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## **Investigation of Noise Pollution in the Sultan Qaboos University, Muscat**

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### **ABSTRACT**

Noise pollution has been well-recognized as one of the major concerns that can adversely affect public health and quality-of-life in urban areas across the globe. Special care should be taken to prevent noise pollution especially in areas which are sensitive to noise such as educational institutions. The aim of this study is to investigate the presence of noise pollution inside the Sultan Qaboos University (SQU) campus - Muscat. Accordingly, an investigation was carried out using the different field technique within the area of study. Nine different locations were selected for determining the noise levels during this study; outside, the internal streets, and inside several buildings of the SQU campus. A social survey on campus inhabitation response to noise pollution was carried out around SQU. Furthermore, Noise measurements were taken using a sound level meter to assess noise levels of noise pollution level in the University. Results of this research were statistically analyzed. The results of noise measurement also obtained and shows that Levels of noise outside the buildings of the SQU campus were higher than those inside the campus were at all periods; also the highest level of noise was recorded during the studying period.

**Keywords:** Noise, Environment, Inhabitants

**I-INCE Classification of Subject Number:** 50

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## **1. INTRODUCTION**

Community noise is one of the most common pollutants. Noise pollution and its effect on human health and his welfare is recently considered as an important and vital issue which encourages scientists to conduct more researches concerning assessment of its levels and harmful effects.[1]

It is defined by the WHO as noise emitted from all activities in the community, except the industrial sectors. Examples of these activities include road, rail and air traffic, educational, construction and public works, recreational and the neighborhood [2]. In recent times, the environmental noise pollution has been recognized as one of the major environmental factors that adversely affects the quality-of-life in all countries of the world, particularly the urban areas.

Noise pollution is among many environmental problems in close proximity to school campuses.

However, with the increase in the number of motor vehicles comes an increase in noise levels. The negative relationship between learning performance and noise levels in educational centers has been determined and noise pollution has been found to reduce learning capabilities [3].

In the learning context, noise affects the behavior and understanding of students, and very noisy places are unfavorable for learning and make teaching exhaustive [4]. High sound levels not only affect the verbal quality of communication but also contribute to serious problems in the intellectual development of students, such as impaired learning, writing and speaking difficulties, limitations in reading comprehension and development of vocabulary [5].

The present study measures the levels of noise level on the Sultan Qaboos University campus. In addition, community survey around the camps has been conducted. The study describes the characterization of noise pollution on a university campus by means of sound level measurements and interviews. The study concentrated at the teaching areas in the university, thus mitigating noise is the first concern with the students and staff psychophysiological wellbeing.

## **2. SITE INVESTIGATION**

This research was conducted in Sultan Qaboos University (SQU) located in Muscat City, capital of Oman. It lies near Muscat international Airport and is surrounded by residential and industrial areas. The residential campus of SQU is located at the North West side.

The built area of the University campus increased from about 1,200,000 m<sup>2</sup> in 1986 to about 3,000,000 m<sup>2</sup> in 2009, while the cost of the equipment used increased from 50 million to 100 million Omani Riyals (about \$129m to \$258m) [6].

The design and construction of the campus was carried out with great attention to the educational objectives, with the overall appearance of the buildings carefully planned to accommodate the physical, intellectual, and spiritual needs of students, faculty and staff. The University was constructed on an axis plan, this axis line starts at the gates of entrance to the University, runs through the Administration Building and extends uninterrupted through the middle of the academic buildings to the University Mosque and two other colleges at the western end of the campus (figure 1).

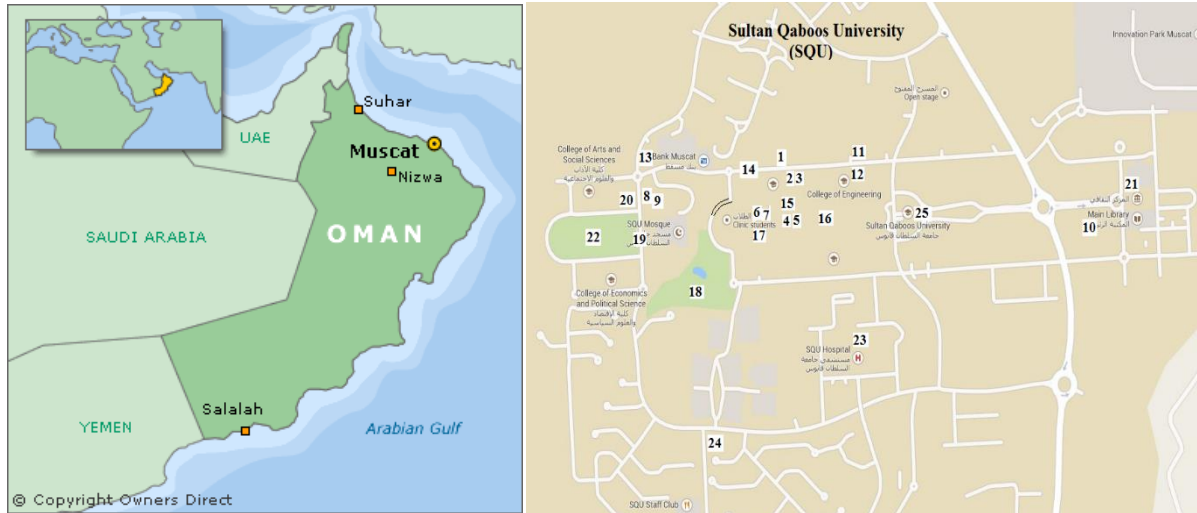
Student enrollment has grown from 500 in 1986 to more than 10,000 in 2005. More than half of the students live off campus due to space constraints. It currently has around 15,357 students of which 7,942 are female students and 7,415 are male students.

SQU campus receives daily more than 4000 cars for students, staff, employees and visitors. No previous studies have been conducted to investigate levels of noise pollution inside

universities campus in Oman. The main aim of this study is the assessment of noise pollution level inside the SQU campus. This study is considered as an initial and indicator for other similar universities in Oman.

### 3. METHODOLOGY

The classification of environmental noise inside the campus of SQU was subdivided into two distinct parts: a subjective part (Social Survey), which consisted of assessing the sound perception of the population that frequents the university campus; and an objective part (Noise Measurement), which involved sound pressure level measurements and noise mapping.



*Figure 1 Map of Muscat city (Oman) and identifying the location of the 25 noise measurement points in the study area*

#### 3.1 Social Survey

The social survey (subjective part) of this study required the preparation of a questionnaire about noise perception, which was applied to the four main categories of people in the study area, i.e., the students, academic staff, administrative and other SQU populations [table 2].

In order to describe sampling error for the current study; the calculation of the necessary sample size is prepared. In the present study, the acceptable sampling error was set at 5%. Based on the universe of 55611 inhabitants (Table 2), the necessary size of the sample was determined to be 852 people[8]. The questions in the questionnaire are aimed at obtaining demographic and behavioral data, and information about sound perception on campus. After the questionnaires were filled out, the results were tabulated and analyzed. The ethical considerations necessary to satisfy the respondents were observed and they were ensured that their views will be kept confidential.

*Table 1 Statistical Highlights of the Sultan Qaboos University Hospital[7]*

Category	#
<b>Sultan Qaboos University</b>	
Postgraduate Diploma	120
Undergraduates	16125
Postgraduates (Masters)	1347
Postgraduates (Doctorate)	198
Teaching staff	1905
Administrative Staff	1499
<b>Sultan Qaboos University Hospital</b>	
Medical Doctor	468
Nursing Staff	1285
Technical Staff	569
Administrative Staff	659
Total Number of In-Patients	31436
Total population	55611

### 3.2 Noise Measurements

Within the scope of the study period, noise measurements were conducted at 25 different sites along the main axes where faculties are located.

Two principles were considered when the measurement sites are selected.

1. The selection of the sites close to the service buildings for educational purposes;
2. select the sites where the movement of vehicles is existed,

Two of locations were selected for measuring noise levels during this study;

- a) External Measurements: outside walls (SQU Buildings), the internal streets (campus roads); including all main streets, such as the main gate, and some of the branched streets.
- b) Internal Measurements: inside several SQU buildings including educational (such as college buildings), administrative (such as the main administrative building of the campus) and services buildings (such as library and lecture theater).

Levels of noise intensity were measured by the EXTECH HD600 device, Sound Level Meter (SLM). This SLM meets ANSI and IEC 61672-1 Type 2 standards. It has three measuring ranges from 30 to 130 dB with 1.4 dB accuracy. Furthermore, it can capture up to 10 readings/sec when connected to a PC.

The noise measurement taken during this study were obtained during a period of the year that has historically represented an average of the annual weather condition. Noise measurements were conducted at 25 sites from February, 2018 through April, 2018 during the following time :

- Morning at time interval from 7:30 AM to 8:00 Am.
- Afternoon at time interval from 1:00 PM to 2:00 PM.
- Evening at time interval from 6:00 PM to 8:00 PM.

At each selected location, the instrument was operated continuously for 1 min as a start-up time. The device was controlled to take one measurement every 10 seconds, and for a continuous measuring 2 times at each location for a period of 3 min during which several

readings of noise were automatically recorded and saved. At the end of this period, the lowest and highest levels in addition to the weighted value (LAeq) were considered as the net results.

The sound level meter had a microphone, and was positioned on a tripod. The noise measurements were 'A' weighted (to equate to human ear hearing) and the time-weighting 'Fast' was applied. The sound level meter was calibrated in-house prior to and subsequent to monitoring. The 25 selected sites are shown in table 2.

*Table 2 Site locations of Noise Measurement*

#	Location
<b>Internal</b>	
1	College of Sciences: Corridors
2	College of Sciences: Computer labs
3	College of Sciences: Chemical labs
4	Classrooms corridors block (A)
5	Classrooms at Block (A)
6	Conference Hall
7	Exhibition Hall
8	Classrooms at Block ( E )
9	Block (E) Corridors
10	Inside the main Library
11	Civil Engineering Construction lab
12	Civil Engineering Computer lab
13	Student Service area
<b>External</b>	
14	At the road opposite to the College of Sciences
15	At the road opposite to the Block (A)
16	Road opposite to the Building C
17	Out of Conference Hall
18	Botanic garden
19	At the road between the Mosque and the College of Commerce
20	Around Block ( E )
21	Around the Cultural Center
22	Al Andalus Garden
23	Around the SQU Hospital
24	SQU Residential Area
25	Main Entrance

#### **4. RESULTS AND DISCUSSION**

The campus of Sultan Qaboos University is locating near of many sources of noise such as high levels of traffic, aircraft noise and others.

The results showed in this study that noise in educational institutions has a negative impact on learning and academic achievement of inhabitants in the university.

## 4.1 Social Survey

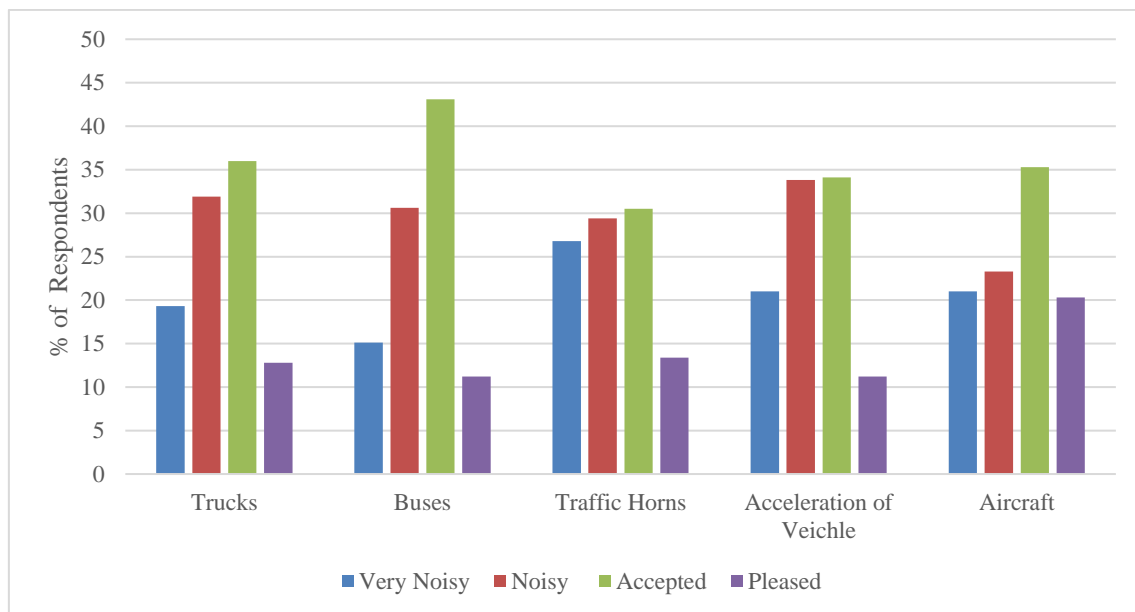
The questionnaire was prepared using google form and the SQU inhabitants were invited to respond through the university mail. The responses were received through a period of 2 weeks during the fall semester'17. 41.6% respondents were males and 58.4% were females. Moreover, 73.5% of respondents were students, 25.9% were Employees and 0.6% were other residents/users in the university campus. Most of the respondents (86%) belong to the 23-year-old age and above group. Among these, 73% are representing undergraduate students, while others, corresponding to SQU employers.

The analysis of the responses were classified into 3 categories interm of noise assessment:

- 1) external noise.
- 2) internal noise.
- 3) some other sounds.

### 4.1.1 External Noise

The respondents were asked if they were concerned by the noise caused on the SQU campus. The respondents were given a list of outside noise sources in SQU compus. The responses obtained were that (26.8%) were categorized the traffic horns as the noisiest sound, followed by the aircraft noise and cars accelerations (21%). Furthermore, figure 2 shows the noise categorization that waere given to the SQU inhabitants to evaluate the noise inside their compus [ V. Noisy, Noisy, Accepted and Pleased ].



*Figure 2 Respondents assessment of external sounds*

### 4.1.2 Internal Noise

The respondents were also given a list of inside buildings noise sources in SQU compus. Figure 3 shows the responses obtained were that (49.8%) were categorized the Laboratory Machines as the noisiest sound, followed by the maintenance, cleaning hoover and air conditioning with 36.8% , 11.4%, 10.8% respectively.

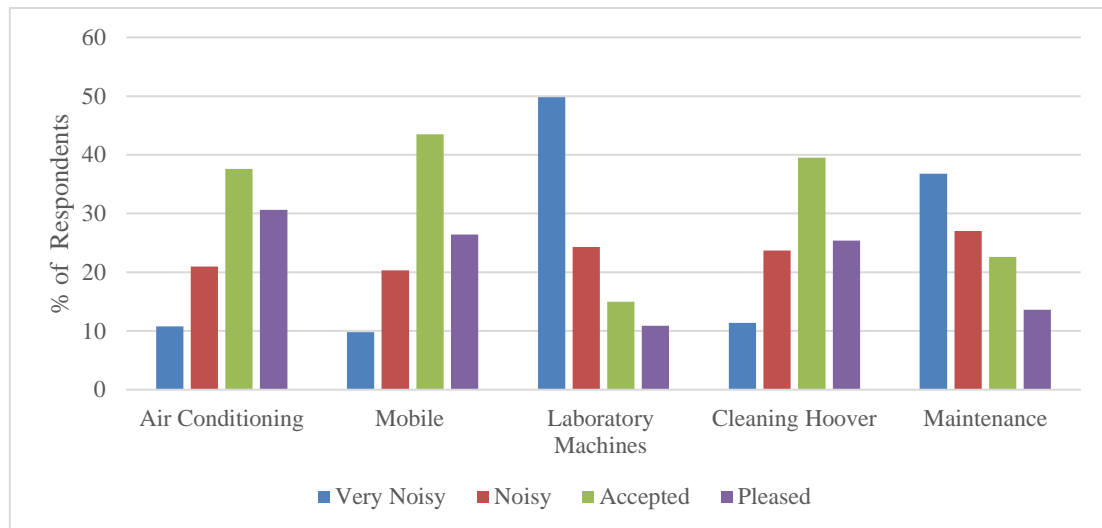


Figure 3 Respondents assessment of internal sounds

#### 4.1.3 Some other sounds

The results show in figure 4 that 23.2% and 18.6% of the respondents classified the noise of construction Works and chatting respectively as the noisiest. Twittering of birds and sound of trees with percentage of 76% and 66.5% and 11.1% respectively were considered as a please sounds.

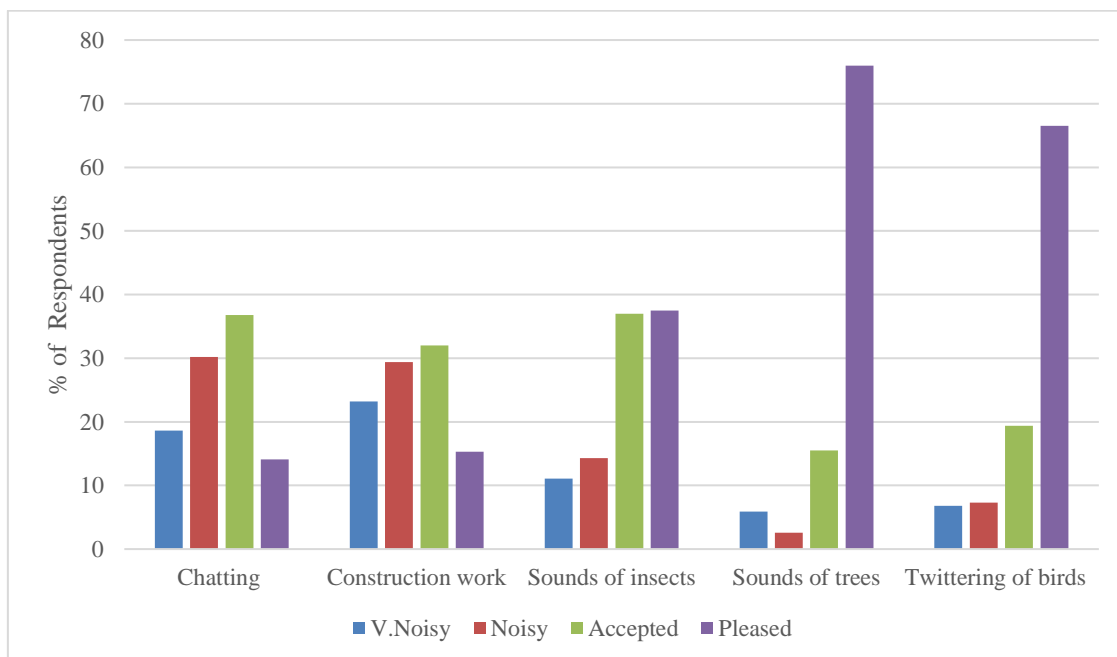


Figure 4 Respondents assessment of other sources of noise

#### 4.2 Noise Measurements

WHO recommended equivalent sound level  $Leq = 55$  dB(A) for urban educational institutes, i.e., areas encompassing universities and schools [9]. According to that recommendation, the results of the noise measurements in SQU were taken and analyzed.

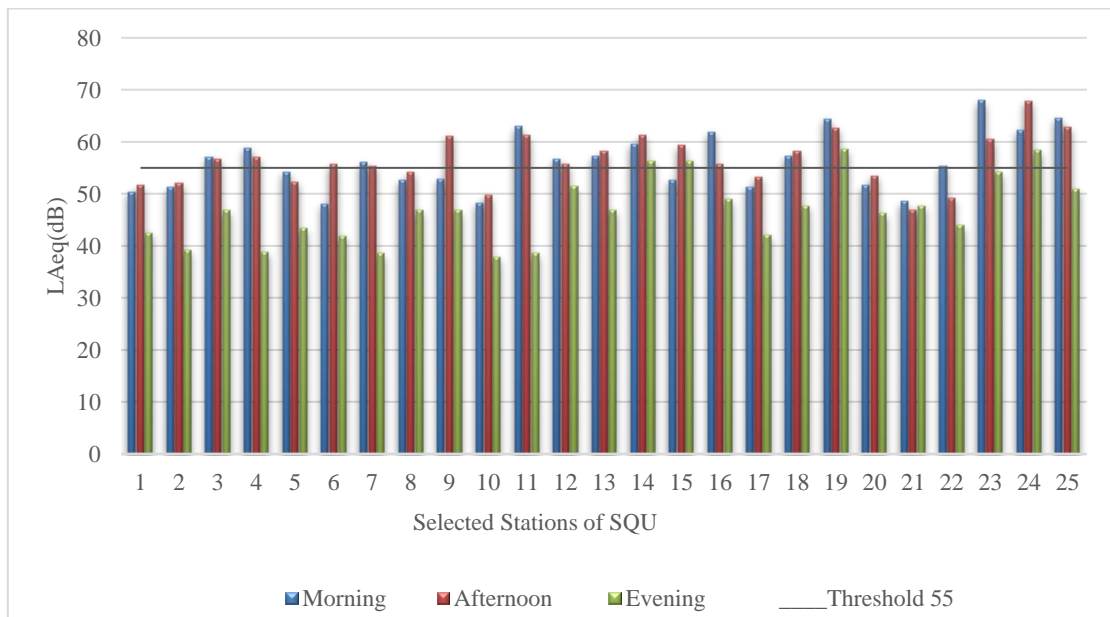
Figure 5 shows the noise levels measurements which showed the mentioned locations designated in the table 3 were exceeded the WHO limit of  $Leq = 55$  dB(A). The remaining locations lie within the range of sound levels up to  $Leq = 55$  dB(A). Those

Significance rates were due to the following noise sources occurred during period of measurement :

1. Air traffic
2. Road traffic
3. Construction Noise, Public Works Noise
4. Building Services Noise
5. Noise from Leisure Activities
6. Domestic Noise including human activities around the concerned locations.

*Table 3 Locations at SQU exceeded WHO limit of Leq noise measurement*

#	Location	Morning (dB)	Afternoon (dB)	Evening (dB)
12	CE Computer lab	56.7	55.8	51.4
3	Chemical labs	57	56.7	46.8
4	Classrooms (A)	58.8	57.1	38.8
13	Student Service area	57.3	58.1	46.9
23	outside SQU Hospital	67.9	60.4	54.1
9	Block (E) Corridors	52.9	61.1	46.8
11	CE Construction lab	62.9	61.2	38.6
19	between Mosque and the C. of Commerce	64.4	62.7	58.6
25	Main Entrance	64.5	62.8	50.9
24	SQU Residential Area	62.3	67.8	58.4



*Figure 5 Noise level at different locations of SQU campus*



Figure 6 shows the LAeq for some selective areas in SQU (Botanic garden, Around the Cultural Center and Al Andalus Garden), these areas were categorized as a place of relaxation and studying. The recorded noise level was lower than 55dB as it was recommended by WHO.

Parks and other urban green spaces are often accessible spaces for residents to be physically active and gain physical and mental health benefits [10].

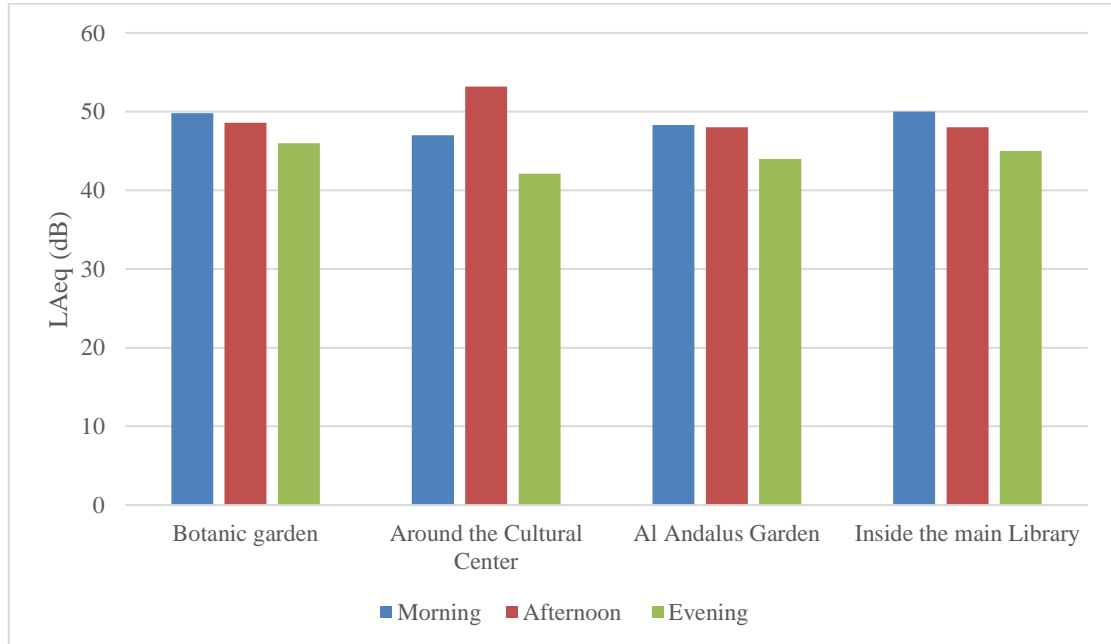


Figure Some areas in SQU which LAeq was recorded below 55 dB

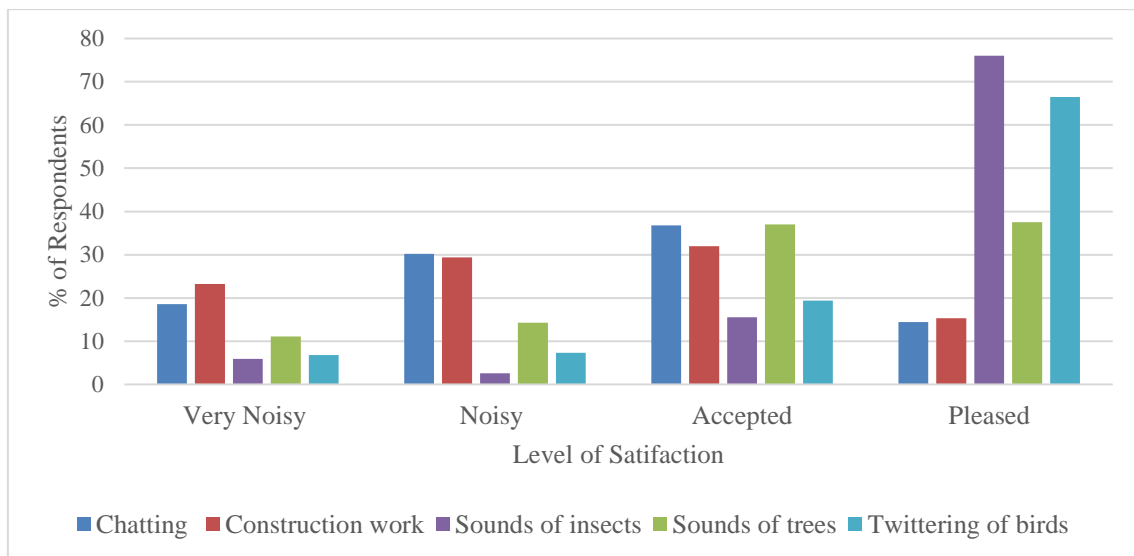


Figure 7 Pleased sounds in SQU

The identification of preferences and experience towards the original and artificial sounds of selected landscape areas in SQU was included in the social survey in this study. A questionnaire was added with covering natural sounds that can be heard in SQU campus.

The respondents at SQU evaluation on preferences of 15 type of sounds was conducted. In Figure 7, sounds of trees, twittering of birds, and sounds of insects shows highest weighted mean with 76%, 66.5% , 37.5% respectively.

In contrary, result also shows perceptible tendencies that majority respondents are rated other type of sounds as noisy or very noisy, which can be considered as less accepted or displeased to the subjects.

## 5. Conclusion

Since the foundation of the SQU in 1986, noise pollution has consistently become a new and serious environmental problem on campus. Evidently, universities have increasingly built into noisy areas over the last few decades. Whatever happens, the complaints about noise has been growing from students or instructors gradually for some time. Such complaints concerning a noticeably heavy noise exposure at educational institutes have been studied scientifically. Therefore, the noise pollution level must be under consideration during the selection of university location in the very busy cities.

This study revealed that there is substantial noise pollution on the Sultan Qaboos University campus. The records of noise levels in some areas of the campus were higher than the recommended guidelines, which mean that most of inhabitants of SQU are exposed to the effects of noise pollution. From the results found in this study which representing the distribution of noise levels and the level of satisfaction of SQU inhabitants, it is clear shown that only some areas of campus has undesirable noise levels. The reason for this unfavorable condition may be that air traffic that is going over SQU campus and road traffic movement inside the SQU campus are the main source of the environmental noise pollution levels, both inside, and outside buildings of the campus. In this respect, it may be suggested that the number of vehicles on the campus should be limited by more effectively controlling the vehicles entering the area. As one of the most effective measures to be taken for the reduction of the noise level, converting the air traffic to areas away from SQU campus. Further more, the SQU administration should identify its role as an environmentally responsible institute and is committed to promoting environmental awareness for all SQU inhabitants.

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