

# MAPPING AND ASSESSMENT OF NOISE POLLUTION USING GIS IN CALICUT CITY

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**Abstract** – Calicut is a rapidly growing city in Kerala. This paper deals with the study of noise pollution scenario of this city, a GIS based noise assessment was carried out at various zones viz.. residential zone, industrial zone, silent zones, commercial zones along with major traffic intersections within the city. The main objective of this paper is to get public awareness about the noisy environment with which we lives today due to the increased urbanization and increased traffic intensity. Using QGIS Software, noise maps are generated to make the awareness more accurately.

**Key Words:** QGIS- Quantum geographic information system, GIS- Geographic information system, SLM-Sound level meter, L<sub>10</sub>: A weighted noise level exceeding 10% of time, Leq- equivalent noise level, dB-decibel, L<sub>50</sub>-A weighted noise level exceeding 50% of time, L<sub>90</sub>- A weighted noise level exceeding 90% of time.

## 1. INTRODUCTION

The influx of people towards the cities and urban Centre are mainly in search of livelihood and better infrastructure amenities. Rapid influx of population has resulted Calicut City into large rate of urbanization. The environmental condition of the city has been changing abruptly along with the rapid growth of urbanization .Reckless use of horns and continuous vehicular movement results the noise pollution problem in the city. The present study is an attempt to evaluate noise pollution load of Calicut city due to urbanization activities and its detrimental effect on the human health and environment.

Noise mapping is an optimization technique that can be derived for different time periods (day/night and peak or non-peak hours). The main use of noise maps is to identify and quantify the scale of noise problems at local, regional, national level and provide information for town planning and traffic management. Noise map provides spatial presentation of acoustic situation. Noise maps build in GIS can be used for analysis and management process. Noise effect can be determined in GIS by combining noise levels with the location of people living in the area and their sensibility to noise.

## 2. STUDY AREA

Calicut also known as Kozhikode, is an Indian city, second-largest urban agglomeration in the State of Kerala and 20th largest in the country with a population of 2 million according to 2011 census.

Calicut city is situated on the West Coast of Indian sub-continent and on the North West of Kerala state, at latitudes between 1109' N to 110 21' N and longitudes between 750 44'E to 750 51'E.Kozhikode Municipal Corporation is one of the urban local bodies looking after the various development projects of the Calicut City. The study is carried out in different zones prescribed by the Kozhikode Corporation in their Master plan of Kozhikode city. The locations are taken by making sure that they are located inside a circumference of 10 km within the city.



**Fig-1:** Map of Calicut city highlighted with respect to map of Kerala and India

### 3. OBJECTIVE

The main objectives of the study are:

- To collect or measure the noise level and monitor the present noise environment in the different zones of Calicut city.
- To assess and compare the noise levels at different zones (residential, commercial, silent etc) in Calicut city with respect to prescribed limits mentioned in CPCB, India.
- Apart from different zones, the noise data of traffic intersections are measured to analyze the impact of traffic volume on noise pollution.
- To prepare noise maps by applying GIS (Geographic information system) and GPS (Global positioning system) techniques with the help of QGIS software.
- To provide recommendations for preventing and controlling the noise pollution.

### 4. MATERIALS AND METHODS

A noise level survey was carried out to assess the noise environment of Calicut city. The noise levels were assessed with Sound Level Meter (SLM) (model SL4010 Digital Sound Level Meter is used in this study) it is designed for sound level measurements according to the IEC standard. The device was manufactured by BEETECH Electrical Electronics corp. Taipei, Taiwan it has measuring range of 30 to 130 dB This instrument measures the sound pressure level in dB (A) i.e. decibels in A weighted scale.

Measured sound level data are interpreted in the form of equivalent sound level pressure (Leq) and the values of Leq are being compared with the prescribed standard of CPCB (Central Pollution Control Board), India Observed sound level data were used to calculate the day time equivalent noise level, night time equivalent noise level, day-night equivalent noise level, L10, L50, L90, Lmax and traffic noise index. The calculations were made based on the following equations.

$$Leq = 10 \log (10) L_i / 10 * t_i / t$$

Where n= number of sound samples  $L_i$ =noise level of i th sample  $t_i$  = time duration of ith sample,  $t_t$  = total time period of event

A-weighting is the most commonly used curves defined in the International standard IEC 61672:2003 and various national standards relating to the measurement of sound pressure level. The sound level meter consists of microphone or receiver, preamplifier, weighting network, amplifier, rectifier and digital LCD display meter

#### 4.1 Noise Level Parameters Measured

The noise levels of  $L_{10}$ ,  $L_{50}$ ,  $L_{90}$ ,  $L_{eq}$ ,  $L_{min}$ ,  $L_{max}$ , noise pollution level (NPL), noise exceedance factor (NEF) noise climates (NC) and Noise Index (NI) are used for analysis.

• **Maximum noise level (Lmax):** it is the highest value measured by sound level meter (SLM) over a given period of time

• **Minimum noise level (Lmin):** lowest value measured by the Sound Level Meter (SLM) over a given period of time.

• **Equivalent continuous noise level (Leq):** preferred method to describe sound level that vary over time, resulting in single decibel value which takes into account, the total sound energy over the given period of time of interest.

• **L10:** A weighted noise level exceeding 10% of time.

• **L50:** A weighted noise level exceeding 50% of time.

• **L90:** A weighted noise level exceeding 90% of time.

• **Noise Exceedance Factor (NEF):** It is the ratio of obtained equivalent noise level (Leq) to the standard permissible noise level prescribed by CPCB.

$$NEF = L_{eq} / L_p$$

Where  $L_{eq}$  = equivalent noise level, dB

$L_p$  = Standard permissible noise level given by CPCB, dB

• **Noise Pollution Level (NPL):** NPL takes into account the variations in the sound signal and hence serves as better indicator of the pollution in the environment for physiological and psychological disturbance of the human system

$$NPL = L_{50} + [(L_{10} - L_{90})^2 / 60] + (L_{10} - L_{90})$$

Where, NPL = Noise Pollution Level  $L_{10}$ ,  $L_{50}$  and  $L_{90}$  respectively indicate the level exceeded for 10%, 50% and 90% of the time in a record of a noise level in a given interval.

• **Noise climate (NC):** Noise climate (NC) is the range over which the sound levels are fluctuating in an interval of time and is given by the relation

$$\text{Noise Climate (NC)} = (L_{10} - L_{90})$$

Where,  $L_{90}$ , the level exceeded for 90% of the time of record, is very near to the background noise level in the absence of any motor vehicle traffic.

• **Noise Index (NI):** It is the measure of annoyance behavior of humans exposed to environmental noise, and this is estimated using the equation given below.

$$NI = 4x(L_{10} - L_{90}) + (L_{90} - 30)$$

#### 4.2 Noise Measurement

The noise level were measured at different locations of the Calicut city covering different zones viz. commercial, residential, industrial, silence zones and traffic intersections.

Average time of 30 minutes was followed for measuring noise levels at each location during peak and non-peak hours of the day. The sound level meter was handled at proper orientation to receive the maximum sound intensity at 1.2m height above the ground. The same procedure was maintained for all the survey points in the city. Noise sampling was carried out at each of the locations for a period of 30 minutes during both peak hours (8Am to 11Am and 4pm to 7pm) and off peak hours (12 pm to 3pm and 8pm to 11pm). The GPS points were also collected for each location for accurate coordinates of the sampling points for the purpose of noise mapping. An appropriate distance and proper orientation of microphone of the sound level meter (SLM) was maintained for each sampling locations.

### 4.3 QGIS (Quantum Geographic Information System)

QGIS known as Quantum GIS is a free desktop geographic information system (GIS) application that supports viewing, editing, and analysis of geospatial data. It is a GIS for working with maps and geographic information. It is used for creating and using maps, compiling geographic data, analyzing mapped information, sharing and discovering geographic information, using maps and geographic information in a range of applications, managing geographic information in a database. QGIS supports shape files, coverages, personal geodatabases, dxf, MapInfo, PostGIS, and other formats. Web services, including Web Map Service and Web Feature Service, are also supported to allow use of data from external sources. QGIS integrates with other open-source GIS packages, including PostGIS, GRASS GIS, and MapServer Plugins written in Python or C++ extend QGIS's capabilities.

### 4.4 Noise Mapping

Noise mapping was prepared using QGIS software for better visual information of the noise environment of Calicut city and its diurnal variations. QGIS software used to plot the noise levels contours using interpolation technique. Interpolation is an effective technique used by various researchers for the purposes of noise mapping. In this interpolation technique is done considering to assess the acoustic behaviour of the geographical area. The noise level maps were prepared in QGIS day to show the diurnal variation of the noise environment in the Calicut city. QGIS, appropriately gives better visual information of the regions with higher noise levels and traffic accumulations and also identifies the more vulnerable areas under the noise pollution threat.

## 5. RESULT AND DISCUSSION

This noise survey reveals that noise environment of the Calicut city is not so satisfactory as per the standards prescribed by CPCB and BIS "The Noise Pollution (Regulation and Control) Rules, 2000" (Table 1).

The scenario is deteriorating day by day with exponential increase in population as well as the number of vehicles in city road.

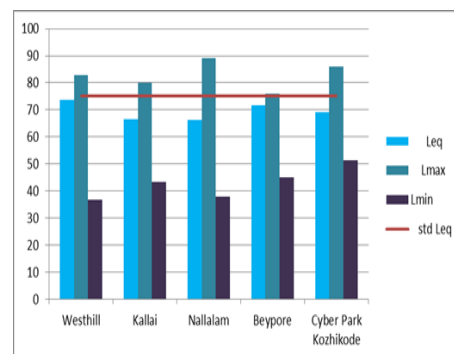
**Table-2:** Ambient Air Quality Standards in respect of Noise (Source: The Noise Pollution (Regulation and Control) Rules, 2000)

Category of Area/Zone	Limits in dB(A) Leq	
	Day Time	Night Time
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

The study area is situated within the city limits included with different locations selected in the different zones like residential, industrial, commercial and silent zones along with the major traffic intersections specially located along the town area of the Calicut city. The noise measurements are tabulated below along with the table the graphical representations showing variations in Leq and std Leq, Lmax (maximum noise level shown by the device during noise measurement in sound level meter) and Lmin (minimum noise level shown by the device during noise measurement in sound level meter) are shown as combination graphs

**Table -3:** Noise Data Collected From Industrial Zones During Peak Hours

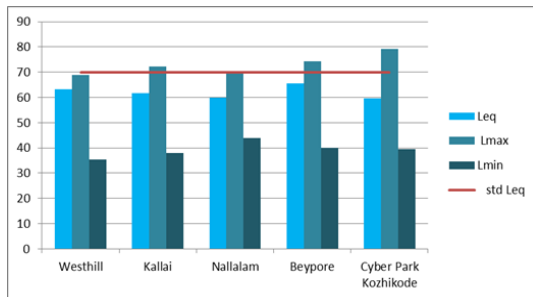
Sl.No	Location	Latitude	Longitude	Leq	Std Leq	Lmax	Lmin	L10	L50	L90	NEF	NI	NC	NPL
1	Westhill	11.28226 N	75.76974 E	73.56	75	82.8	36.9	82.6	78.3	74.5	0.98	76.9	8.1	87.5
2	Kallai	11.23524 N	75.79383 E	66.56	75	79.9	43.4	76.5	74.6	72.3	0.89	59.1	4.2	79.1
3	Nallalam	11.20352 N	75.8138 E	66.31	75	89.3	37.8	74.4	71.9	67.8	0.88	64.2	6.6	79.2
4	Beyyore	11.18333 N	75.80699 E	71.82	75	75.9	45.1	68.3	65.6	63.5	0.96	52.7	4.8	70.8
5	Cyber Park Kozhikode	11.25418 N	75.83703 E	68.98	75	85.9	51.3	75.8	72.5	70.1	0.92	62.9	5.7	78.7



**Chart -1:** Graphical Representation of Noise Data in Industrial Zone during Peak Hours

**Table-4:** Noise Data Collected From Industrial Zones during Non-Peak Hours

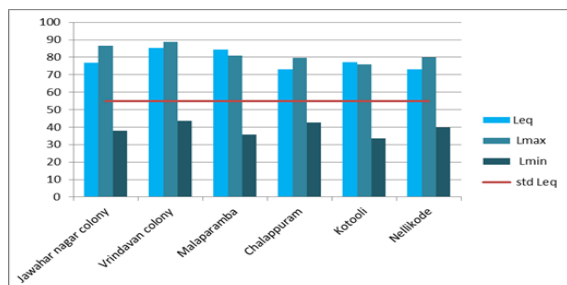
Sl.No	Location	Latitude	Longitude	Leq	std Leq	Lmax	Lmin	L10	L50	L90	NEF	NI	NC	NPL
1	Westhill	11.28226 N	75.76974E	63.29	70	68.8	35.4	64.2	61.6	58.5	0.9	51.3	5.7	67.8
2	Kallai	11.23524 N	75.79383E	61.77	70	72.3	37.9	61.6	58.2	55.8	0.88	35.4	2.4	60.7
3	Nallalam	11.20352 N	75.8138 E	59.92	70	70.4	43.8	67.8	64.2	62.9	0.86	52.5	4.9	69.5
4	Beypore	11.18333 N	75.80699E	65.65	70	74.4	40.1	68.2	64.3	61.1	0.94	59.5	7.1	72.24
5	Cyber Park Kozhikode	11.25418N	75.83703E	59.67	70	79.2	39.6	66.7	63.3	60.1	0.85	56.5	6.6	70.63



**Chart -2:** Graphical Representation of Noise Data in Industrial Zone during Non-Peak Hours

**Table-5:** Noise Data Collected From Residential Zones during Peak Hours

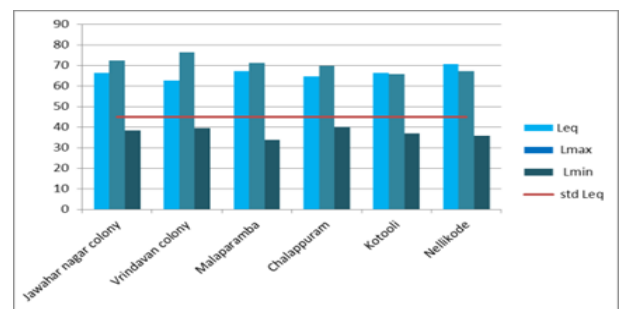
Sl.No	Location	Latitude	Longitude	Leq	std Leq	Lmax	Lmin	L10	L50	L90	NEF	NI	NC	NPL
1	Jawahar nagar colony	11.26872 N	75.78125 E	76.84	55	86.5	37.8	72.5	68.3	61.9	1.4	75.9	10.6	80.8
2	Vrindavan colony	11.27506 N	75.81708 E	85.15	55	88.9	43.6	69.1	67.3	59.9	1.55	66.7	9.2	77.9
3	Malaparamba	11.28568 N	75.81145 E	84.32	55	80.8	35.7	75.8	72.6	62.7	1.53	85.1	13.1	88.6
4	Chalappuram	11.24063 N	75.79092 E	72.96	55	79.7	42.5	79.3	72.8	70.1	1.33	76.9	9.2	83.4
5	Kotooli	11.26209 N	75.79967 E	77.27	55	75.9	33.6	76.6	72.2	65.8	1.4	79	10.8	84.9
6	Nellikode	11.25572 N	75.81521 E	73.05	55	79.9	39.9	73.2	72.18	63.9	1.33	71.7	9.3	82.9



**Chart -3:** Graphical Representation of Noise Data in Residential Zone during Peak Hours

**Table-6:** Noise data collected from Residential Zones during Non-Peak hours

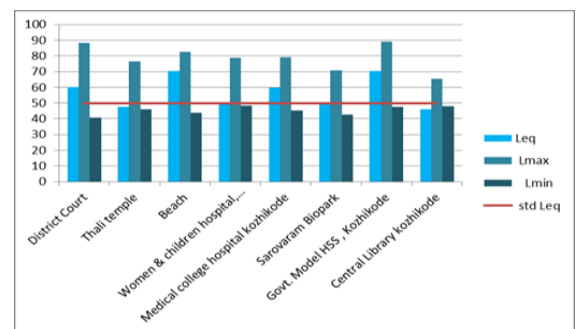
Sl.No	Location	Latitude	Longitude	Leq	Std Leq	Lmax	Lmin	L10	L50	L90	NEF	NI	NC	NPL
1	Jawahar nagar colony	11.26872 N	75.78125 E	66.31	45	72.2	38.3	63.1	59.4	57.5	1.5	49.9	5.6	65.5
2	Vrindavan colony	11.27506 N	75.81708 E	62.57	45	76.2	39.5	60.2	57.8	55.4	1.4	44.6	4.8	63
3	Malaparamba	11.28568 N	75.81145 E	67.3	45	71.17	33.8	68.3	65.2	62.3	1.5	56.3	6	71.8
4	Chalappuram	11.24063 N	75.79092 E	64.7	45	69.8	40.1	61.4	58.5	56.3	1.44	46.7	5.1	64
5	Kotooli	11.26209 N	75.79967 E	66.23	45	65.8	36.9	69.5	65.2	63.1	1.5	58.7	6.4	72.3
6	Nellikode	11.25572 N	75.81521 E	70.7	45	67.2	35.7	65.7	63.5	60.1	1.6	52.5	5.6	69.6



**Chart -4:** Graphical Representation of Noise Data in Residential Zone during Non-Peak Hours

**Table-7:** Noise data collected from Silent Zones during Peak hours

Sl.No	Location	Latitude	Longitude	Leq	std Leq	Lmax	Lmin	L10	L50	L90	NEF	NI	NC	NPL
1	District Court	11.2519 N	75.7755 E	60	50	88.2	40.6	58.9	57.4	55.8	1.2	38.2	3.1	60.7
2	Thali temple	11.24772 N	75.78736 E	47.4	50	76.6	46.2	54.9	52.6	51	0.95	36.4	3.8	56.6
3	Beach	11.25459 N	75.7708 E	70.5	50	82.7	43.7	78.2	72.3	70.9	1.4	70.1	7.3	80.5
4	Women & children hospital, Kozhikode	11.25022N	75.78316 E	49.2	50	78.6	48.5	50.9	58.2	53.7	0.98	52.5	7.2	66.3
5	Medical college hospital kozhikode	11.27221 N	75.8372 E	59.8	50	79.3	45.4	63.9	61.8	59.9	1.2	45.9	4	66.1
6	Saravaram Biopark	11.26663 N	75.79275 E	50.2	50	70.9	42.7	67.8	65.3	59.8	1	61.8	8	74.4
7	Govt. Model HSS, Kozhikode	11.25483 N	75.77879 E	70.3	50	88.9	47.6	81.2	71.4	71.4	1.4	80.6	9.8	82.8
8	Central Library kozhikode	11.25285 N	75.78108 E	45.9	50	65.6	48.1	60.7	57.2	57.2	0.92	50.8	5.9	63.7



**Chart -5:** graphical representation of noise data in Silent zone during peak hours.

**Table-8:** Noise Data Collected From Silent Zones during Non-Peak Hours

Sl.No	Location	Latitude	Longitude	Leq	std Leq	Lmax	Lmin	L10	L50	L90	NEF	NI	NC	NPL
1	District Court	11.2519 N	75.7755 E	49.1	40	59.9	38.7	62.1	59.8	47.6	1.23	75.6	14.5	77.8
2	Thali temple	11.24772N	75.78736 E	46.3	40	69.8	35.1	56.2	54.3	50.2	1.16	44.2	6	60.9
3	Beach	11.25459N	75.7708 E	72.86	40	87.9	33.2	82.1	76.1	70.1	1.82	88.1	12	90.5
4	Women & children hospital, Kozhikode	11.25022N	75.78316 E	44.65	40	80.2	36.8	73.2	71.5	69.3	1.12	54.9	3.9	75.7
5	Medical college hospital kozhikode	11.27221N	75.8372 E	64.2	40	88.9	38.4	60.1	58.3	55.6	1.61	43.6	4.5	63.1
6	Saravaram Biopark	11.26663N	75.79275 E	55.4	40	70.1	32.8	65.3	63.1	60.8	1.39	48.8	4.5	68
7	Govt. Model HSS, Kozhikode	11.25483N	75.77879 E	52.1	40	89.6	43.5	78.3	75.6	72.1	1.3	66.9	6.2	82.4
8	Central Library kozhikode	11.25285N	75.78108 E	44.4	40	68.3	42.8	54.1	51.6	49.8	0.99	37	4.3	56.2

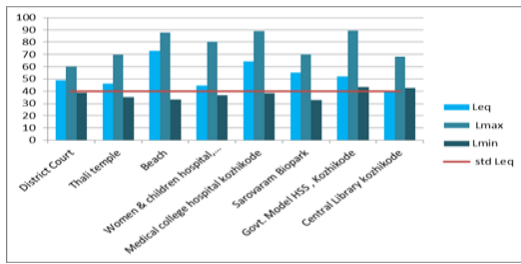


Chart -6: Graphical Representation of Noise Data in Silent Zone during Non-Peak Hours

Table-9: Noise Data Collected From Commercial Zones during Peak Hours

SLNo	Location	Latitude	Longitude	Leq	std Leq	Lmax	Lmin	L10	L50	L90	NEF	NI	NC	NPL
1	Big Bazar (valiyangadi)	11.24895 N	75.77524 E	72.56	65	89.5	49.7	76.5	75.3	71.8	1.12	50.5	4.7	80.4
2	S M Street (mittayi theruvu)	11.25283 N	75.78147 E	74.98	65	91.6	43.3	78.1	72.1	70.3	1.15	71.5	7.8	81
3	Vegetable market palayam	11.24964 N	75.78521 E	77.96	65	90.9	39.2	76.5	72.3	69.8	1.2	66.6	6.7	79.7
4	Hilite Mall	11.24842 N	75.83335 E	72.44	65	79.1	33.3	73.8	70.5	66.7	1.11	65.1	7.1	78.4
5	Focus Mall	11.25864 N	75.78577 E	69.3	65	82.6	40.1	70.1	65.9	62.3	1.07	63.5	7.8	74.7
6	Mavoor road	11.25895 N	75.78057 E	82.52	65	93.6	51.6	88.5	80.1	79.9	1.27	84.3	8.6	90
7	Railway Station calicut	11.24587 N	75.7804 E	86.42	65	108.6	54.2	98.4	93.8	89.7	1.33	94.5	8.7	103.7
8	Mofusal Bus Stand, Calicut	11.259 N	75.78635 E	83.39	65	101.1	47.6	93.7	89.9	86.3	1.29	85.9	7.4	98.2

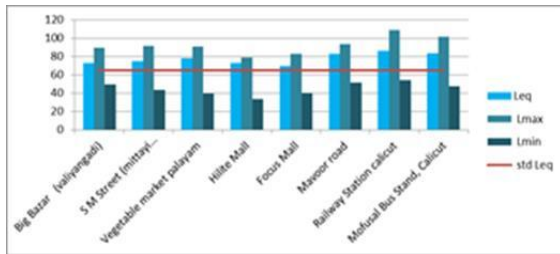


Chart -7: Graphical Representation of Noise Data in Commercial Zone during Peak Hours.

Table-10: Noise Data Collected From Commercial Zones during Non-Peak Hours

SLNo	Location	Latitude	Longitude	Leq	std Leq	Lmax	Lmin	L10	L50	L90	NEF	NI	NC	NPL
1	Big Bazar (valiyangadi)	11.24895 N	75.77524 E	77.33	55	82.6	49.2	73.2	71.3	70.1	1.41	52.5	3.1	74.5
2	S M Street (mittayi theruvu)	11.25283 N	75.78147 E	72.69	55	87.8	48.9	75.3	72.1	71.8	1.32	55.8	3.5	75.8
3	Vegetable market palayam	11.24964 N	75.78521 E	81.46	55	85.2	51.7	78.2	75.5	69.9	1.48	73.1	8.3	85
4	Hilite Mall	11.24842 N	75.83335 E	72.21	55	78.9	40.8	71.3	70.2	68.8	1.31	48.8	2.5	72.8
5	Focus Mall	11.25864 N	75.78577 E	70.29	55	80.5	47.6	70.8	68.3	65.7	1.28	56.1	5.1	73.8
6	Mavoor road	11.25895 N	75.78057 E	81.39	55	88.3	49.8	80.6	78.1	75.3	1.48	66.5	5.3	83.9
7	Railway Station calicut	11.24587 N	75.7804 E	82.43	55	99.7	47.9	89.7	87.6	82.6	1.49	81	7.1	95.5
8	Mofusal Bus Stand, Calicut	11.259 N	75.78635 E	79.68	55	94.6	49.6	90.1	89.8	87.9	1.45	66.7	2.2	92

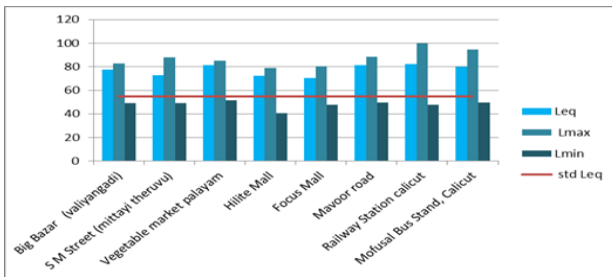


Chart -8: Graphical Representation of Noise Data in Commercial Zone during Non-Peak Hours

Table-11: Noise Data Collected From Traffic Intersections during Peak Hours

SLNo	Location	Latitude	Longitude	Leq	std Leq	Lmax	Lmin	L10	L50	L90	NEF	NI	NC	NPL
1	Erinjipalam Junction	11.27925 N	75.78423 E	87.62	80	113.1	56.7	98.3	96.1	93.2	1.1	83.6	5.1	101.6
2	Bank Road Junction	11.25712 N	75.78027 E	88.96	90	101.3	50.8	97.8	95.3	92.9	0.99	82.5	4.9	100.6
3	Pushpa Junction	11.24279 N	75.78514 E	85.15	90	99.9	53.4	95.7	93.2	91.9	0.95	77.1	3.8	97.2
4	Palayam Junction	11.2488 N	75.78392 E	90.29	90	98.5	49.9	97.3	95.2	91.7	1	84.1	5.6	101.3
5	Pottammal Junction	11.26003 N	75.80815 E	85.5	80	103.8	54.7	103.8	98.3	95.8	1.07	97.8	8	107.4
6	Malaparamba Junction	11.28705 N	75.80098 E	84.1	90	101.2	49.9	98.7	96.4	92.7	0.93	86.7	6	103
7	Christian College Junction	11.26491 N	75.7796 E	86.1	90	94.8	51.8	90.6	88.7	85.3	0.96	76.5	5.3	94.5

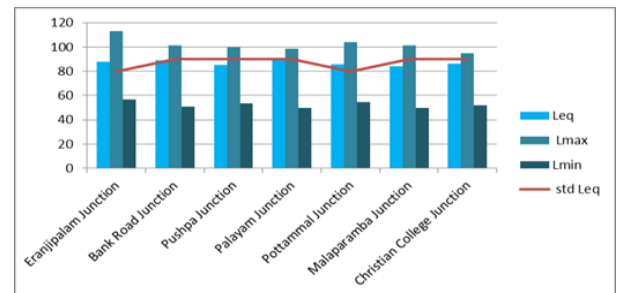


Chart -9: Graphical Representation of Noise Data in Traffic Intersections during Peak Hours

Table-12: Noise Data Collected From Traffic Intersections during Non-Peak Hours

SLNo	Location	Latitude	Longitude	Leq	std Leq	Lmax	Lmin	L10	L50	L90	NEF	NI	NC	NPL
1	Erinjipalam Junction	11.27925 N	75.78423 E	84.97	70	98.9	49.3	92.8	90.3	87.3	1.2	79.3	5.5	96.3
2	Bank Road Junction	11.25712 N	75.78027 E	86.6	80	99.7	43.5	96.1	93.7	92.5	1.08	76.9	3.6	97.5
3	Pushpa Junction	11.24279 N	75.78514 E	82.46	80	103.1	39.9	90.7	88.3	85.6	1.03	76	5.1	93.8
4	Palayam Junction	11.2488 N	75.78392 E	84.2	80	93.2	45.3	89.3	87.1	83.2	1.05	77.6	6.1	93.8
5	Pottammal Junction	11.26003 N	75.80815 E	77.4	70	89.7	42.7	88.7	85.1	82.1	1.1	78.5	6.6	92.4
6	Malaparamba Junction	11.28705 N	75.80098 E	80.6	80	88.9	40.8	90.5	88.9	86.3	1	73.1	4.2	93.4
7	Christian College Junction	11.26491 N	75.7796 E	83.3	80	97.6	46.6	93.8	90.7	87.8	1.04	81.8	6	97.3

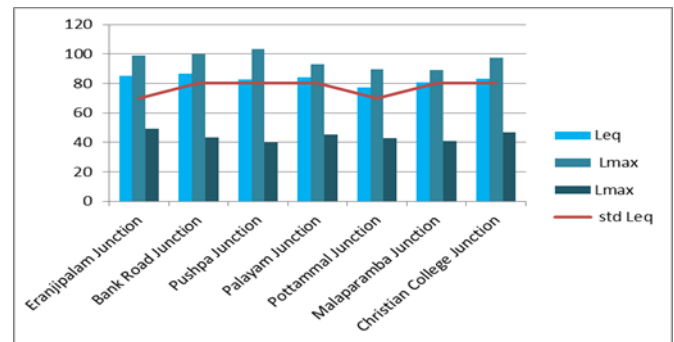


Chart -10: Graphical Representation of Noise Data in Traffic Intersections during Non-Peak Hours

### 5.1. Noise mapping

Noise level data obtained from various locations of the Calicut city along with geographical coordinates collected with GPS were plotted in QGIS software. Interpolation technique was applied for noise mapping, considering the distances between the sampling locations and noiselevels at each location. The noise mapping images of each zones during peak and non-peak hours are mapped separately using QGIS software.

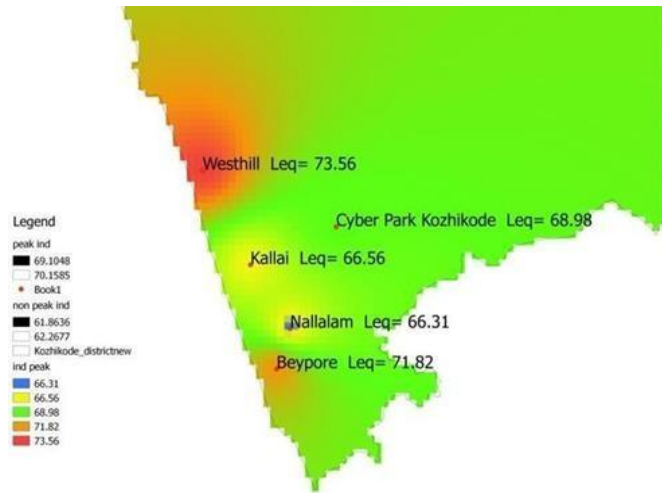


Fig-3: GIS mapping of the locations under industrial zone during peak hours done in QGIS

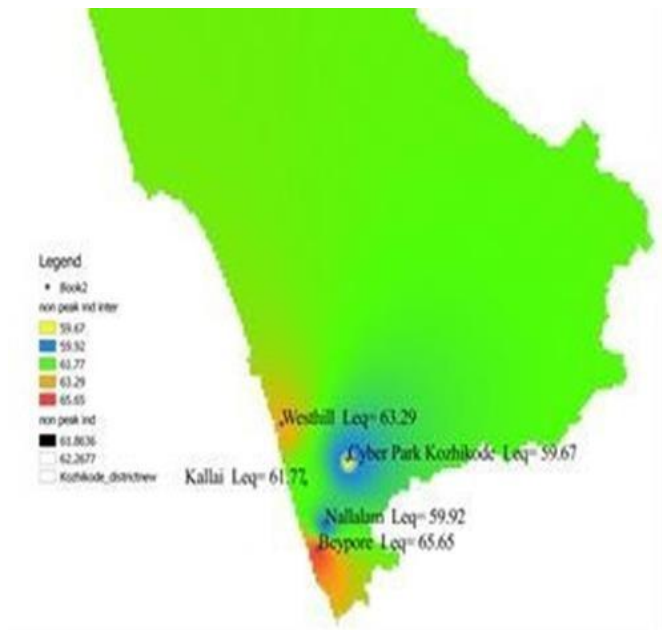


Fig-4: GIS mapping of the locations under industrial zone during Non-peak hours done in QGIS using Leq

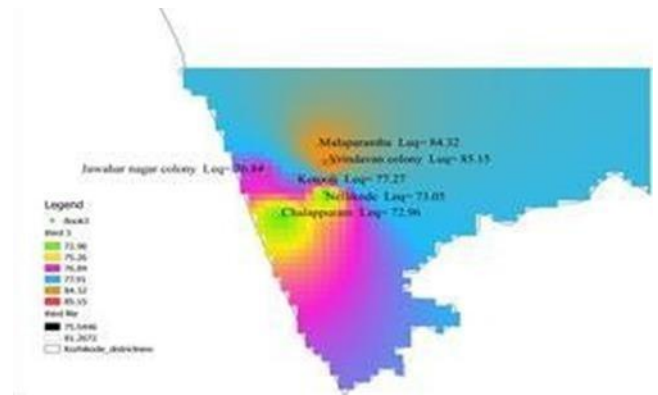


Fig-5: GIS mapping of the locations under Residential zone during peak hours done in QGIS using Leq

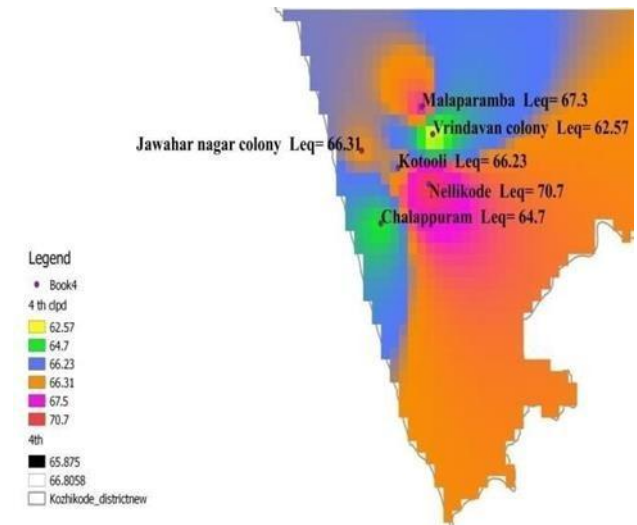


Fig6: GIS mapping of the locations under Residential zone during Non peak hours done in QGIS using Leq

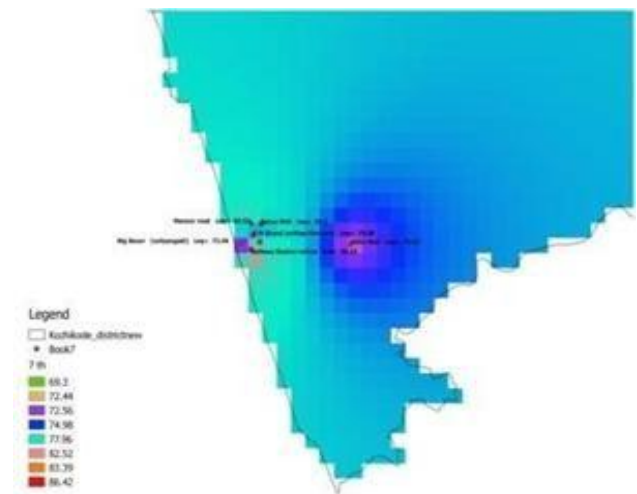
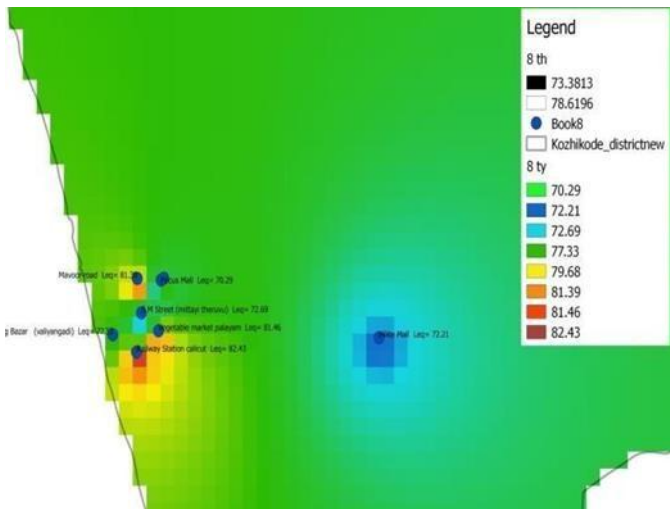
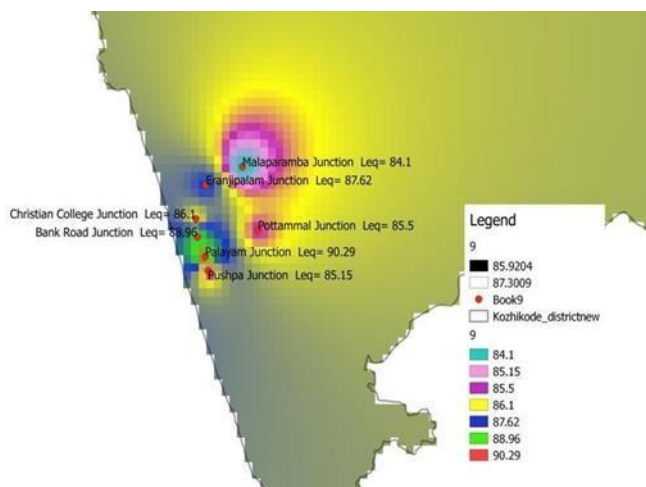


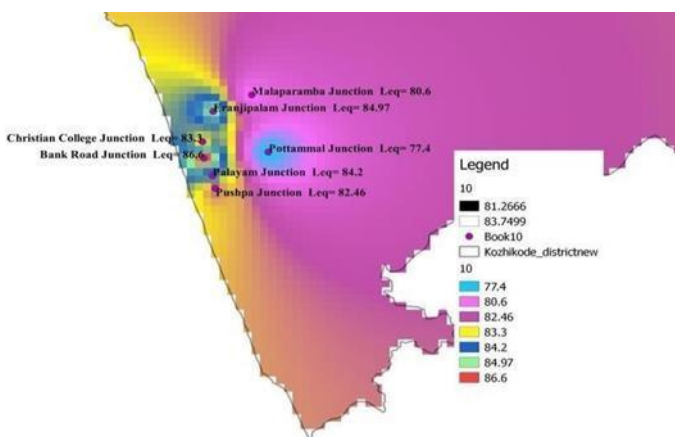
Fig-7: GIS mapping of the locations under Commercial zone during peak hours done in QGIS using Leq



**Fig-8:** GIS mapping of the locations under Commercial zone during Non peak hours done in QGIS using Leq



**Fig-9:** GIS mapping of the locations under Traffic intersections during peak hours done in QGIS using Leq



**Fig-10:** GIS mapping of the locations under Traffic intersections during Non peak hours done in QGIS using Leq

From the tabulated result and noise map it is assessed that,

- Noise level during peak and off peak hours in all the locations at Industrial area are within the limit noise exceedance factor where all less than 1 which implies that all the locations are in safe in industrial zone.

- In residential zone during peak hours and non-peak hours the noise levels are beyond the limits and the noise exceedance factor during peak hours are all greater than one while 2 stations (Vrindavan colony and malaparamba) are showing exceedance greater than 1.5 which shows there is chance for risk of noise pollution at very high level in this area .During off peak hours in residential zone every point is facing the risk of noise pollution.

- Noise level at silent zone during peak hours implies that out of 7 sampling stations, 3 of the stations are within limits (ie; near Thali temple, W&C hospital, central library) other 5 locations are above the limit while during off peak hours only central library was within the limit and other 4 are above the standard levels that are prescribed by CPCB

- Noise levels that are at all the locations in commercial area during peak and off peak hours exceeds the standards as there is a lot of loading and unloading activities during off peak hours specially during night and during peak hours due to commercial activities the limits are going beyond the limit.

- In traffic intersections during peak hours 4 of the intersections where at border and not exceeding the standard while 3 of the 7 exceeds above the standard limit. while during off peak hours only one station is within the limit and the other six are beyond the standard limit. The results of maps shows that majority of locations are not meeting the required standards during both peak and off peak hours . but in case of industrial area, all of the stations meets the standards and in residential area all the stations are beyond the limit in peak and off peak hours. In silent zones it is mixed result. In industrial areas, the activities found for noise generation are industrial activities, loading and unloading of materials and vehicular motion. Noise generating activities in commercial zones are vehicular movement, blowing of horns, use of public addressing system , loading and unloading of goods, constructional activities and human noises. The most noticed impulsive sound are vehicular horns and the use of single cylinder diesel engine auto rickshaws. Modification of silencer of some vehicles also cause noise pollution in streets.

In silent zones, especially in school college areas major factor of noise generation are human noise and mainly vehicular noise. The use of public addressing system, household activities and constructional activities are found to be the source of noise in silent zones and residential areas. Even though the use of horns and public address systems are legally banned there are plenty of incidents noticed inside the city. It is found that vehicular noise is the most common cause of noise pollution in every zones but unfortunately no action plans are initiated officially to regulate this.

Although master plans have been foreseen by the corporation of

Kozhikode the development of the city is not executed in a well planned systematic manner. Most of the roads of the city were not in good conditions and some of the roads of different zones was under process thereby resulting in traffic congestion as well as equipment used in the construction of roads were also the cause of exceeded noise levels.

## 7. CONCLUSION

Existing scenario of noise pollution in Kozhikode city was experimentally studied. The average noise level for silent zone, traffic intersections and silent zone shown some sampling stations with undesirable values. The residential zones located within the city shown higher limit of noise level both during peak and non-peak hours while the locations involved in industrial area shown noise levels lower than the standards prescribed by the pollution control board. It was concluded that the major reason of noise pollution inside the city was due to air horns and vehicular movements. The study gives a base line data for Kozhikode city that would help in planning and developing action plans for the future development of the city

### 7.1. Recommendations

According to the result obtained in the study, the following recommendations are proposed to keep the noise levels within the existing standards.

1. Limit the noise level of air horns and to be implemented strictly
2. Regulate the noisy vehicles like single cylinder diesel engine auto rickshaws.
3. Provide pro-elastic traffic roads for noise control.(eg: rubberized tar roads)
4. Strictly control the modification of silencers in vehicles.
5. Demarcate no-honking zones in residential and silent zones.
6. Strictly implement the no -honking of air horns in silent areas.
7. Forbid all types of heavily noise generating vehicles in silent zones.
8. Create baffle zones in sensitive areas.
9. Provide noise barriers like belt and curtain plants for hospitals and educational institutions.
10. Enforcement of speed limits for heavy vehicles in residential areas.
11. Provide tree belt and hedges on the roadside to control vehicular noise pollution.
12. Take appropriate actions like "reduction at source itself" to reduce noise pollution from industrial and point sources.
13. Adopt and follow proper land use plans.
14. Regulate the use of noisy fire crackers in festivals and on special occasions.

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