

Investigation of Noise Pollution of Nanded City, Maharashtra Case Study using GIS and Data Mining Technique

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Abstract—In this study we examine the level of noise present in Nanded city of Maharashtra with the help of Geographical information system and Data mining technique. The noise data is collected during the month of March and April 2017. The spatial data mining algorithm natural neighbor was applied to generate the surface model. Unsupervised data mining techniques i.e. Shapiro-Wilk normality test and supervised data mining technique Wilcoxon rank sum test were applied to identify the significant difference in day and night time noise pollution. In this study we followed the CPCB 2000 guideline. Data was collected from Residential and commercial area. The investigation results reveals residential as well as commercial areas pollution noise level is beyond the permissible limit in evening session. Furthermore, there is need of action to control the Noise level in Nanded city.

Keywords- GIS; Data Mining; Natural Neighbor algorithm; Nanded; Noise pollution;

I. INTRODUCTION

Noise is energy source of unwanted sound which causes several effects on human body. Several sources are presents which cause noise pollution. The noise pollution is similar kind of toxic as chemical pollutant present in the environment. Basically noise is sound wave pressure which mostly generated by vehicle horns, transportation in urban environment. In today's life Noise pollution becomes a global issue which caused due to rapid development activities, industrialization, automation industry, transportation, highway- transport, airports [1].it become one of the leading problem in metropolitan's cities in India. Noise is undesirable, unpleasant, bothering sound which acts as pollutant in the environmental atmosphere which creates health problems. It is a byproduct of transportation in urban environment. The incising human population, uncontrolled vehicle growth rate with rapid industrialization is the leading sources which generate complex noise pollution, which may lead to reduce the quality of life [1, 2]. The large amount of noise pollution is generated in day by day situation which become mandatory to control and prevent the noise pollution to get effective results. An unknown activity made by human beings creates the noise pollution. In past several studies has shown the effect of noise pollution on health

problems viz. deafness and mental breakdown, sleep, concentration, communication, and recreation [12]. Over a period of time we are facing the effect of noise pollution which can easily damaged our hearing capacity. Several studies have shown that noise pollution reduces our sensitivity to sounds so that our ears pick up unconsciously to regulate our body's rhythm [15]. Noise pollution is unpleasant sound which causes temporary disruption in the natural balance. In today's environment it becomes very difficult to escape from noise pollution. In developing country like India noise is one of the major continents of environmental pollution and become a permanent part of urban and semi urban life. Greater attention needs to pay towards noise pollution enforcing regulation for noise emission limits, elimination and control noise pollution. In this study we tried to investigate the noise level present in the Nanded city of Maharashtra. The noise level varies from 0 to 180dB [3]. Human being can absorb the noise level at the limit of 90dB. In India the level of noise pollution exceeds the permissible limits. The following table shows the standards assigned by central pollution control board act 2000 of Noise pollution in India. Based on the given standards we monitored the Noise level in Nanded city[3, 12]

Table 1. STANDARDS OF CENTRAL POLLUTION CONTROL BOARD CPCB.2000

Sr. No.	Category of Area / Zone	Limits in dB(A) Leq*	
		Day Time	Night Time
1	Residential area	55	45
2	Commercial area	65	55
3	Industrial area	75	70

In various investigation researchers identified in their study that the level of noise had affected on the quality of life and to overcome such situations continuous monitoring become necessary to recover the environmental loss. Some researcher also highlighted that 86.7% of noise was generated by vehicle which become responsible for noise generation in city. Some researcher also investigated the noise level in night session which found to be high due to violation of sound limit [13].

GIS based spatial analysis model was implemented for identification of vulnerable zones of noise pollution. The proposed model was based on vector database which analyzed the influenced sound propagation. Also, a raster DEM model database and numerical databases computed wind direction and speed, sound intensity. The change in noise level in respective hours were analyzed for identifying the hotspots and characterized by major traffic flows specific to rush hours. The results were represented in the form of maps for local administration as a source for decision making [1]. Oyedepo and Saadu (2009) investigated in their study, the level of noise in various parts of Ilorin metropolis. The study was performed during the year 2004 and 2005 of Ilorin metropolis of Kwara state. In their study, 47 locations were selected based on the parameters viz. busy roads/road junctions, passengers loading parks, commercial, industrial and residential areas. Statistical techniques were performed to compare areas like the industrial areas and low density residential areas, industrial areas and high density areas, industrial areas and passengers loading parks, industrial areas and commercial areas, busy roads / road junctions and low density areas, passengers loading parks and commercial areas and commercial areas and low density areas which shows ($P < 0.05$) significant difference. No significance difference ($P > 0.05$) was found in industrial areas and busy roads/road junctions, busy roads/road junctions and high density areas, busy roads/road junctions and passengers loading parks, busy roads/road and commercial areas, passengers loading parks and high density areas, passengers loading parks and commercial areas and commercial areas and high density areas [9]. Engel et al. (2014) examined the noise perception in urban environment of Curitiba with factor analysis and multinomial logistic regression by stating the null hypothesis that the model is not significant. 23 noise samples were

monitored with three parallel streets along with 397 interviews. The questionnaires of noise perception were analyzed by factor analysis. The interviews process consist 21 variables out of which major factors were extracted by applying multinomial logistic regression. 85.2 % of the noise-related symptoms found quite satisfactory. Chi square was used to identify the model efficiency and result shows that the model efficiency was very high as p-values indicated 100% [2].

In this study we used R open source statistical computing software. It provides wide range of linear and nonlinear modeling, classical statistical tests, time-series analysis, classification, clustering along with highly extensible graphical results. Furthermore, R also provides several functions for manipulation of data, data calculation and graphical display with efficacious data handling and storage facility. it is also a intermediate tools for data analysis. R provides the data manipulation feature for data set for easy access and analysis. Multivariate datasets are easily analyzed by R with various indexing techniques. Various data analysis tools are developed by computer scientists and statisticians communities such as testing of hypothesis, model fitting, clustering and other machine learning techniques. R allows user to develop their own capabilities for data visualization [13].The data mining is a process of discovering a meaningful knowledge from the dataset which consist of exploration techniques. These techniques are the collection of analytical methods and tools which controls the data set. These techniques are used to find out the novel pattern for forecasting from large database. Basically data mining techniques are strongly related with machine learning. For the enhancement of existing information resources values to produce new outcome with high performance data mining can analyze the massive databases. The outcomes of these techniques are the long process investigation and research development activities. Day by day large amount of data is generated in continuous manner with high complexity. Due to this is become impossible to made proactive decisions to find out patterns and to discover knowledge in such databases manually. Such kind of complex situation can be resolved by data mining techniques. Data infrastructures (DIs) and data mining became a key challenge of a modernistic social club. Use of technical information is now a core part of our surviving. To access such kind of information within changing world we need to accomplish the information by applying standard process [4].GIS is a spatial database which consists of the location based information of particular geographic region for the analysis of spatial products. Geographical Information Systems(GIS) is one of the planning support tools and have been widely used in recent years for dealing with the decision making process. GIS techniques are more useful in data mining to discover the relationship between urban attributes for the analyzing multi-dimensional relational complexity of urban environment. To overcome these problems spatial data mining and Geographic knowledge discovery

progresses as an active research area, especially focuses on development/construction of a methodology for extracting the information as well as knowledge from monolithic and composite spatial data. Extracting interesting and useful patterns from spatial datasets are more difficult than the corresponding patterns from traditional numeric and categorical data due to the complexity of spatial data types, spatial relationships, and spatial autocorrelation. New possibilities for gathering, analyzing and presenting geographical data can be achieved by spatial data mining by extending their capabilities to discover hidden patterns in databases. GIS technology can able to combine old data set with new information to perform spatial analysis operation which can be centralized in a single database [7].The main objectives of this study are, to identify the vulnerable zones of Noise pollution in Nanded city with GIS and data mining techniques; to identify the hotspots and major traffic flow area in Nanded city with GIS and data mining techniques and. to test the significance between commercial and residential area. In the subsequent section methodology, result and discussion and conclusion are discussed in detail.

II. STUDY AREA

Nanded city having multifunctional environment which is district headquarter which is situated at latitude of 19.15 and longitude of 77.30 (Fig 1) .The present study is based on the North Nanded the North Nanded is divided in six different regions as Anand Nagar, Itwara, Taroda Bu, Vazirabad, Shivaji Nagar, Taroda Kh. [12, 14]

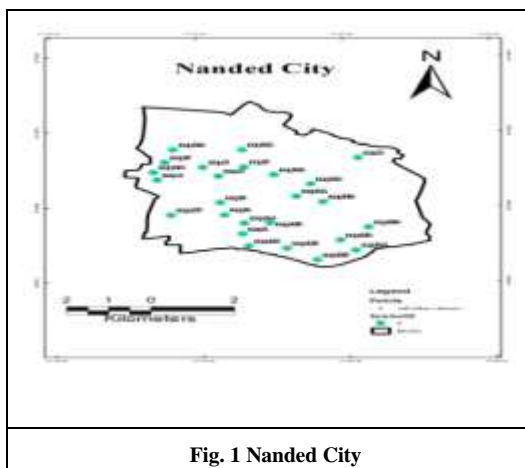


Fig. 1 Nanded City

III. METHOD OF DATA COLLECTION

In this study, we have tried to evaluate the noise pollution level in Nanded city. Sound Meter application (3.2.4 Version) downloaded from Google play store was used for various noise samples collection from Nanded city using. Data was collected from commercial, residential areas. The noise level has been monitored twice in a day i.e. 7-9 A.M. and 6-8 P.M., for commercial area. For residential area, the data is monitored

during 10 to 12 AM. The data collection was performed during the last week of March and 1st week of April 2017. Standard guideline of central pollution control board was followed for the collection of noise data [3]. Table 2 shows the result of noise monitoring we have selected 15 major points of Roads for investigation. The Noise frequency during 7 to 9 in the morning and 5 to 8 pm in the evening were examined.

IV. RESULTS AND DISCUSSION

For the investigation of noise level in Nanded city areas like Shivaji Nagar, Taroda, Deglur Naka, Workshop, Bafana point, Hingoli gate are considered as commercial area and represented by sample number.

We have applied the Natural Neighbor algorithm on collected noise dataset to generate the accurate surface model in linear fashion. Natural neighbor interpolation is most commonly used spatial algorithm of data interpolation which produces most bourgeois, ruse-free, which results the output by finding weighted averages. In this method each point is associated with subset of data which are natural neighbors of these points. The Natural neighbor interpolation works on following function.

$$G(x, y) = \sum_{i=1}^n w_i f(x_i, y_i)$$

where: G(x,y) is the NN estimation at (x,y);

n is the number of nearest neighbors used for interpolation;

f(x_i,y_i) is the observed value at (x_i,y_i); and

w_i is the weight associated with f(x_i,y_i). [5]

The natural neighbor method is very useful in those conditions where data samples points are distributed in uneven density.The outputs of this spatial function have generated in the form of maps. The Natural Neighbor model is used for interpolation of noise level of morning and evening session’s dataset and is represented by spatial distribution maps (Fig.2-3). The minimum and the maximum noise level of morning session was 44.4969 and 78.8301 percent respectively. For evening session the minimum and the maximum noise level was measured as 44.49 and 87.9801 percent respectively. It is observed that the North West region of the study area is highly polluted in morning and evening sessions. The Natural Neighbour algorithm was applied on following table

TABLE I. COMMERCIAL MONITORING NOISE DATA

Sr · N o.	Site	Morning Noise Data			Evening Noise Data		
		Min- Maz	AVG	D-dB	Min-Max	AVG	N-dB
1	S.p office	63 -90	76	74	53-96	73	76
2	Shivaji Nagar	62-79	71	70	53-96	68	71
3	ITI	64-91	73	71	54-91	73	70

4	Mor Chowk	37-90	66	71	40-81	56	71
5	CS Chowk	38-96	69	77	52-96	74	76
6	Taroda	39-85	70	76	52-96	74	71
7	Chaitanya Nagar	56-85	73	71	53-94	71	78
8	Workshop	64-90	73	72	55-94	79	79
9	N.chouk	65-83	74	73	46-85	68	80
10	LIC Office	49-82	71	71	51-85	71	73
11	Bafana Corner	55-82	72	76	45-92	74	78
12	Deghur Naka	44-93	66	71	53-93	76	85
13	Hingoli Gate	47-91	65	71	53-92	71	79
14	Railway Station	47-91	66	76	55-95	74	74
15	Mondha	54-90	69	74	64-96	76	86
	AVG	52.26-87.86	70.26	72.93	52.93-92.13	71.86	76.46

Above mentioned table represents the noise level of commercial area of Nanded city during the morning and night session .it is found that the level of noise

TABLE 3 RESIDENTIAL MONITORING NOISE DATA

Sr. No.	Site	Morning Noise Data			Evening Noise Data		
		Min-Max	AVG	D-dB	Min-Max	AVG	N-dB
16	P.N collage	43-72	53	44	45-72	52	52
17	Mahaveer society	43-78	53	51	45-83	52	52
18	G.Nagar	42-78	53	42	41-70	50	57
19	Kabara Nagar	42-78	53	44	46-75	51	54
20	Bhagya Nagar	40-79	52	48	45-62	50	48
21	Shoba Nagar	36-79	51	41	41-80	48	49
22	Taroda Bu	38-54	45	44	43-74	51	47
23	Haider Bagh	32-62	45	35	43-74	52	49
24	Holi	35-58	42	55	40-61	48	48
25	Gadipura	35-58	44	38	39-61	44	42
	AVG	38.6-69.6	49.1	44.2	42.8-71.2	49.8	49.8

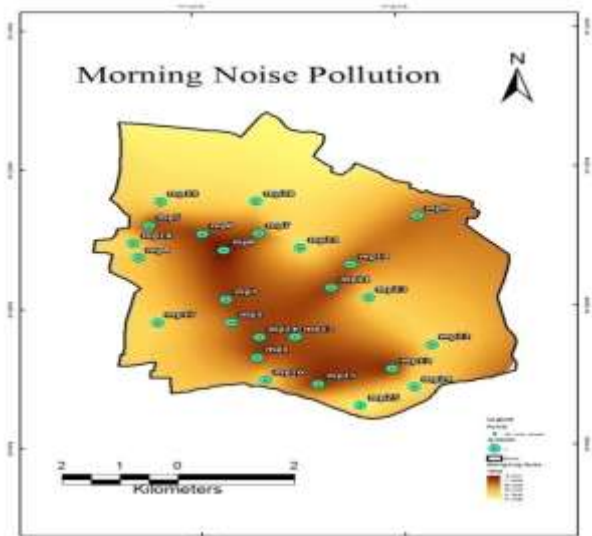


Fig 2: Morning Noise Pollution

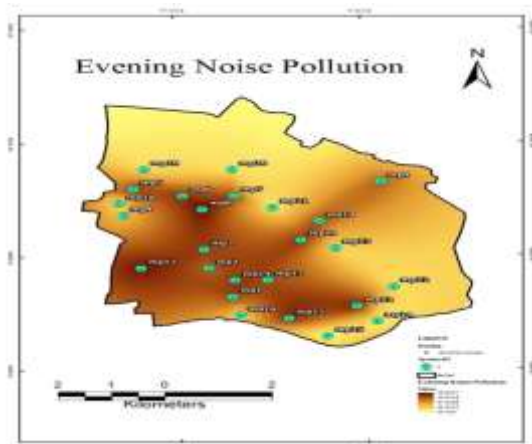


Fig 3: Evening Noise Pollution

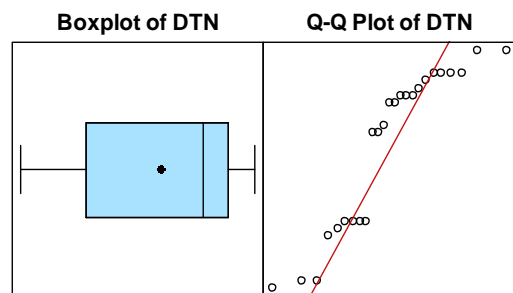
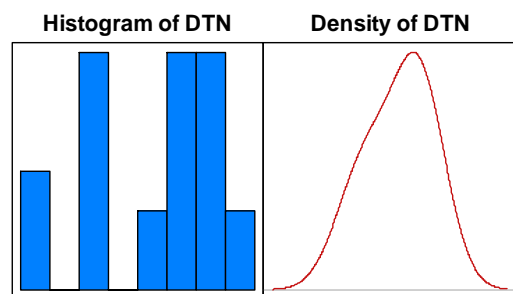


Fig.4a Normality of Morning Session

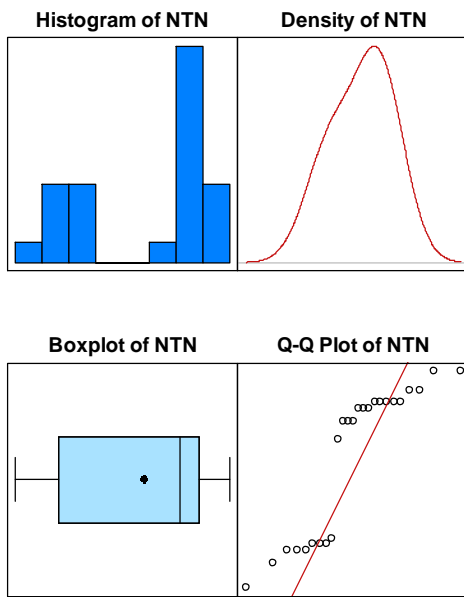


Fig.4b Normality of Night Session

One of the major of the objective of this study is to find is there any significance difference among day and night time noise pollution among the samples collected from various part of the city? To answer this question we implemented exploratory statistical tests, (Fig. 4a-b) which states that, data is slightly skewed in nature and hence normality of the data is

checked through the Shapiro-Wilk normality test. Because of non normality of data i.e., DTN (p-value = 0.002154) and NTN (p-value = 0.000192) are coming from non-normal population. We applied the Wilcoxon rank sum test with continuity correction which reveals that, (p-value = 0.2844) there is no significant difference among day and night time noise pollution. Further, data reveals that, there is no significance among the noise variation level between day and night time (F test, p-value = 0.5795).

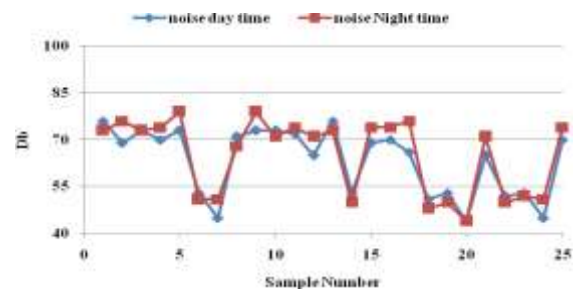


Fig. 5 Distribution of Day-Night time noise pollution

Table 4 CLASSIFICATION OF NOISE DATA (SLUM AND NON SLUM AREA)

Area	Day Time				Night Time			
	Residential		Commercial		Residential		Commercial	
Limits	<55	>55	<65	>65	<45	>45	<55	>55
Slum	7, 14, 20	16	Nil	3, 9, 11, 17, 21	7,14, 20	16	Nil	3, 9, 11,17, 21
Non-Slum	6,18 19,22 23, 24	8,10,25	Nil	1,2,4,5, 12, 13, 15	Nil	6,8,10,18,19,22, 23,24,25	Nil	1, 2, 4, 5,12,13 15

From Figure 5 it is concluded that, most of the samples crossing the permissible limit. Table 4 is detailed representation of classification of the study area according to area, time and location wise distribution of samples. In this study, 60% of the samples were collected from commercial area and rests of them (40%) were collected from residential area as per the standards [3]. Further in Table 4 represents the comparison of noise level in slum area and non-slum area .it is found that, the noise level below the permissible limit is more in slum area than commercial area.

V. CONCLUSION

In this investigation both morning and evening session noise is monitored for commercial and residential area. The outcome of this investigation reveals that there is no significance difference in morning and evening time . 15 samples sites from commercial area were selected for both

morning and evening session out of which 71.86 percent of the noise pollution is observed in evening, which is greater than the morning noise pollution i.e. 70.26 percent. For residential area 10 sites were selected for noise pollution and data were collected during 10 to 12 AM. The 49.1 percent of average data was calculated in residential area which is acceptable as per the guideline of CPCB 2000. We also found that the noise level in the evening was averagely found 49.8 percent which shows slight higher percent of the noise level than the morning. The output also reveals that the noise level in commercial area is beyond the permissible limit and noise level in residential area is quite acceptable. The noise level in evening session was found to be highly dense. The spatial distribution of noise is represented in the form of map which shows the spatial variation of noise in the study area. The spatial distribution result reveals that the maximum value of Noise parameters was located in North West region. The noise

quality of North East region was found better than North West region. The sample locations rnp1-3, rnp5-8, rnp10-15 and rnp17 in both the session were comes under vulnerable zones. The residential zones in morning session are lies within the permissible limit. With the help of Geo-statistical technique it is found to be more effective for better understanding of the noise pollution level. To avoid the noise pollution it is recommended that, more trees plantation in the city is essential.

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