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Ambient noise levels in Major Cities in Kerala

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ABSTRACT
Acoustic noise beyond a level is harmful. The fact that a regulation to abate noise is in force should remove all doubts about the damaging aspect of noise pollution. The cities being the most polluted, the main thrust is towards estimating the level of pollution in the cities. Of all kinds of noise, traffic noise is known to contribute the maximum. Hence, as a first step towards assessment of noise pollution, measurement was taken up with emphasis on traffic noise. Measurements of noise levels were carried out in the three major cities in Kerala, viz. Thiruvananthapuram, Kochi and Kozhikode to assess noise pollution.

Two types of instruments with a calibration source were used for measurement. One Integrating Precision Sound Level Meter was used for measuring the equivalent continuous level (L_{eq}) and the spectrum of sound. A second instrument, a Noise Dose Meter, was used for continuous monitoring. Both instruments were calibrated before each field session using a secondary standard. All measurements were A weighted.

Measurements of noise levels were carried out in the commercial zones of the three cities. The results indicate that the noise levels are higher than the limits prescribed by the Ministry of Environment & Forests, Government of India. The silence zones in the cities also showed higher levels. The measured sound level inside residential buildings at night during festival time exceeds the prescribed limit by 30 to 40 dB. Announcements from vehicles fitted with public address systems can cause sound levels above 100 dB A at distances of 10 to 15 metres.

INTRODUCTION

Our activities on earth since the Industrial Revolution have continued to modify the environment. Fortunately, the concerns about our environment and the need for its protection have been gaining importance. It has been recognized that rise in the level of pollution of all kinds should be checked. Most of the pollutants that affect our environment are chemical in nature. Noise, a physical pollutant, is not easily recognized. This is because the sensitivity of human ear gets automatically adjusted to the ambient level of sound and so slow increases in the ambient level go unnoticed. Therefore noise continues to do the damage, silently.

Pollution, in general, is a by-product of some essential function or activity. Therefore it is almost impossible to completely eliminate the pollutant, but can be controlled or reduced. Most of the pollutants can be tolerated only up to a certain level, the level being dependent on the type of the pollutant. When the level of pollution continues to increase, it becomes necessary to know the amount by which the permissible limit has been exceeded so that their increase can be checked by the introduction of suitable regulations. To know the level of pollution the pollutant has to be measured. In the case of noise pollution, measurement is all the more essential because of the incapability of our auditory system to recognise slow changes.

The influence of noise on the human body can be due to direct effects upon the auditory system, on non - auditory physiological processes and on purely psychological mechanisms, (Tromp 1980; Ramakrishna 1974). The Ministry of Environment and Forests, Govt. of India, has time and again come out with notifications regarding allowable limits of noise. Through the comprehensive 1986 air act of the Ministry of Environment and Forests noise pollution has become an offence in India (Singal 1992). Permissible limits of noise have been specified for different urban environments. The latest one, The Noise Pollution (Regulation and Control) Rules, 2000, released in February 2000, clearly classifies our environment into four different categories and specifies the allowable limits of noise separately for day and night time for each category (see Table 1).

Table 1.

ZONE / AREA	DAY **(0600 – 2200 hrs)** Limits in dB(A) L_{eq}	NIGHT **(2200 – 0600 hrs)** Limits in dB(A) L_{eq}
INDUSTRIAL	75	70
COMMERCIAL	65	55
RESIDENTIAL	55	45
SILENCE	50	40

The different sources that contribute to noise pollution are the equipment used in construction, laying of the highways, take off and landing of air crafts, movement of trains and noise caused by vehicular traffic on the roads etc. Extensive surveys carried out in many other countries have identified traffic as the most widespread and annoying source of noise Sharp & Donovan (1979). Research conducted to identify the relative annoyance of different types of noise has shown that, for a given level, the noise produced by traffic is more annoying than that from trains or air crafts.

Pioneering work in the field of noise measurement, analysis and evaluation in India was done by National Physical Laboratory, New Delhi in the late fifties. The programme included survey of city noise, traffic noise, indoor and outdoor noise and diurnal variations of noise for the cities Delhi and Bombay. The results showed that daytime city noise varied from 60 dB in quiet localities to 95 dB in congested busy localities. The primary work created a lot of interest and made a way to extend the survey to Calcutta. In a later work in residential areas like Matunga in Bombay, affected by vehicular traffic the day and night time values were found to be 80 dB(A) and 60 dB(A). Kameswaran (1992) has done measurement of traffic and industrial noise in the cities of Madras, Coimbatore, Cochin and Trivandrum and found Trivandrum to be least noisy compared to the rest. Spot readings of traffic noise at four busy places in Trivandrum showed the noise levels to be about 70 dB(A) in 1982. Singh Brij Bhan, Chitranshi & Nigam (1986a, 1986b) have studied the noise levels in the sugar industry environment.

In the light of these measurements, a programme to assess the noise levels in the three major cities of Kerala state was taken up. Emphasis for the measurement of traffic noise was given. Apart from traffic noise, spot measurements of nose due to public address system were also carried out.

METHODOLOGY

As mentioned above, the emphasis of this study is on measurement of traffic noise. Traffic density varies during a day and so the noise due to traffic also varies. Therefore, the time and duration of measurement have to be fixed carefully if the measured values have to be representative of the actual noise distribution. In order to do this, the pattern of variation of traffic during the course of a day has to be determined.

After estimating the time and duration of sampling, measurements are to be made at different locations identified in each city. These locations also should be representative of the noise environment of the route or region of measurement. Such measurements are to be repeated in each city to arrive at a representative picture of the noise regimes.

The main thoroughfares of each city were first identified and measurement locations in these routes were selected. The selection was based on two considerations: one, the selected location is truly representative of the spatial distribution of noise in the region, and, two, the noise field at the point is not modified by structures and no obstacle modifies the measurement.

Apart from these measurements, spot measurements also have to be made of sound generated when public address systems are used, to gain a preliminary understanding of its contribution to environmental noise.

In order to make measurements of noise levels it becomes necessary to use standard equipment and procedure. Therefore, instruments conforming to an international standard manufactured by Bruel & Kjaer (B&K) have been employed in the measurements reported here. The B&K 2238 Mediator is a sound level meter with a pre-polarized ½-inch condenser microphone at the front end. This instrument has two modes of operation. In one mode it works independently as an Impulse Precision Sound Level Meter capable of measuring sound pressure level (SPL) with selectable frequency (A, C, Linear) and time (fast, slow or impulse RMS detector) weighting. In other words, it is capable of measuring sound pressure level precisely in either A, C, or Linear weighted mode or in impulse mode. It can store up to 500 such measurements. The stored file can be later transferred to a Personal Computer for analysis.

In the second mode of operation the Mediator works as a combination of sound level meter and 1/3 octave frequency analyser. Normally, it is necessary that such equipment should conform to relevant Indian standards for making reliable measurement. Because of the fast pace of development in electronic instrumentation the standards require frequent revision, Singal (1991). The equipment conforms to the following international standards. [IEC 1672 Class 1, IEC 651 Type II, IEC 804 Type I and ANSI S.1.4.3. Type S1].

The B&K 4443 is a noise dose meter capable of measuring Sound Pressure Level in A weighted mode. This has a ¼-inch pre-polarised free field condenser microphone at the front end. This meter computes the dose according to the criteria to which the meter is programmed. Programming and automatic measurement control can be achieved through a Personal Computer loaded with the necessary control soft ware. This can also be used as a sound level meter.

The dose meter conforms to IEC 942 - 1988 Class 1 and ANSI S.1.4.0 -1984 standards.

DATA COLLECTION AND ANALYSIS

As explained already it is necessary to determine the pattern of variation of traffic density before a decision can be taken on the time at which measurements can be made and the duration of each measurement. All vehicles are sources of noise and the measured noise is the resultant of all of them. Hence, it is necessary to know the number of vehicles producing the noise. Further, it is advantageous to know the number of vehicles in each class, like two wheelers, cars, heavy vehicles, etc. This information would be helpful for determining the source of each kind of noise. Therefore, determination of long duration traffic density (No. of vehicles / unit time) is a must. To obtain the traffic density data, a video camera was engaged to record the traffic in M.G. Road, Thiruvananthapuram, on one of the normal working days when all the institutions and commercial establishments were working. The record was taken from 0800 to 2000 hrs from a first floor balcony of a building almost jutting on to the road. The recording was done over 10 min. intervals with 10 min. breaks. In other words, records of 10-minute samples were taken after every 10 min. interval. Here, it is assumed that the traffic density does not vary much within a period of twenty minutes. The videotape was played back in slow mode and traffic density was estimated by counting the number of vehicles. The variation in traffic density with time is shown in Fig.1.

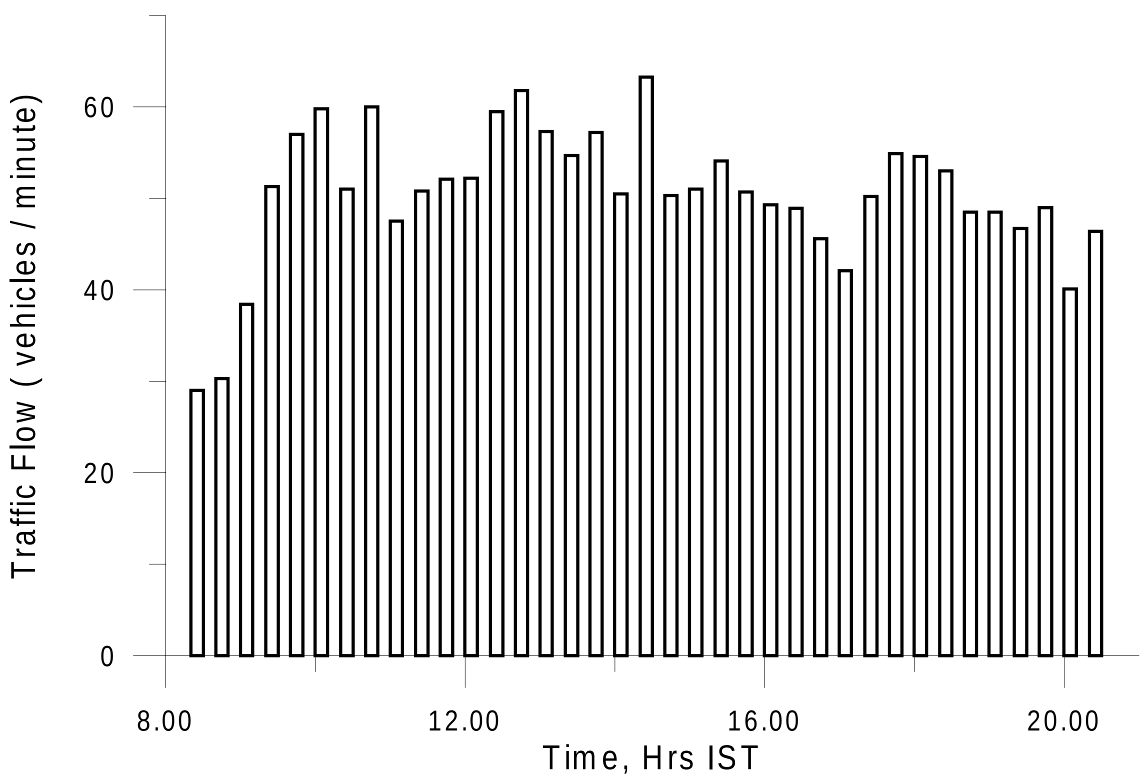

Figure 1. Variation of traffic flow during the course of a day taken using a video camera on a working day at Thiruvananthapuram

All the highs and lows seen in the curve are natural except the low near 1700 hrs, which was because of disruption of traffic for a few minutes due to the formation of a 'Human Chain' on that day. If this dip at 1700 hrs is ignored, the data shows that traffic density does not vary significantly over a day. However, it can be seen that on an average, after the traffic has picked up at about 0930 hrs and before it tapers of after 1900 hrs, more vehicles ply in the forenoon than in the afternoon. Hence, noise measurements were mostly conducted in the forenoon, that too preferably between 0930 and 1130 hrs. This ensured that the noise levels obtained were possibly the highest that could be expected at the site.

Since the pollution aspect in terms of harm to the human health is of concern, all measurements were A weighted. A few measurements were made to inter compare the Dose Meter with the Mediator and then all sample measurements were taken with the Dose Meter in 'A' weighted, equivalent continuous sound pressure level (LA_{eq}), logging mode. Measurement was made at each location for 10 minutes. The meter was programmed to record LA_{eq} for each minute during the measurement. The number of vehicles passing per minute at the time of measurement was noted down. In addition, the approximate distance from the middle of the road was also noted. This was only visual judgement. The meter was calibrated before every measurement using the sound level calibrator.

Noise measurements at Thiruvananthapuram

Measurements were taken at 21 locations out of which 19 were commercial zones and the other two belong to silence zones being hospitals. The measurements were made on two working days between 0945 and 1140 hrs keeping the duration of measurement at 10 minutes each location. On an average, it has been found that the commercial zones recorded a noise level of 81.3 dB(A), that is 16.3 dB above the permissible noise level as per Table 1. The silence zones recorded 78.7 dB(A) that is about 28.7 dB above the permissible level. In fact, the silent and commercial zones have recorded almost similar noise levels.

Noise measurements at Kochi

Measurements were taken at 26 locations; out of which two were in silence zones, one in a residential zone and the rest in commercial zone. The average noise levels in the commercial zone are 78.5 dB(A), 13.5 dB(A) above the permissible limit. The silence zones recorded 76.55 dB(A), 26.55 dB(A) above the permissible level. The sole residential zone recorded 40.7 dB(A) 15 dB(A) below the limit. In Kochi also, the silence zones and the commercial zones have recorded equal noise levels and well above the permissible limit.

Noise measurements at Kozhikode

Measurements were taken at 21 locations; out of which five were in silence zones and the rest in commercial zone. The average noise levels in the commercial zone is 77.5 dB(A), 12.5 dB(A) above the permissible limit. The silence zones recorded 74.7 dB(A), 24.7 dB(A) above the permissible level. In Kozhikode too, the silence zones and the commercial zones have recorded equal noise levels and well above the permissible limit.

The silence zones are Hospital zones in all the three cities and at Kochi include the zone around a court junction also. It can be seen that the hospital areas or silence zones have developed into almost commercial zones to cater to the needs of patients and the visitors. Proper approachability, transport, hotels, lodges, shops, medical laboratories have all made these silence zones into commercial zones that becomes inevitable. It is desirable to make measurements inside these hospitals and then compare them with the permissible levels. A good approach would be to make measurements inside and around such hospital or silence zones so that contours of equal noise levels can be made and then silence zone can be delineated. The noise levels in commercial zones being well above the permissible levels need to be carefully looked into. It may be worthwhile to study the effect of noise on population working in the commercial establishments in these commercial zones to see whether any impairment in their hearing is seen.

Fig.2 shows a comparative picture of noise levels measured in the three cities. As explained before, all the 3 cities experience more or less the same noise levels both in the commercial and silence zones.

Noise measurements during special events

Noise measurements were carried out during some festivals in Thiruvananthapuram city. These measurements show that the noise levels in the area of the festival are very high. These levels have gone very much beyond the prescribed limits in residential localities even at night. Table 2 shows some of the results from these measurements. In addition to L_{eq}, the table also gives the maximum sound level (L_{max}) during the measurement period.

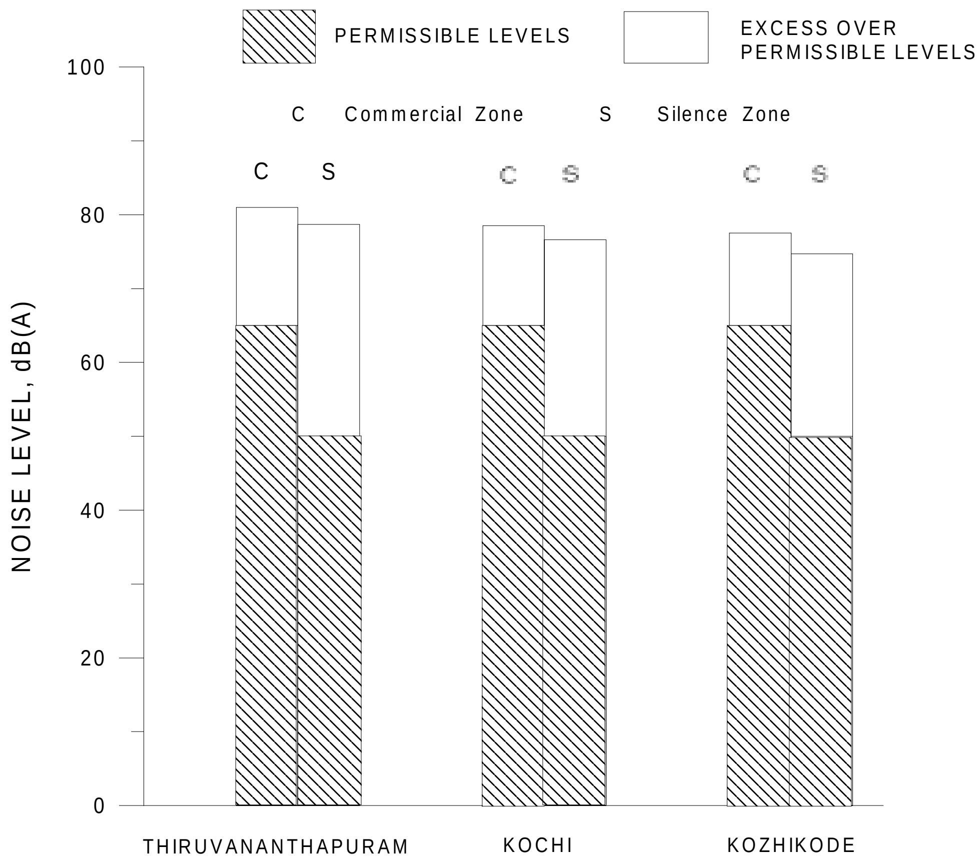

Figure 2. Measured ambient noise levels in the commercial and silence zones in the three major cities of Kerala. The permissible levels in these zones specified by the Ministry of Environment & Firests, Govt. of India are also shown.

Table 2.

No.	Area	Date & Duration	Classification	L_{eq} (dB A)	L_{max} (dB A)
1	Manacaud	8/3/2001: 1956 to 2019	Commercial	102.4	117
2	NCC Nagar	01/3/2001: 1744 to 2254	Residential	76.3	93.6
3	NCC Nagar (Inside House)	01/3/2001: 2255 to 0036	Residential	87.7	105.8

The election to the Kerala Legislative Assembly was held during May 2001. The campaign was conducted, as usual, using vehicles fitted with loud speakers. Noise levels generated by these vehicles during the closing period of the campaign were measured. It indicates the typical noise levels generated by similar campaigns and advertisements. These values are quite high L_{eq} averaging about 95 dB and L_{max} varying between 102 and 120 dB(A); the only redeeming factor, if we can consider it so, is that they are temporary.

CONCLSIONS

The measurement of noise levels in the three major cities in Kerala viz. Thiruvananthapuram (Trivandrum), Kochi(Cochin) and Kozhikode (Calicut) shows that the commercial zones experience about 15 dB(A) noise level above the prescribed limit. The silence zones experience similar noise levels and hence about 25 dB(A) above the prescribed limit. Special events like festivals, election campaigns generate noise levels that are prohibitively above the permissible limit with the only redeeming factor being that they last over a comparatively shorter duration.

Delineation of silence zones and commercial zones with closer measurements spatially will help to make these zone classifications more meaningful.

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