Noise mapping of sports turfs in residential areas of Kerala

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Abstract

It was during the Covid-19 pandemic that the idea of football turfs became very popular, which resulted in a community nuisance in many areas due to land scarcity, especially in residential areas. The whole of Kerala accounts for more than 500 artificial grass pitches out of which 70 are in a 20 to 30km radius of Kochi. Most arenas operate for 24 hours and peak timings are between 9 pm to 12 am. The noise generated from these arenas can be categorized as noise produced by ball impacts, by players and spectators, and during their commute. The nocturnal noise has several health effects, especially for the non-participating bystanders, in this case, it is the dwellers nearby[1]. Most arenas haven't considered environmental conditions and are not properly equipped to accommodate larger crowds even during big events like tournaments. This study aims to determine noise pollution from such arenas and to generate noise mapping of pitches in various contexts. It helps to find out the safe radius at which the LAeq and LAFmax parameters are within the thresholds set by BS 8233,1S 4954-1968 and WHO so that the pitches can be placed near noise-sensitive receptors without annoying the dwellers. The results show a significant change in the ambient noise level and the noise level during game sessions. The LAFmax value obtained from a bedroom of a nearby residence was in the range of 72-85 dBA. The change in LAeq and LAFmax with varying distances from the pitches was also studied.These resulted in the need for noise mitigation measures which must be taken while the construction of sports turfs and further helps to ensure laws and policies which will provide legal remedies for the dweller's nearby sports arenas.

Keywords: Noise pollution, leisure noise, community noise, nocturnal noise, noise assessment, noise standards

1. Introduction

Sports turfs are artificial grass turfs specially designed for sports, particularly football and cricket, in the Indian context. The transformation of natural grass/ ground to synthetic turf was led by less maintenance, safety advancements, prolonged playing time due to floodlighting etc. The activities of the turf are noisy. Environmental noise crosses certain thresholds, which can have adverse short-term or long-term physiologicalor psychological effects on an individual exposed to it, known as noise pollution[2]. In countries like USA, Noise Impact Assessments are carried out before the placement of sports facilities[3], whereas, in India, no such impact assessments are carried out. Due to this, the noise impacts on dwellers nearby are critical. Also, due least land availability, many turfs are set up withminimum setbacks and haven't taken any noise mitigation measures.

After Covid 19, the spread of turfs in many parts of the country became a trend and a profit-earning business.

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Since the young generation is crazy about football and cricket matches,in the future also, the number of such turfs only increases and can affect the peaceful life of the neighbors. Thus, the sports turfs will turn into an environmental stressor in residential settings during the night-time. Now also issues regarding nocturnal noise from the sports turfs in many parts of the state, especially in Kerala have arisen. Excessive night-time noise exposure has a baneful effect on public health[4]. But due to inefficient provisions, the victims are getting suppressed. So, it's high time to take measures regarding the noise pollution from such arenas. Since the main objective of the study is to address the noise pollution from the arenas now spreading.

2. Objectives

- To Addressand quantify all the noise produced by or along with the sports turfs.
- To generate noise mapping of the sports turf in various contexts.
- To derive the safe distance for the placement of sports turfs.

3. Methodology

Figure 1 depicts the methodology adopted for the study.

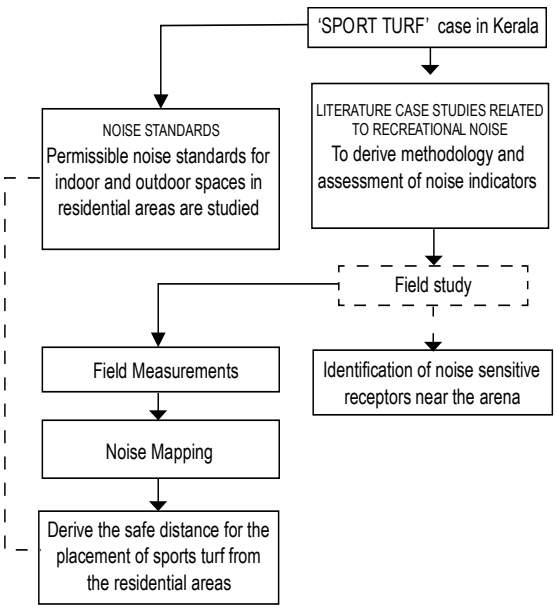

Figure 1 – Methodology

4. Noise assessment indicators

Leisure noise problems are growing, but specific studies focusing on noise from sports arenas are not so plentiful in India.The noise assessment indicators used in the study are LAeq(1hr) and LAmax.The residential development recommendations from the World Health Organization are typically calculated during a 16-hour daytime period.A 16-hour assessment period won't accurately represent the noise impact for an artificial grass pitch because it takes into account both times of total use and non-use. Hence it is recommended that the assessmenttime for a game is for an hour,LAeq (1hr) since this is the normal length of a community sports session happening on an artificial grass field. [5].

An existing noise assessment study identified that football pitches typically produce noise in the range of 60 dB LAeq and 75 dB LAFmax at 10 meters distance and in the worst case it is up to around 62 dB LAeq and 80 dB LAFmax during matches[6]. In another study, a typical free-field noise level from an AGP at 10 m from the sideline halfway marking is 58 dB LAeq (1hr) [5].There are studies lacking in the Indian context regarding the noise assessment of sport arenas.

5. Relevant noise exposure standards

According to Central Pollution Control Board, the acceptable average night-time noise levels for a residential area is limited to 45 dBA[7]. In IS 4954:1968, they elaborated on the acceptable outdoor noise levels in residential areas: rural (25-35dBA), suburban (30-40 dBA), urban residential (35-45 dBA), city (45-55 dBA) and industrial (50-60dBA) [8].To allow individuals to sleep with their bedroom windows open, the WHO recommends that outside sound levels at 1 meter away from the facades of living spaces not exceed 45 dB LAeq at night[9]. Additionally, for indoor spaces, the recommended values for bedrooms are 45 dB LAmax for single events and 30 dB LAeq for continuous noise[9]**.** In BS 8233, it is suggested that the

external noise level should not exceed 50 dB LAeq,T, with an upper value of 55 dB LAeq,T, which is acceptable only in noisier environments.

6. Field study

TwoKUSAM-MECO Digital Sound Level Meter (SLM), model type- KM928 MK-1 and tripods have been used for the fieldwork.

The two SLM was placed behind the center of the goal line and side-line. Both SLMs were pre-calibrated to assure sampling accuracy. The data were analysed and plotted using Microsoft Excel.

6.1 Investigation

6.1.1 Site location and details

The noise assessment study has been carried out for five football turfs across the state of Kerala. Arena A is in a residential area in a complete residential zone. There are residences identified within a 10 m distance from the turf. As soon as the turf started, neighbors began to complain about nocturnal noise pollution. The noise generated from the pitches and anti-social behavior associated with the turf is a significant issue. Arena B is located in a silent zone according to the Noise rule India, 2000. The distance to the nearest noise-sensitivereceptor is only 8 mfrom the pitch boundary. Arena C is also located in a residential area with residences at 10 m. ArenaD like Arena is completely detached from the road trafficand identified residences sharing compound walls with the arena. Different from other cases, Arena E is in an isolated area surrounded by trees but few residences have been identified. All these arenas are active till 12 am, sometimes the games may extend till 2 am.

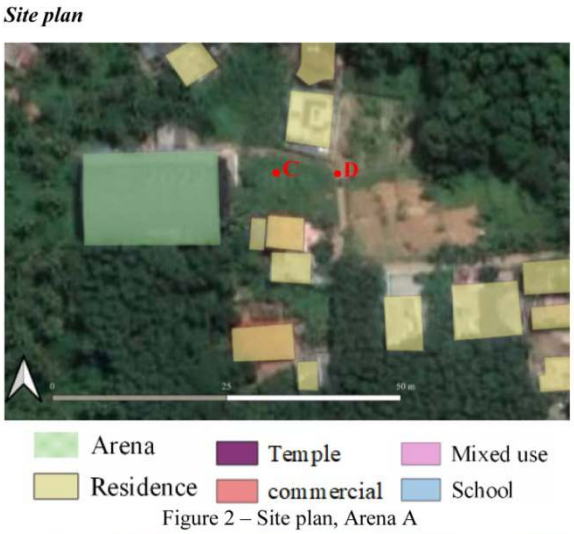

Figure 2 – Site plan, Arena A

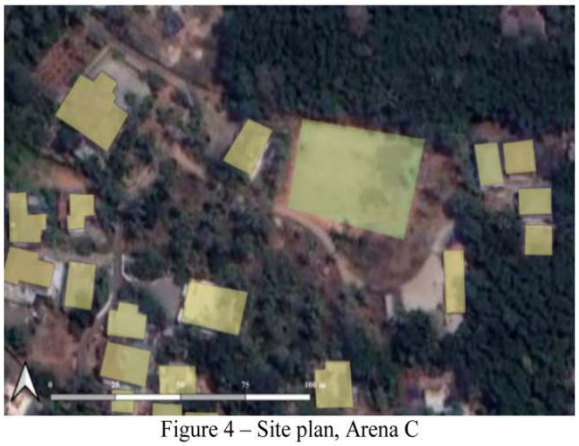
Figure 4 – Site plan, Arena C


Figure 3 – Site plan, Arena B


Figure 5 – Site plan, Arena D

Figure 6 – Site plan, Arena E

Table 1 shows the number of players and spectators who were present during the event. Climatical conditions were also recorded during the event (Table .2).

Table 1 - Number of players and spectators during sessions

Site	No of players	No of spectators
Arena A	12	4
Arena B	12	5
Arena C	12	5
Arena D	12	20
Arena E	12	70

Table 2- Climatic conditions during sessions

Site	Temperature (°C)	Humidity (%)	Wind Speed (m/s)
Arena A	27.3	77.7	0.1
Arena B	27	77.3	0.3
Arena C	28	77.5	0.5
Arena D	27.5	77	0.6
Arena E	28	77.9	0.3

7. Result sand Discussion

The results of this study are categorized into different parts. All the measurements were taken during the night-time as per 'The Noise Pollution (Regulation and Control) Rules, 2000. Ambient noise level is measured in the absence of game sessions, refer Table 3.

Table 3- Background (Ambient) Noise Level, LAeq dBA. (No activity on pitches) (night time)

Site	Ambient noise dBA
Arena A	49
Arena B	62
Arena C	48
Arena D	55
Arena E	38

Arenas B and D show higher ambient noise due to the presence of road traffic(Table.3). LAeq obtained for other arenas are less than 50 dBA due to the absence of traffic noise.

The results from the noise measurements taken during the sessions shows higher LAeq values at the goal linefor Arena A, B and C and Arena D and E have higher LAeq values at the sideline (Table.3).Unlike other countries, the pitch size is small, the players will reach the goal post at the earliest, and the actions like penalties and players distribution have led to the highest LAeq value at the goal post than the sideline.

Arena D and E accountfor a greater number of spectators and the distribution of the spectators near the sidelineis responsible for more noise at the sideline.

7.1 Field measurements

Noise levels were measured behind the goal line and sideline asshown in Table 4 and has depicted graphically in figure 7.Comparison of Ambient noise, LAeq and LAmax are shown in table 5 and has graphically represented in figure 8.

Table 4 - Measured Noise Levels (dBA)

Session Period and site	Monitoring location 'A' behind Goal Line		Monitoring location 'B' behind Sideline	
	LAeq (1 hour)	LAmax (fast)	LAeq (1 hour)	LAmax (fast)
22:00 to 23:00 hrs Arena A	69	90	68	85
22:00 to 23:00 hrs Arena B	70	96	68	93
22:00 to 23:00 hrs Arena C	67	97	64	89
22:00 to 23:00 hrs Arena D	59	85	69	96
22:00 to 23:00 hrs Arena E	69	96	80	1055

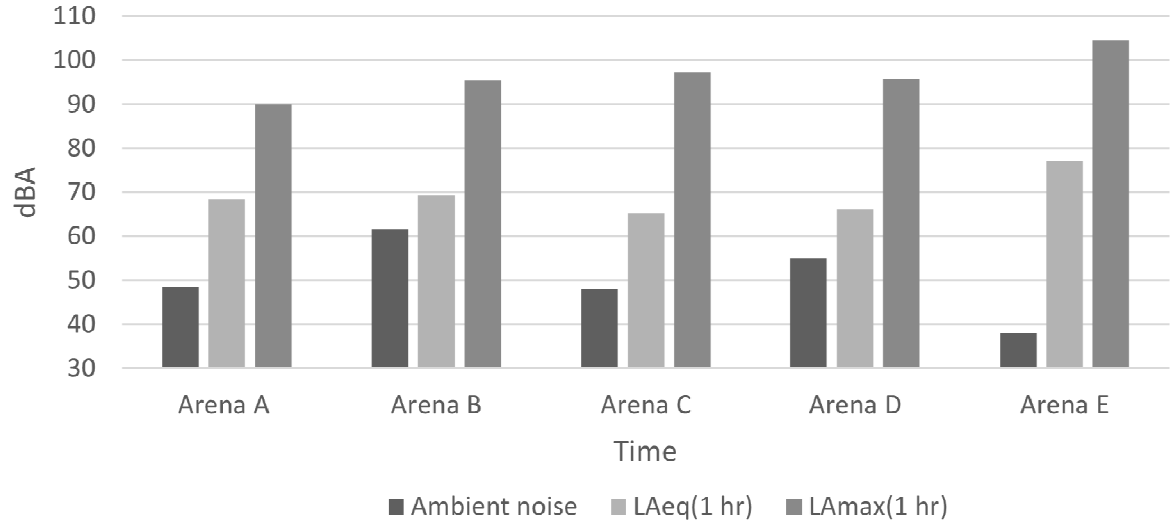

Figure 7- Overall Results by session

Table 5 - Comparison of Ambient noise, LAeq and LAmax

Site	Ambient noise	LAeq (1 hr.)	LAmax
Arena A	49	68	90
Arena B	62	69	96
Arena C	48	65	97
Arena D	55	66	96
Arena E	38	77	105

*LAeq (1 hr) is the average taken from goal line and sideline measurements

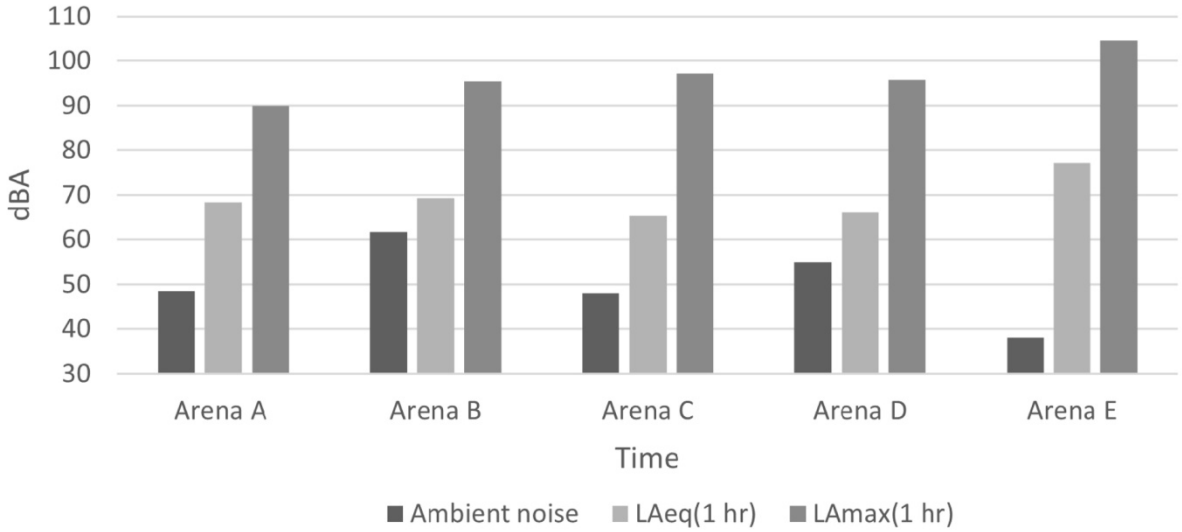

Figure 8- Graphical representation of comparison of Ambient noise, LAeq and LAmax

7.2 Standardization of noise from the arena

The noise generated from the source of an artificial sports turf can be standardized as per the study as 72 dBA LAeq(1hr)(average of all the sessions taken from the five arenas) and LAmax value can be standardized as 88 dBA at the source. In each location, there was a 10 dBA difference betweenthe ambient noise and LAeq(Table .4). Except for Arena B,a difference of 15 dBA noise was found

between LAeq and ambient noise (Table .4). More than 10 dBA change in sound levels can cause major short term and long-term health impacts according to the Institute of Environmental Management and Assessment (IEMA) Guidelines for Environmental Noise Impact Assessment, Version 1.2.

7.3 Noise at noise-sensitive receptors

Noise measurements were also taken from the nearest noise-sensitive receptors (bedroom). During the sessions. LAeq and LAmax obtained were50.8 dBA and 75 dBA at a 20 maway bedroom from Arena A.In the case of Arena B, the nearest noise-sensitive receptor is located at an 8 m distanceand the LAeq and LAmax obtained were56 dBA and 85 dBA respectively during the night-time session. Both the dataexceeds the accepted noise levels or indoor spaces suggested by WHO which is 30 dBA LAeq and 45 dBA LAmax.

Since Arena B is closer to the road, LAmax values were also taken with sessions and without sessions inside the same bedroom for continuous 5 minutes from 8.30 pm to 11.30 pm. The comparison of impulsive noise with session and without sessionis shown in figure 9.

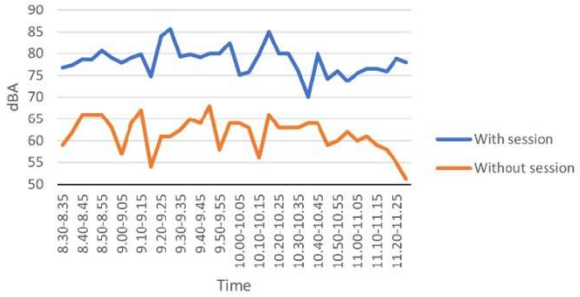

Figure 9- The comparison of LAmax values with sessions and without session

From the readings (Fig .9), it is identified that the noise from the play sessions has more impact than the noise from the road for Arena B.

7.4 Noise categorization

7.4.1 Analysis ofLAeq (5min total)

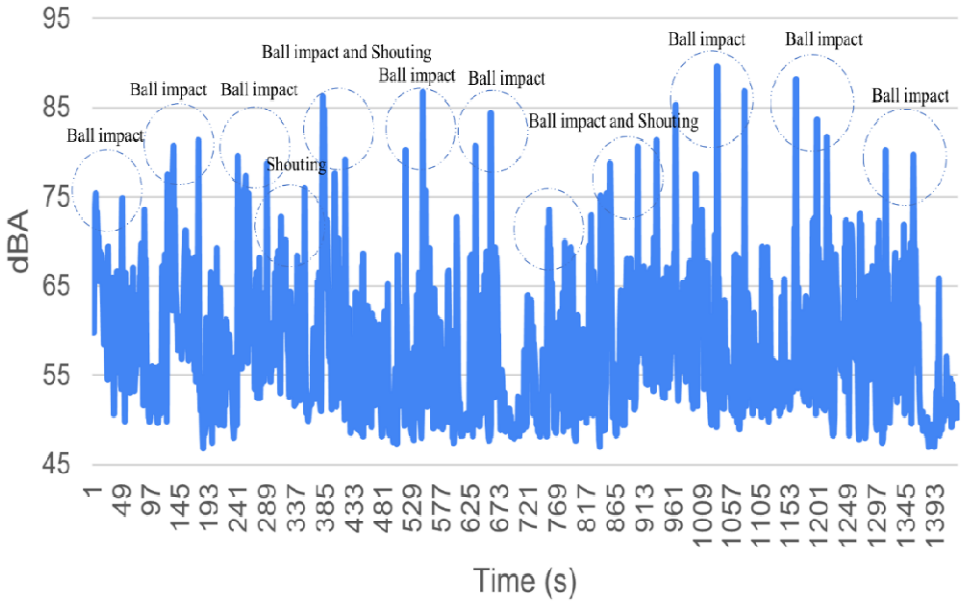

Figure 10- Arena A- LAeq (5 mins)

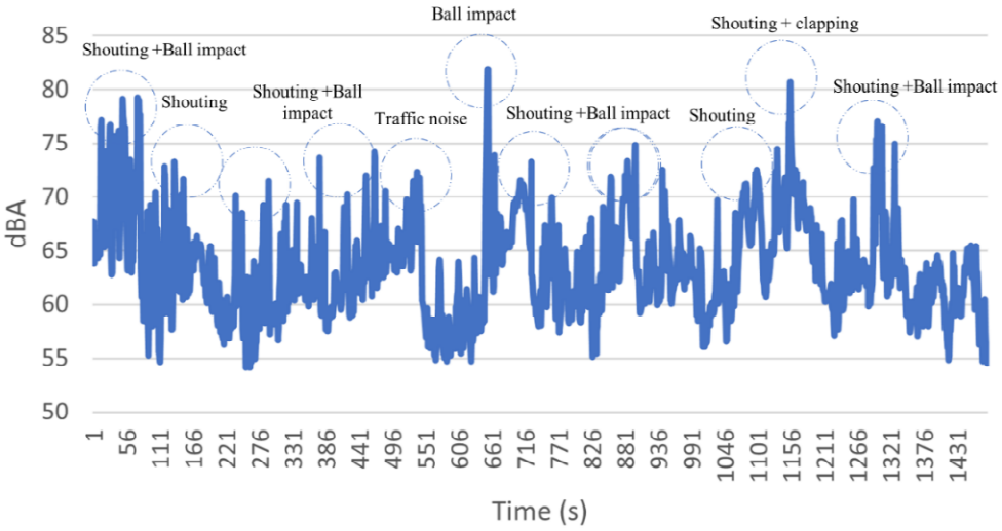

Figure 11- Arena B- LAeq (5 mins)

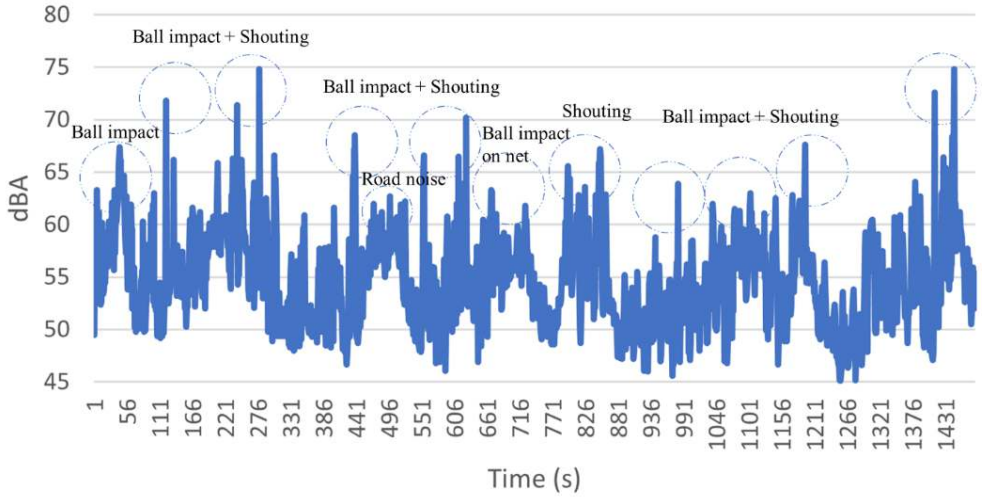

Figure 1- Arena C- LAeq (5 mins)

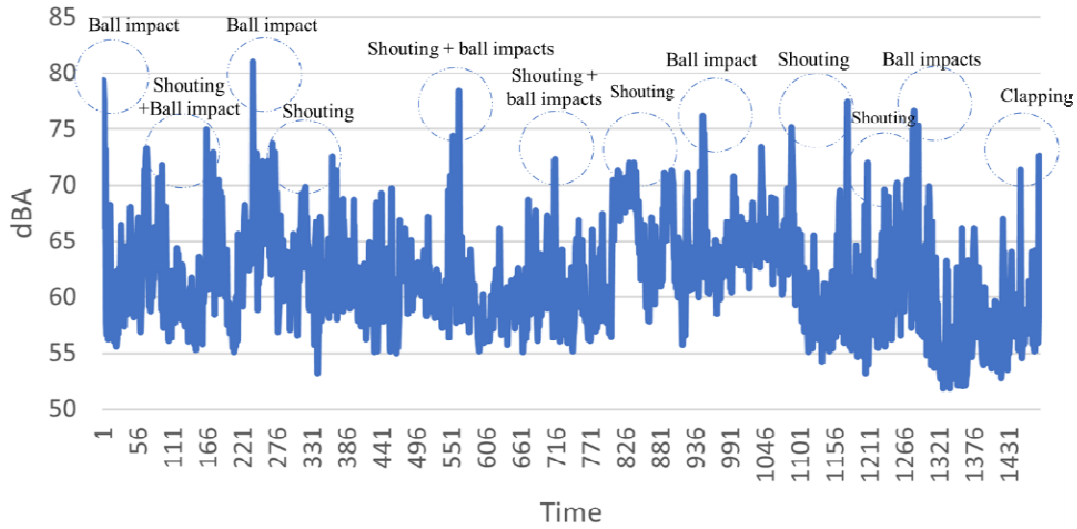

Figure 132- Arena D- LAeq (5 mins)

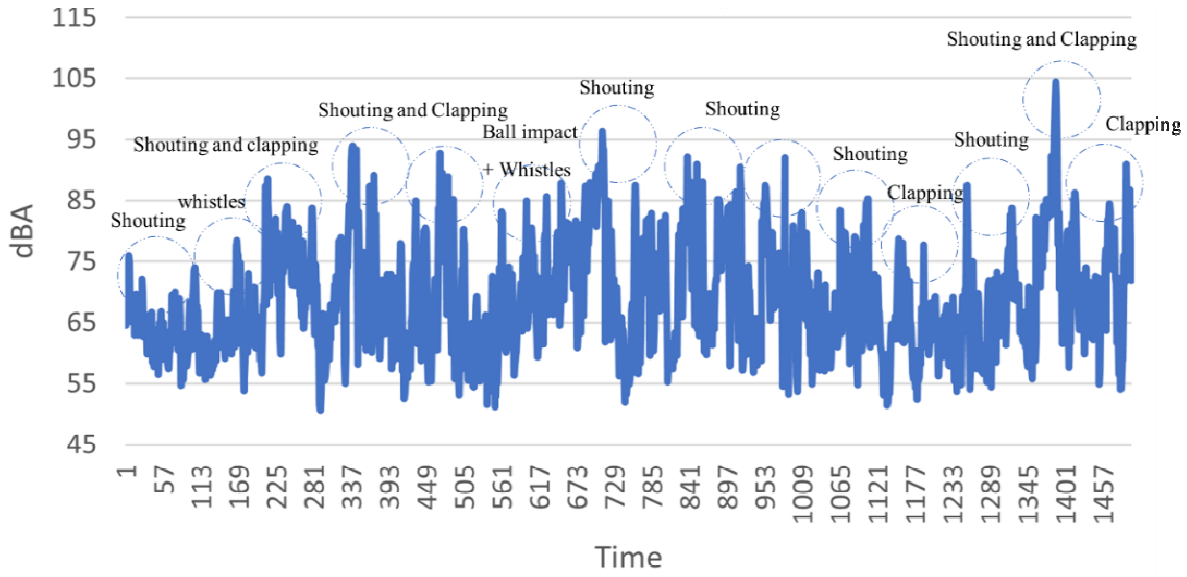

Figure 14- Arena E- LAeq (5 mins)

Figure 10 to 14 shows the 5 minutes samples taken from all the arenas. The noise is categorized through the field study and using the software Adobe Audition. Noise connected to the pitches can be categorized as ball impacts, shouting, clapping, whistling sounds, and noise by visitors' vehicles. The ball impacts include a ball contacting the foot, striking the metal mesh, and a goal post. Shouting is the raised voices of players and spectators. The ball impacts, shouting and clapping contribute to higher noise levels above 80 dBA. The whistling sound was identified only at Arena Edue to the tournament.

7.5 Noise emissions from the arenas

To understandthe noise emitted from the arenas, the acoustic model was generated using SoundPLANessential 5.1.The assessment is based on the noise modeling methodology using an area source covering the pitch as the noise source. The methodology has been validated in the Noise Impact Assessment - Proposed Replacement Artificial Grass Pitch of Stamford Schoolby Daniel Oldaker in 20203.The following graphs(fig. 15-22) show the noise emissions from the arenas at 1.5 meters above the ground,representative of head height.

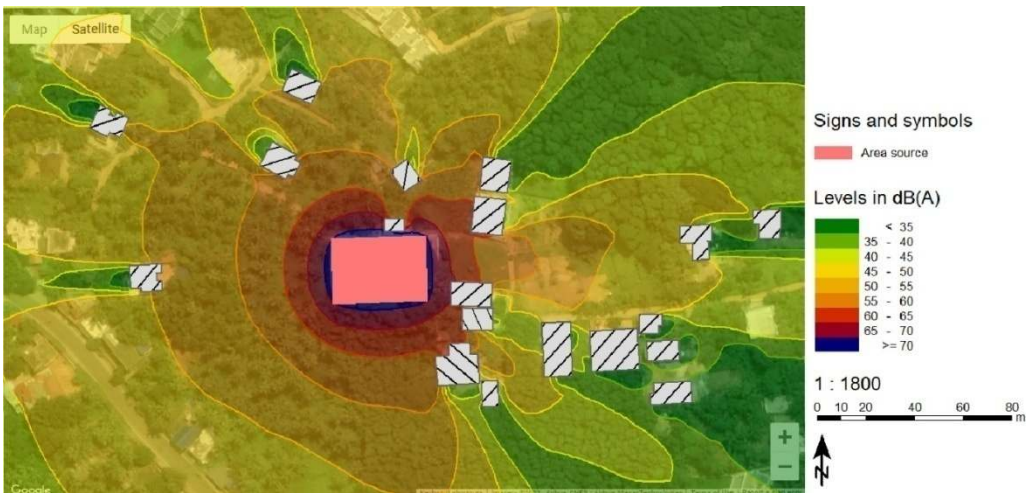

Figure 15- Noise emission, Arena A

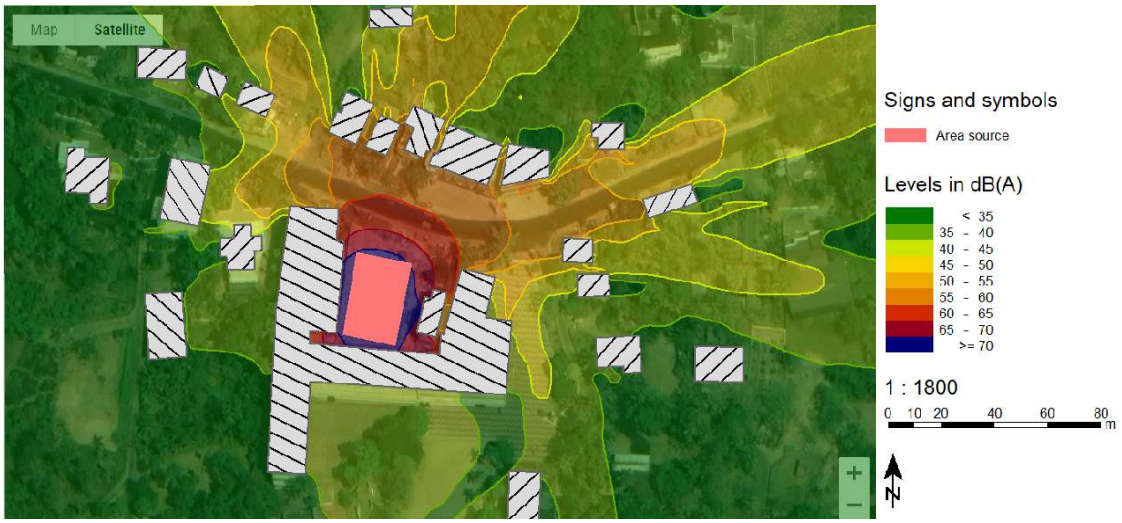

Figure 16- Noise emission, Arena B

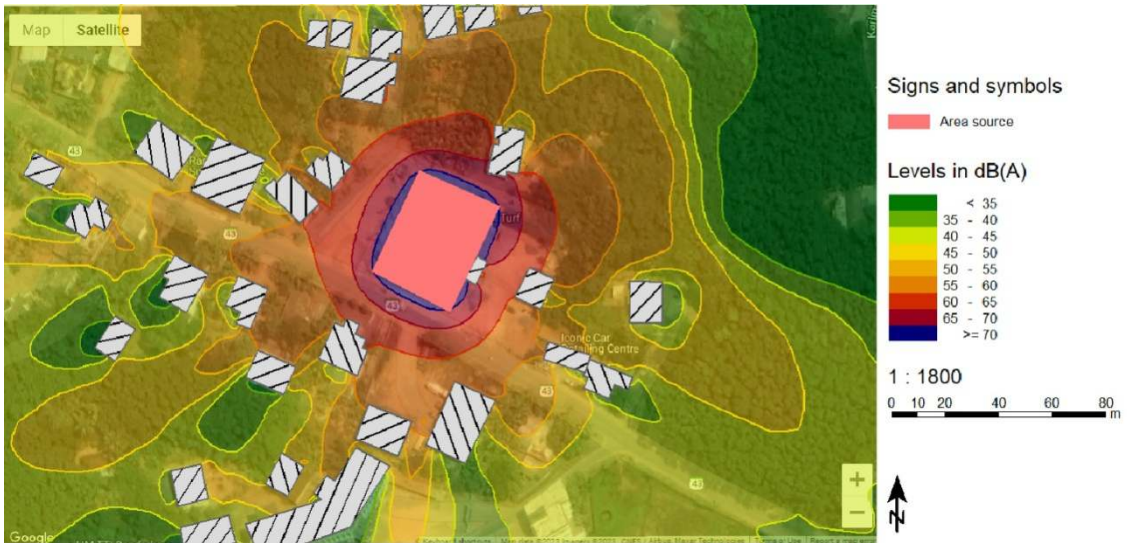

Figure 17- Noise emission, Arena C

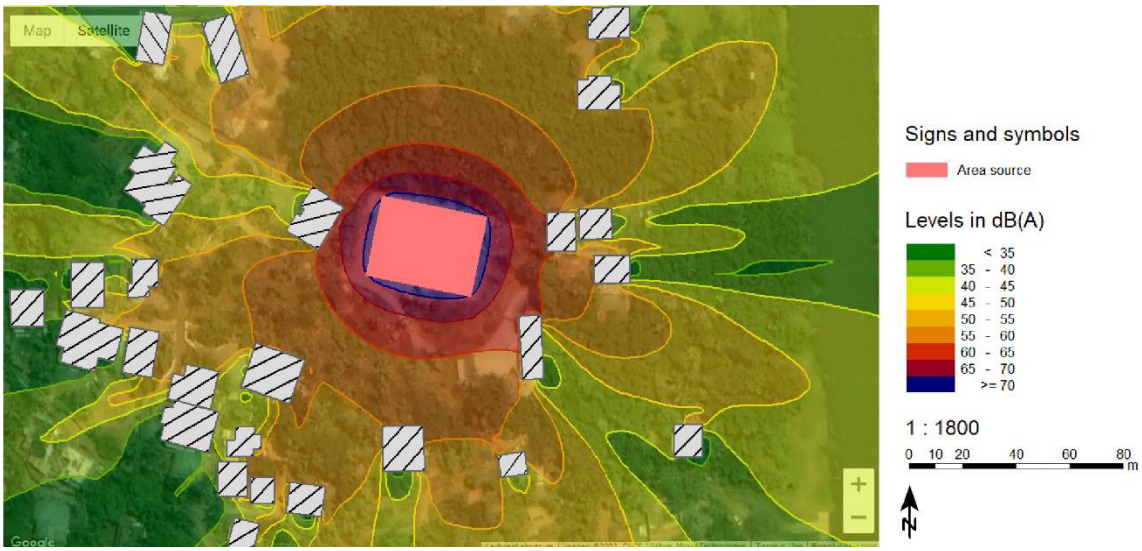

Figure 21- Noise emission, Arena D

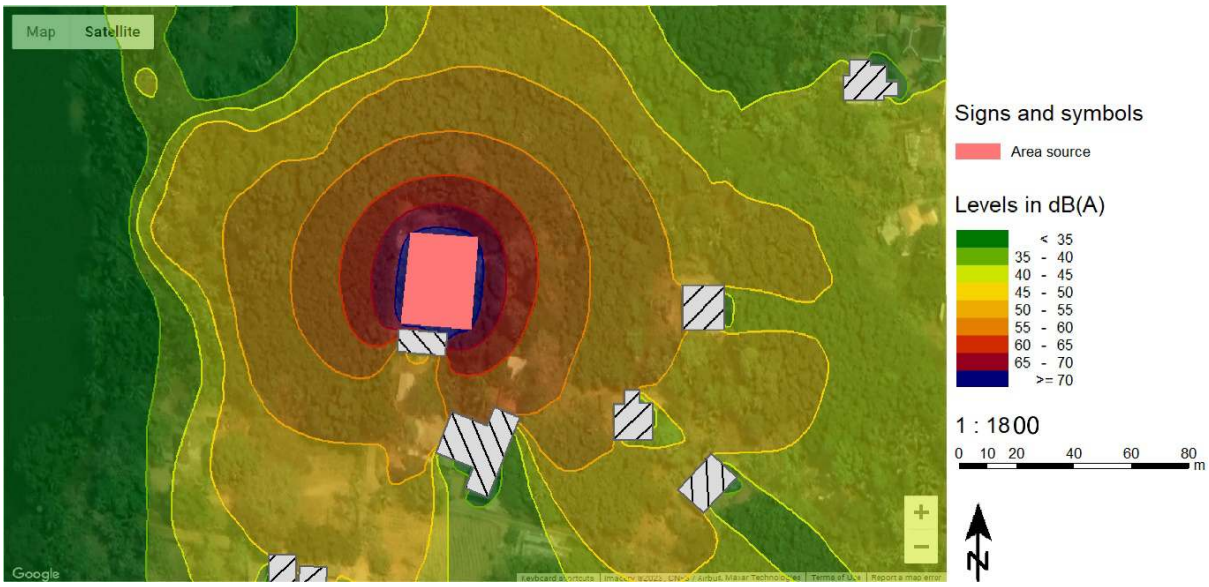

Figure 21- Noise emission, Arena E

The noise experienced at the façade of all the arenas except Arena E,are in the range of 65-70 dB LAeq(1hr). For Arena E, the residence is located at about 60 m, and the LAeq obtained at the façade of the nearest residence was in the range of 55-60 dB LAeq(1hr). The noise wasn't within the criteria set by BS 8233, IS 4954-1968and WHO. According to the standards, 45 dB LAeq is suggested for night-time noise exposure in residential settings[7,9].

The maximum distance at which the LAeq (1hr) obtained is within 45 dB is identified (Table. 5). Due to building reflections the distance from the pitch where 45 dB LAeq(1 hour) is achieved is greater for Arena C and Arena D5. As the result of the study, 120m to 140m away from the pitch boundary is identified as a critical zone.

Table 6- Distance at which LAeq obtained is >45 dBA

Site	Distance in Meter
Arena A	130m
Arena B	130m
Arena C	140m
Arena D	140m
Arena E	120m

8. Conclusion

The study verifies that the spreading of sports turfs across the nation causes environmental stresses like noise pollution. The LAeq and LAmax obtainedinside the bedroom closer to an arena were56 dBA and 85 dBA respectively. The study shows a strong need forguidelines for placing sports turfs in residential areas. The noise generated from the source of an artificial sports turf as per the study can be standardized as 72 dBA LAeq(1hr). According to the contexts studied, 120 to 140 meters away from the pitch boundary poses the threat of noise pollution in which the LAeq obtained is more than 45 dBA. The research also quantifies the noise connected to the pitches. It includes ball impacts, shouting, clapping, whistling sounds and noise by visitor's vehicles. The ball impacts include a ball contacting the foot, striking the metal mesh, and a goal post. Shouting is the raised voices of players and spectators.

Some other findings include,

- Goal line has a higher LAeq value than the sideline when spectators are not considered. Factors such as penalty and the small size of the pitch, the player's distribution along the goal

lines are responsible for higher LAeq value, so always better not to align the goal line near the noise-sensitive receptors.

- While considering the spectators, the number and their distributions also account for higher LAeq values. During the game, most spectators will distribute along the sideline for a better view and in conducted case studies, the seatings are provided parallel to the sideline. It causes higher LAeq values at the sideline. So, it is always better to place the spectator'sseating away from the noise-sensitive receptors.

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