Soundscape Study of Urban Public Spaces along the Sea Shore

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ABSTRACT

The cities are profound with variety of sounds that keeps fluctuating at different time intervals. However one restless source lying on the border of Chennai city, India is the wave sound of Marina Beach. It is one of the important urban public spaces that attract number of visitors every day. To carry out the soundscape study of Marina Beach, a stretch perpendicular to the sea comprising of three levels – the Traffic road, a linear double rowed vendor shops and the seashore is chosen. Sound walk followed by a questionnaire study is carried out at each level to investigate the transition of sound along the stretch. Psycho-physical data analyses of verbal descriptions expressed by respondents at each level are observed to be different. The Leq levels are found to be varying throughout the day and found to record the values of about 70 – 80 dB(A) at peak hours, measured using Norsonic sound level meter type 118. The role of vendor shops in providing acoustical aid to the transition from traffic noise to wave sound was mapped for the stretch. Based on the subjective surveys few recommendations are discussed in the full paper to improve the soundscape of the seashore.

Keywords: Soundscape, Soundwalk, Acoustical aid I-INCE Classification of Subjects Number(s): 56.3

1. INTRODUCTION

Soundscape study is a multidisciplinary study that involves many fields (1). Schafer a Canadian musician introduced the concept of soundscape; a holistic way of studying sonic environment (2) .The soundscape quality of any public space will enhance the experience of the people. Urban spaces are populated with heterogeneous sound sources. There are very few studies related to urban soundscape with reference to Indian cites (3-5). Sound heard from a mixture of sources may inflate the annoyance level leading to health hazards. On the other hand it also adds up to the liveliness of the place. Some studies in Indian cites (5) states that the interference of horn noise is more in the urban public spaces. So the verdict lies with the ear witnesses directly exposed to the sound sources. The aim of this paper is to identify the locations / points at which liveliness of heterogeneous sound sources tends to become annoyance. Relevant to this, seashore of Marina is picked as the area of study as it serves as the most bustling spot of Chennai city, India. Forming the shoreline of Chennai it reveals to be the most popular hangout place and also attracts a large number of tourists. The space has managed to remain a popular public space despite the intrusion of urban noise sources into an otherwise idyllic setting.

Being the second longest seashore, it spans for about 13kms (511819.1 in), and has a maximum width of 437m (17208 in). The widest stretch comprises of one of the major arterial roads of Chennai, the Kamarajar Salai at one end, and the shore at the other end. Both these ends are bridged with a stretch of vendor shops. As day passes into night the place becomes abuzz with activity causing major fluctuations in sound level. The sound level is measured at both ends - the traffic noise from the road recorded a reading of about 70 to 80dB which was annoying to most of the people whereas sound level when measured at the shore gave similar readings of 70 to 80dB which was the liveliest sound mark of

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that place. In order to identify the reason for this extreme psychological difference in the mindsets of people despite the same sound level readings, and also to figure out the transition point the entire stretch was studied.

During the study a gradual transition of sound caused by different sources was observed throughout the stretch. It is notable that people residing in urban environment tend to become passive listeners due to the continuous exposure of unwanted noise that remains omnipresent throughout the day (6). Are the visitors supposed to adapt to the environment even if it is filled with the heterogeneous noise sources? Or should the public space be designed and programmed with sensitivity to the existing and future acoustical environment? Betterment of a place acoustically lies not only by eliminating unwanted sound sources, but also by transforming the unpleasant source into pleasant source by means of thoughtful planning measures. According to this statement few recommendations that alter the existing planning measures by incorporation of passive design strategies are discussed in this paper.

2. METHODOLOGY

2.1 Site Description

Marina beach being a vast stretch, a prime part of it is chosen for the research. The selected space welcomes most of the tourists as it is located near the famous Anna memorial and MGR memorial - former chief ministers of Tamil Nadu state. The Triumph of Labour statue marks the entry to the stretch. This important landmark was the earliest erected statue in Marina. Towards the left is a fountain and the bus stop. Behind the Labour statue, a flight of steps marks the entrance to the vendor shops in the sandy stretch. The narrow, linear vendor shops runs throughout the width of the beach for about 400m (15748.28in). The full view of the Sea Shore is shown in Figure 1, and the stretch researched is illustrated in Figure 2. There are a variety of shops with North Indian and South Indian fast food, sea food, decorative items, balloon shoots, photo studios and many other entertainments. With all its collections, the stretch is the favorite spot for shoppers. The shops start to fade away as progression is made towards the beach waters.

Figure 1 – Marina: Full view

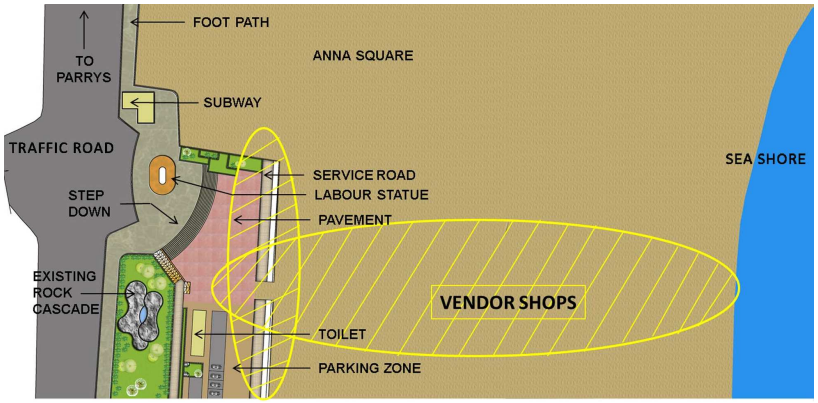


Figure 2 – Descriptive plan of the selected stretch

2.2 Soundscape Study of the described site

The following described method is adopted for the soundscape research of the seashore.

A series of sound walks throughout the site at representative times of the day helped the research to gain an understanding of how the types, character of activities and sound varies over the course of typical days. Walks occurred at different time of the day. Listening was made the main criteria for data collection, as listening forms the basis for soundscape research. Listening to the soundscape, in the context of this work, is perceived as being important for deepening our understanding of the soundscape of the Marina. Qualitative observations of the type, level, time, duration and source of sound are recorded during the sound walk.

The field data are observed by a series of sound walks. During the sound walks the noise levels are monitored using Norsonic sound level meter type 118. The sound level meter is place above 1.2 m (47.24in) from the ground level and away from the obstacles. Sound level meter is calibrated before each recording. Each recording is performed for a time period of five minutes. The readings are taken for different time of the days such as early morning (6.00 to 8.00), morning (8.00 to 10.00), forenoon (10.00 to 12.00), afternoon (12.00 to 2.00), evening (2.00 to 5.00) and late evening (5.00 to 8.00). The measurements procedure is repeated for ten consecutive days.

Three different zones on the site are identified as shown in Figure 3. The classification of zones is according to its geography, usage and activities taking place as shown in table 1.

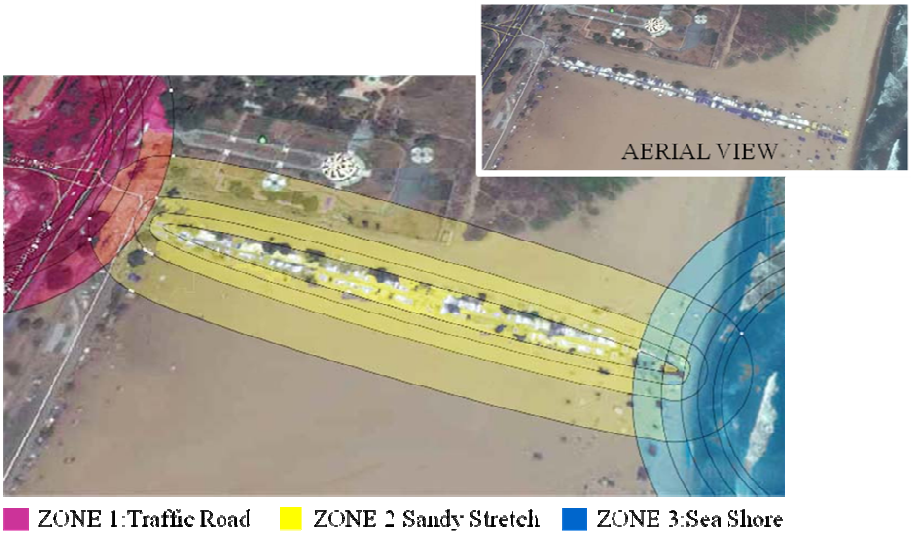


Figure 3 - Location of the three zones

Table 1 - Zonal Classification

Zone	Name	Geography	Description	Activities
1	Traffic Road	Leveled Vehicular Road	Arterial Road	Commuters, Visitor's parking, people waiting for the buses
2	Vendor Shops	Sandy stretch	Linear passageway flanked by vendor shops on either side	Busy fast food, decorative shops, photo studios and balloon shoots
3	Sea shore	Sea (Bay of Bengal)along the eastern coast	Sea is parallel to traffic road and perpendicular to vendor shops	People playing in the sea, taking a stroll, enjoying the breeze and waves.

Short term measurements of specific acoustic events identified in each zone and which is contributing to the ambient $L_{eq\ (5mins)}$ levels are recorded at 13 distinctive points as shown in Figure 4.

The graph of recorded values is shown in Figure 5.

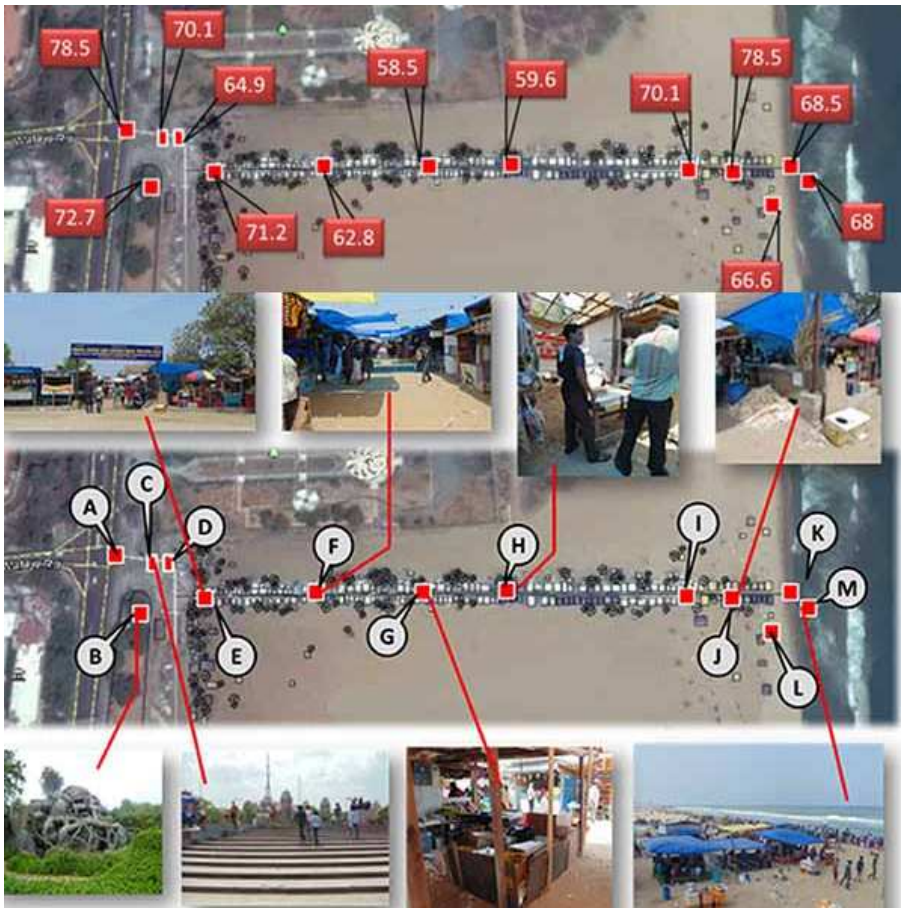


Figure 4 - Sound level measurement points

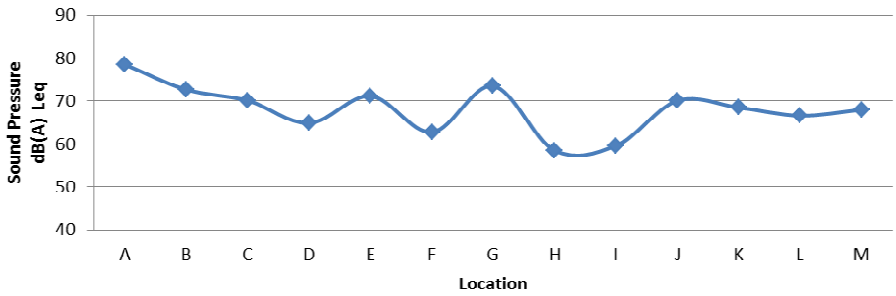


Figure 5 – Graph showing sound levels throughout the stretch

Considering the various opinions and feelings held by different individuals towards similar sounds, a count of 50 people are approached and interviewed about the soundscape of Marina. The construction of questionnaire adopted in this study is accustomed to the existing environment of the seashore. Questionnaire is intended to identify the community and their inclinations for Marina's urban noises. The people approached with the questionnaire were from a range of social groups in terms of age, gender and occupation status. The age group of 18 -20 are dominating as students with assertive knowledge of acoustics were approached for the questionnaire. A summary of the database established is shown in table 2.

Table 2 – Participant's database

Factors	Classification	Percentage of people
Age	10 to 20	50
	21 to 30	10
	31 to 40	10
	41 to 50	10
	51 to 62	20
Gender	Female	62
	Male	38
Type	Police	6
	Senior Citizen	4
	Students	52
	Vendors	6
	Workers	10
	Housewives	16
	Foreigners	6

Marina exhibits a heterogeneous mixture of different sound sources as shown in Figure 6. In the first part of the questionnaire, the people were invited to select the noise sources that were pleasant, moderately pleasant or unpleasant based on their experience and perception. The various noise sources examined in the questionnaire are listed in table 3. Noise sources are classified into 3 main categories –natural, mechanical and human.

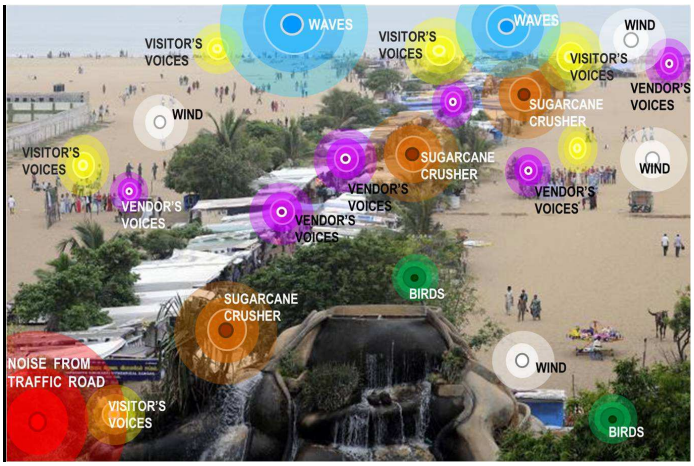


Figure 6 - Heterogeneous sound sources

Table 3 - Classification of Sound sources

Mechanical	Natural	People
Four wheelers	Birds	People playing in water
Auto Rickshaws	Breeze	People's conversations
Police whistle	Crow	People's footsteps
Shops	Dogs' Bark	Vendor's bell
Two wheelers	Waves	Vendor's voice
Traffic Noise		
Sugarcane juicer machine		

The second part of the questionnaire addressed the three zones. The people were asked to relate each topic listed in table 4 to the three zones and were also asked to express their opinion on their preferences and expectations of each zone.

Table 4 - Queries relating to the zones

Zonal Preferences	
Which among the zones	Needs improvement? Doesn't have enough green spaces? Is suitable to meet people? Is congested? Is noisy? Hosts lots of activity? Is well maintained? Is suitable to stroll around? Has pleasant atmosphere sound wise? Is not safe? Is a nice place? Has Humanly expressive soundscape?

A psycholinguistic analysis of spontaneous verbal descriptions was conducted to identify the acceptable categories of environmental sounds and what all sound sources can be enhanced, deciphered or transformed in the urban soundscapes.

3. RESULTS AND DISCUSSIONS

Human approach to sounds varies from person to person on account of their family, culture and personal experiences. Through the questionnaire process, it is observed that a vendor shop owner feels the sound emitted by a cane juicer machine is not noticeable whereas, it is the most annoying sound to majority of the visitors. Thus, giving a definite suggestion on the soundscape preferences is difficult. But, this research aims at making maximum justice for the better understanding and betterment of soundscape of Marina.

3.1 Questionnaire Findings

The investigation of the first part of questionnaire affirms that sources related to natural elements rather than artificial are preferred by most of the visitors as elaborated in Figure 7, 8 & 9. The outcome of second part of the questionnaire is consistent with that of the first part. The investigation of the second part revealed that the zone 3 – Sea Shore, is preferred by dominant percentage of people. The findings are tabulated in Figure 10.

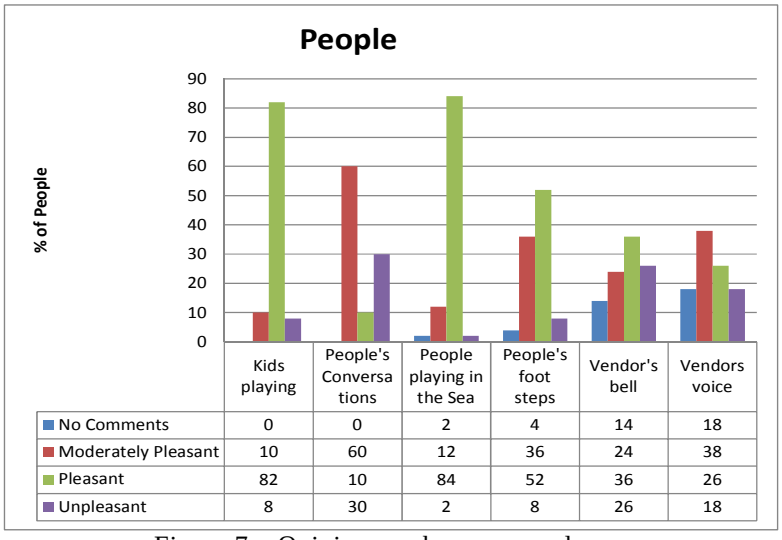
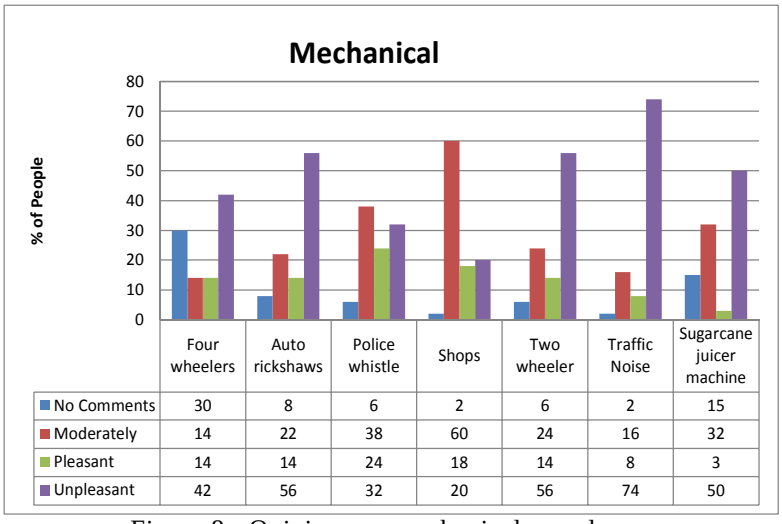
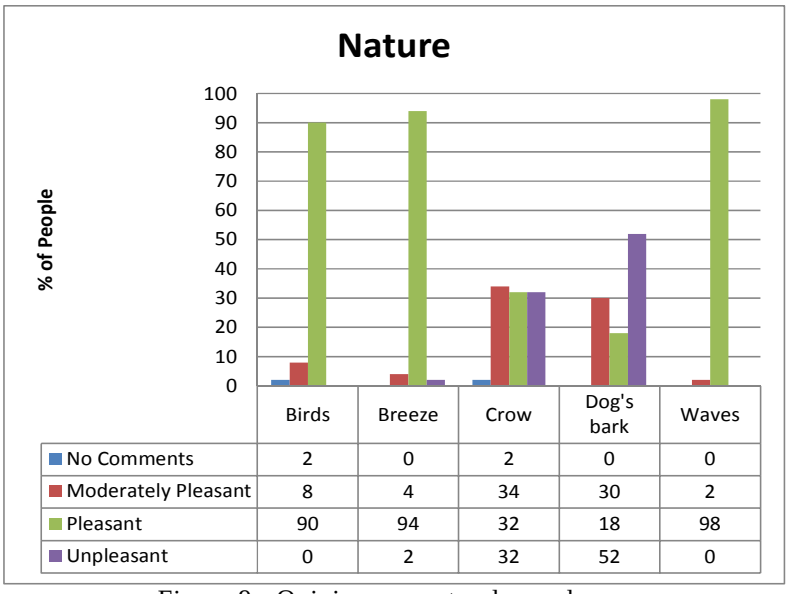


Figure 7 – Opinions on human sound sources



	Four wheelers	Auto rickshaws	Police whistle	Shops	Two wheeler	Traffic Noise	Sugarcane juicer machine
No Comments	30	8	6	2	6	2	15
Moderately	14	22	38	60	24	16	32
Pleasant	14	14	24	18	14	8	3
Unpleasant	42	56	32	20	56	74	50

Figure 8 - Opinions on mechanical sound sources



	Birds	Breeze	Crow	Dog's bark	Waves
No Comments	2	0	2	0	0
Moderately Pleasant	8	4	34	30	2
Pleasant	90	94	32	18	98
Unpleasant	0	2	32	52	0

Figure 9 - Opinions on natural sound sources

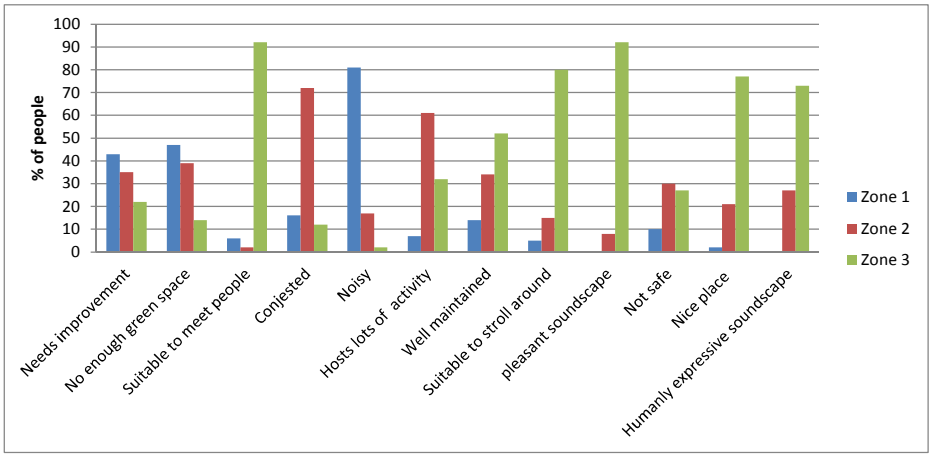


Figure 10 - Opinions on zones

3.2 Observations

Zone 1: The zone is dominated by traffic sound. The average L_{eq} (1hr) level is found to be 79 dB (A). The traffic sound functions like sound walls, creating a barrier to hearing all other sounds like people's conversation and distant wave sound. The eyes can see far ocean but the ear cannot hear beyond the acoustic immediacy of the motor vehicles, i.e. everything looks wide open visually but acoustically however, one is closed. The traffic noise is masked at one point by the sound of a 9.75m (384 in) high fountain. The fountain provides a positive deviation in the soundscape of the space. 80% of the people surveyed at this point felt the sound of water from the fountain to be dominating and refreshing than the prevailing adjacent traffic noise. From the traffic road, a level difference of 1.8m (70.86 in) from the road level aids in extrusion of traffic noise. The L_{eq} value measured here is 64.9 dB which is about 7 dB lower than that measured at the road level; this is described in Figure 11.

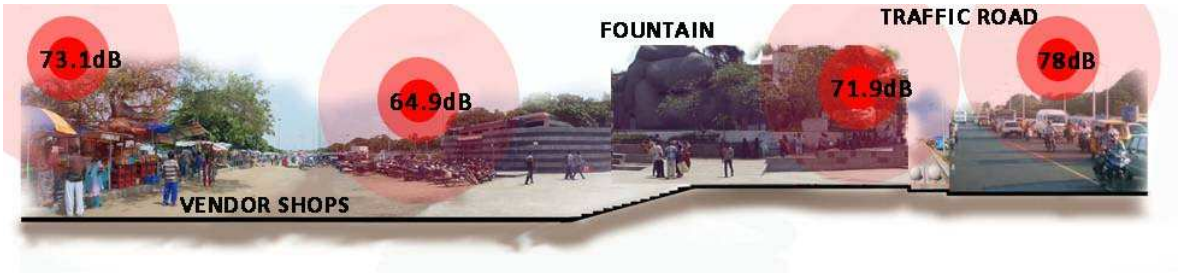


Figure 11 – Section describing the difference in sound level

Zone 2: The sound level throughout this zone is fluctuating as the space hosts loads of different activities. A 71.2 dB (A) sound emitting sugarcane juicer shop marks the entrance of zone 2.Continued by different other shops with sound level ranging from L_{eq} values of 54.3 dB (A) to 65 dB (A). This average sound level is interrupted by abutting sugarcane juicers at different intervals. As the cane juicer machine halts at intervals, the voices that were unintelligible murmur suddenly become clear and coherent. The background sound of people's conversation and traffic noise slowly transforms into people's conversation and wave sound. A point about 300m (11811.21 in) from the traffic road marks the first point of clear audibility of the wave sound, provided the cane juicer machine is halted. As the juicer machine starts off the wave sound becomes unintelligible and gradually increases again with further progression in distance, the lower end of zone 2 has sound of waters omnipresent but most of the time ignored. But they are there, and they shape the soundscape of the place.

Figure 12 – View of vendor shops (left), sugarcane juicer machine (right)

Zone 3: It is completely filled by the wave sound. The dB (A) level i.e. the physical property of the wave sound being similar to traffic noise is the most preferred sound of the soundscape. It is the sound mark of Marina. The zone has lot of people enjoying all their sensory experiences. As is evident from the results of the questionnaire, zone 3 is self-sufficient with its boundless sea, endless wave sound and enjoying people.

Figure 13 elaborates the conceptual sound distribution throughout the stretch along with the color-key.

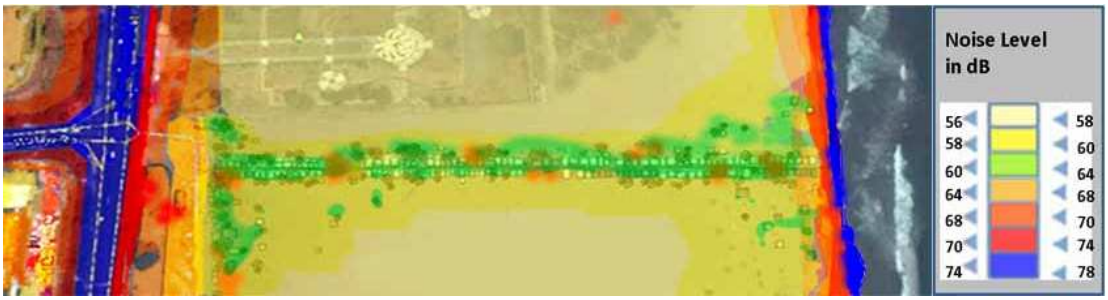


Figure 13 – Noise mapping

3.3 Noise Control Measures

The seashore is one of the important recreational public places of Chennai. This urban public space is bound to be affected by severe noise pollution in spite of its naturally existing acoustical elements. Hence passive planning measures can be adopted to revise the existing conditions. The seashore contains much acoustical enrichments which can be developed or modified like the below described points:

Vendor shops: There are trees found throughout the sandy stretch along the shops. It acts as sound absorbers and reduces the impact of noise on the environment. (7) The location of trees just behind the shops prevents the trees from absorbing the sound. Hence arrangement of the vendor shops can be altered from a narrow row into a wider one to make profitable use of trees. A conceptual description of the existing and suggested arrangement is described in Figure 14. The shops being made up of temporary materials can be replaced with cheap sound absorbing materials like egg cartons.

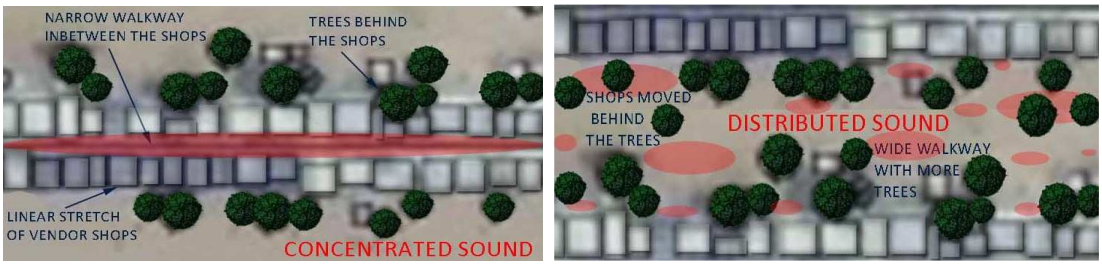


Figure 14- Existing arrangement of Vendor shops (left), Suggested arrangement to reduce noise (right)

Level Difference: There is an existing landscaped area with level difference that buffers traffic sound entering into the sandy stretch. Even though the traffic noise is getting buffered, there are other noise sources at the receiver point in the lower level that makes the level difference ineffective as shown in Figure 15. So the other sound sources apart from the traffic noise that contribute to the noise pollution must be masked or buffered. Example- a sound absorbing mask can be provided to cover the noise emitting part of the cane juicer machine.

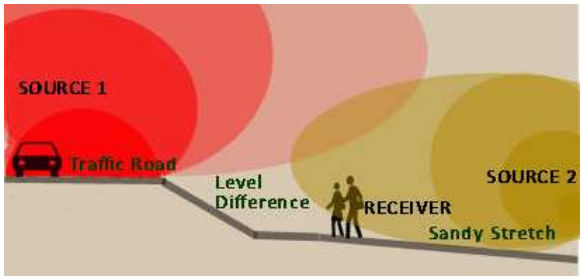


Figure 15 – Cross sectional representation of the level difference.

Fountain: It is present next to the traffic road as an element that attracts and welcomes people into the sea shore. The sound from the 9.75m (384 in) fountain distracts people from the surrounding noise and hence people ignore the annoying sound that affects them psychologically. But the presence of one fountain in the entire stretch is negligible even though it has positive impact. Hence more number of fountains can be placed.

Activities: Certain activities like conservation program for birds, first aid and rescue - awareness programs, that happens often, distracts people, making them forget about their surrounding and keeps them engaged. This distracts the audiences from unwanted noise. The calm environment created makes the high noise levels like those from cane sugar juicer and vendor bells clearly hearable. This makes the noise creators to reduce it by themselves. Hence permission for many such educational programs can be encouraged.

Other solutions: A retaining/decorative wall at intervals between zone 1 (traffic road) and zone 2 (sandy stretch) can be designed with absorptive barrier surfaces to reduce the traffic noise to a certain extent. More dense trees can be added to the landscaped stretch. Sound absorbing roads can be included. More buffer spaces between the traffic road the sand area can be designed. Within the vicinity of Traffic road, recorded and edited wave sound can be played to create a masking effect.

4. CONCLUSIONS

This paper analyzed the soundscape of urban public space which is located adjacent to the seashore. It is observed that people prefer natural sounds like waves, water and birds sounds compare to mechanical sounds. It is also observed that the wave sound of 75dB (A) is not annoying to the public where as the sound level of same 75dB (A) emitted from traffic/sugarcane juicer are annoying more. Habituation plays an important role in the annoyance and soundscape study. It is evident from the subjective survey that noise emitted by sugarcane juicer is not annoyed to the vendor whereas the same source is considered as one of the most annoying source by the public. But around 10% of urban residents being exposed to urban noises continuously throughout their life feel that the mixture of traffic sound, waves, sugarcane juicer, people's conversation, kid's playing etc marked the liveliness of Marina seashore, whilst the remaining 90% of the people prefer only natural sound sources. Hence the soundscape of urban public spaces can be improved by better architectural designs.

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