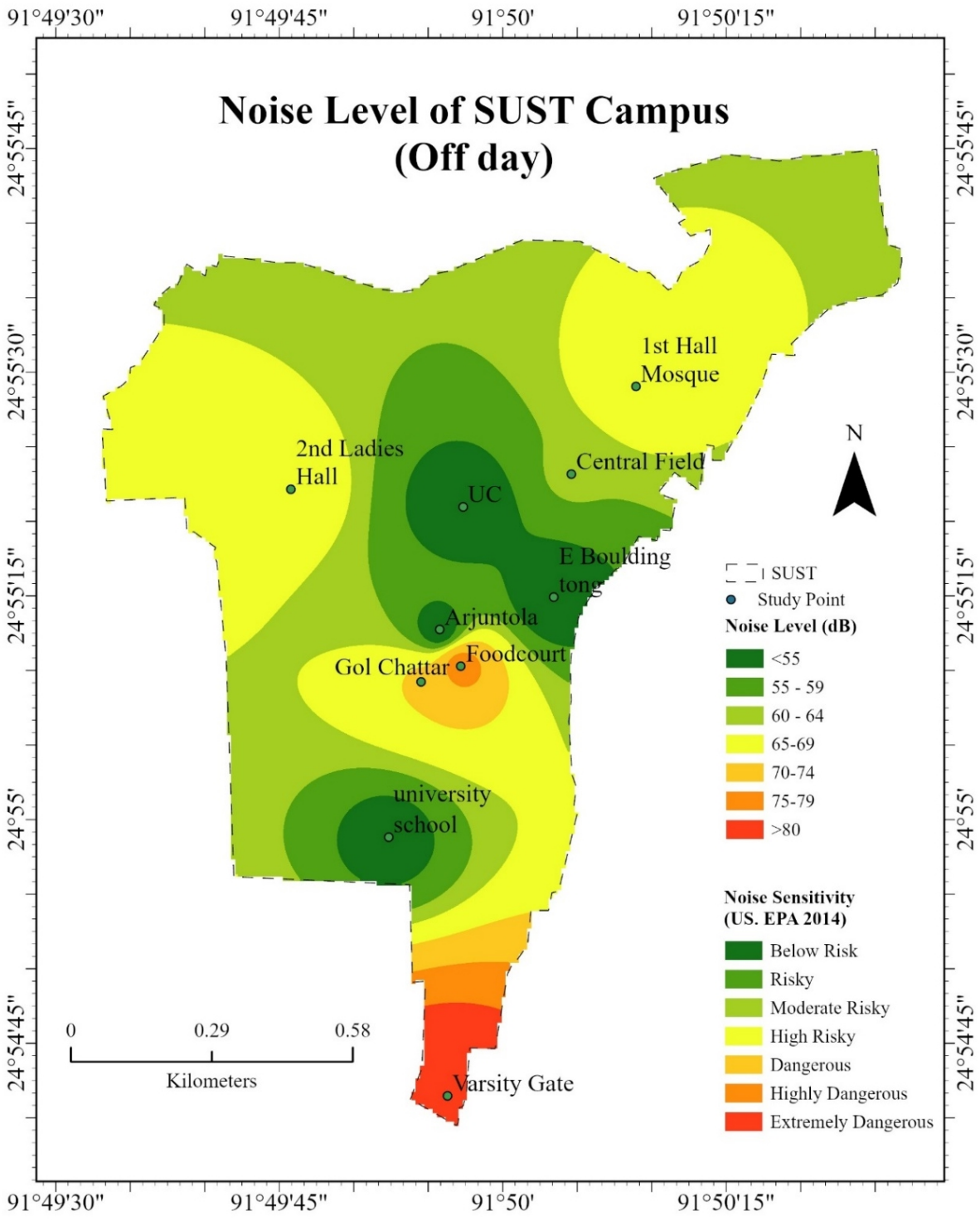

Figure 3: *Spatial Noise Mapping in the Off Day in SUST Campus*

Figure 3 shows that the highest average noise level (70.6) was found in the off day near varsity gate and the lowest average noise level (59.0) was found in the off day near E build Tong area. Generally, the noise level is low in all areas of the campus due to holidays. The tongs, where students usually hang out, are also closed.

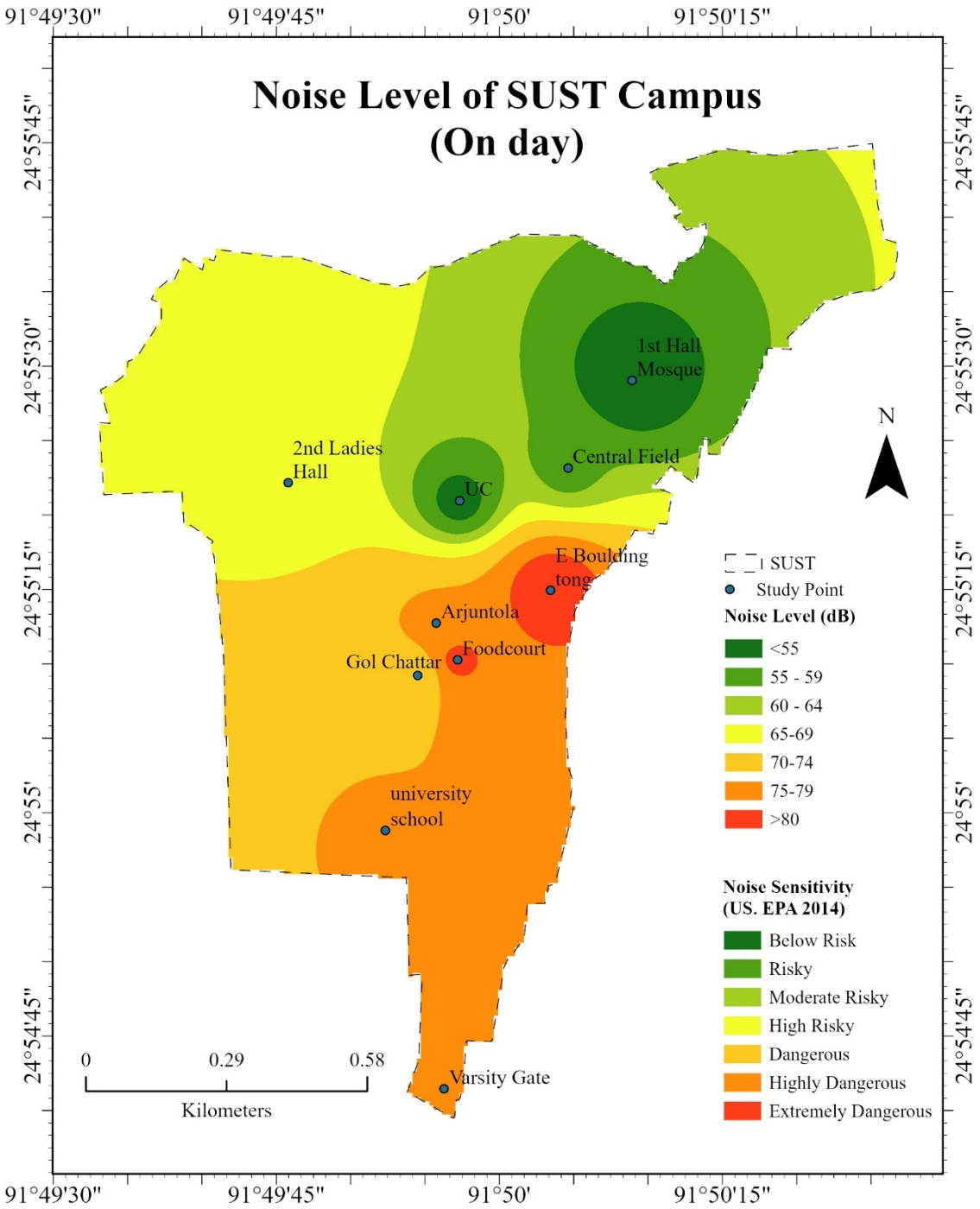

Figure 4: *Spatial Noise Mapping in the On Day in SUST Campus*

Figure 4 shows that the highest average noise level (80.7) was found in the on day near E Boulding tong area and the lowest average noise level (56.6) was found in the off day near 1st Hall (Shahporan) Mosque.

The obtained Spatial Analytic Maps showed that SUST Campus's noise level is higher than the guideline values in on day, almost ideal noise level with the guideline value in off day. The maps showed the intense noise-affected areas in Shahjalal University of Science and Technology Campus.

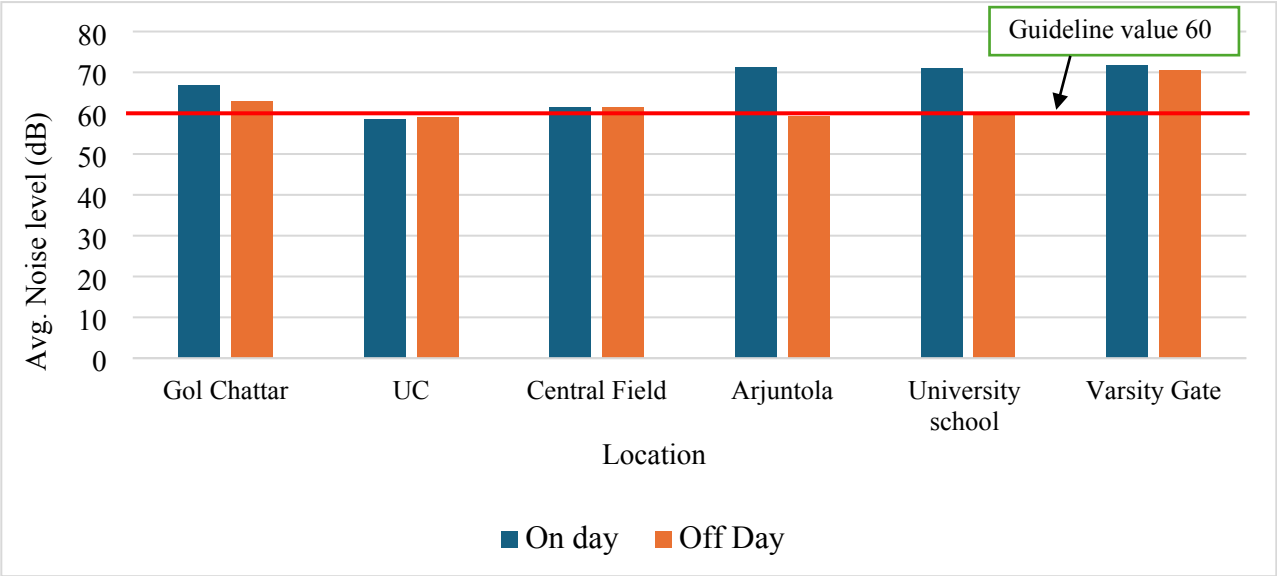

Figure 5: *Variations of noise levels with time in Mixed areas*

Figure 5 shows a variation of noise levels with time at Mixed areas of SUST Campus. The highest average noise level was found at Varsity Gate in the on day about 71.8 dB and the lowest noise level was found at University Center in the On day about 58.4 where the guideline value for sensitive areas should not exceed 60 dB.

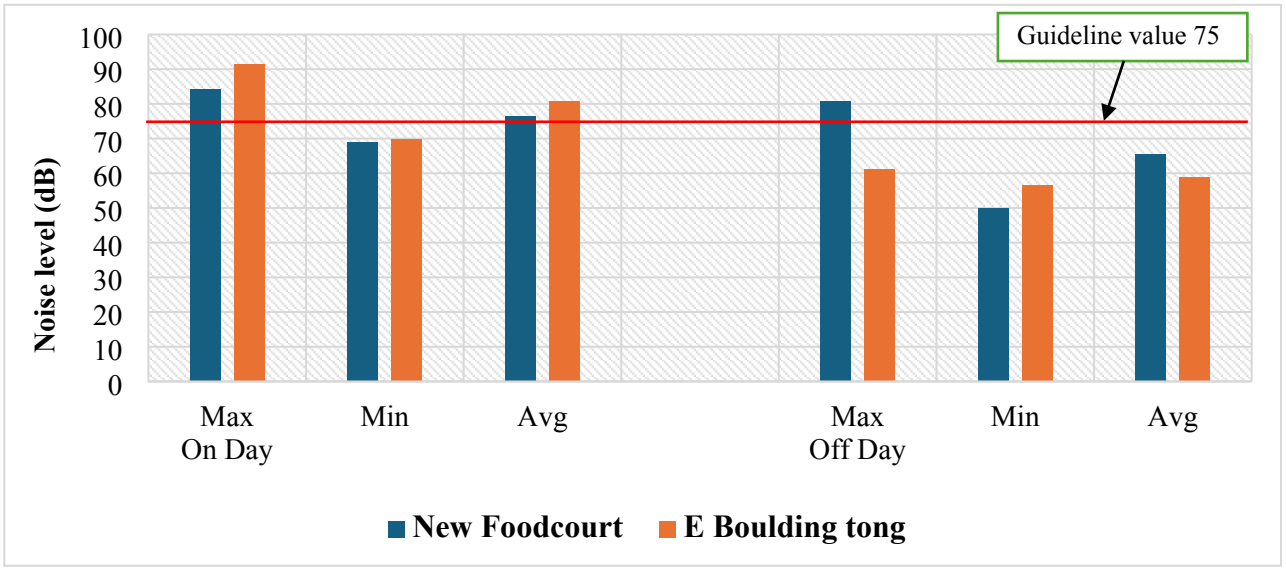

Figure 6: *Variations of noise levels with time in Commercial Area*

Figure 6 shows the variation of noise levels with time at Commercial area of SUST Campus. The highest noise level was found at E Building Tong in the on day about 91.5 dB and highest average noise level was 80.7 dB. The lowest noise level was found at New foodcourt area in the off day about 50.1 dB and lowest average noise level was 58.95 dB, where the guideline value is 75 dB.

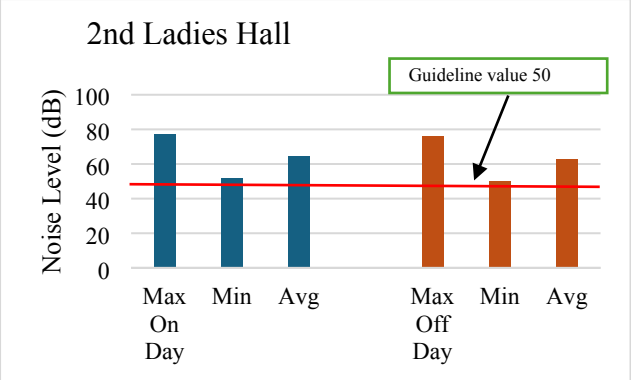

Figure 7(a): *Variations of noise levels with time in Residential Area*

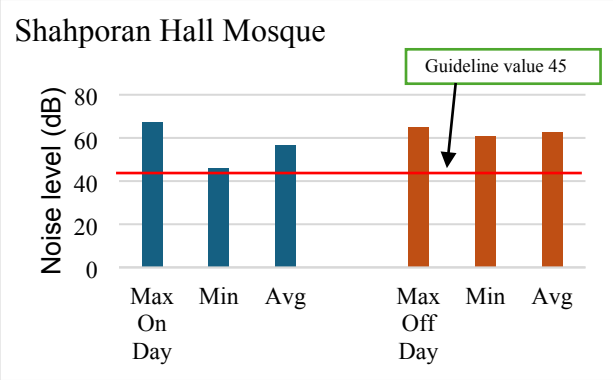

Figure 7(b): *Variations of noise levels with time in Silence Area*

Figure 7(a) shows the variation of noise levels with time at Residential of SUST Campus. The highest noise level was found at 1st ladies hall in the on day about 77.3 dB and lowest noise level was about 49.8 dB in off day, where the guideline value is 50 dB.

Figure 7(b) shows the variation of noise levels with time at Silence of SUST Campus. The highest noise level was found at 1st Hall Mosque area in the on day about 67.3 dB and lowest noise level was about 45.8 dB, where the guideline value is 45 dB.

Conclusion

In this study, we explored the issue of noise pollution within the Shahjalal University of Science and Technology (SUST) campus in Sylhet, Bangladesh, employing a GIS-based noise mapping approach to quantify and analyze the spatial distribution of noise levels across different campus locations. Our findings revealed that noise levels exceeded the permissible limits set by the Department of Environment (DoE) for Bangladesh in several areas of the campus, particularly in commercial and mixed-use areas, indicating significant environmental stressors that could potentially affect the well-being and academic performance of students and staff.

The study demonstrated the utility of GIS technology in identifying noise hotspots, with the highest average noise levels recorded near the E Building tong area on working days, and significant variations in noise levels observed between working and off days across the campus. This spatial and temporal variability underscores the complex nature of noise pollution within urban educational environments, influenced by a range of factors including traffic, construction activities, and campus events.

Our research contributes to the broader discourse on environmental quality in educational settings, offering insights into the specific challenges faced by urban campuses in developing countries like Bangladesh. The findings highlight the need for targeted interventions to mitigate noise pollution at SUST, such as the implementation of noise-reducing infrastructure, the planning of quiet zones, and the regulation of noise sources, to ensure a conducive learning and teaching environment.

This study also underscores the importance of integrating environmental health considerations into campus planning and management practices, advocating for a holistic approach to environmental stewardship in educational institutions. By addressing noise pollution, SUST can enhance the quality of campus life, promote the well-being of its community, and set a precedent for sustainable campus management practices in Bangladesh and beyond.

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