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Noise Pollution and Its Impact on Human Health and Social Behavior using Systems Approach-A Case Study in Kurnool City

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Abstract
The main objective of this paper is to evaluate the noise pollution problem in the Kurnool city of Andhra Pradesh, India and its effect on the public. Transportation and horn used in vehicle are the major source of noise pollution. Noise is one of the environmental problems that make daily life uncomfortable. It is an unidentified pollution that causes adverse effects on human life. Noise interferes in complex task performance, modifies social behavior and causes annoyance. Six different locations are chosen for study. Noise levels are monitored at different times in the day and night. Bronfenbrenner's systems approach is used to illustrate the socio behavioral changes in human life due to noise.
Keywords: Traffic noise – severe health issues - effect on social behavior - systems approach.

1. Introduction:

With the fast development of the world, particularly with developing counties urbanization has become quite phenomenon. Added to it, growth in the GDP with urban areas has become relatively high compared to rural areas. Migrations have grown in multiple folds to urban and semi-urban towns and cities overcrowding them in recent few years. Consequently the vehicular traffic, both goods and passenger has become unmanageable as there is no proportional widening of roads or alternative modern systems. With people looking for personal comforts and giving top priority for status, started looking at personal transportation needs instead of much desired public transportation. This has further aggravated the urban traffic congestion problems touching the new peaks. The change in attitude of the people and the challenging needs of the traffic congestions, several new and innovative type of horns have found to play a significant role creating nuisance, in the name of "noise pollution". It has different type of impacts on different type of people working on different jobs and professions.

It is obvious that noise affects human health. Resistance to noise is different among people of different age and sex. A survey shows that 84% of people report effect on hearing in which 83% are from male group and 81% are from female group. 90% of people suffer from sleep disturbance in which 96% are from female group and 85% are from male group. It is found that majority of male population feels the adverse effect of noise on hearing, efficiency, inter personal communication. But in other parameters like (annoyance, disturbances in sleep) the female population feels the higher impact than the male population. However, in terms of deafness there is no marked difference between male and female groups, survey on noise pollution [9].

It is evident that noise pollution causes disturbance to concentration and focus, damage to health and even shall lead to disasters. Kurnool is one of the fast developing cities having rich number of educational institutions ranging from kindergarten schools to institutions of higher learning. Several of them being technical and professional institutions suffered migrations from different rural areas. It has also good number of hospitals nursing homes offering high quality of medical and health services. It being the headquarters of the district, crowded with offices including district secretariat, has many other important governmental and nongovernmental establishments. It has several thousands of commercial establishments starting from road side push carts to corporate multiplexes. The stake holders of all such organizations, institutions, activities are lakhs in number and to meet their needs and also to fulfill their business needs both passenger and goods, vehicles have become needy and grown exponentially in recent times. However, the pace of growth with road facilities and adequate number of traffic islands and traffic regulations has developed; the users do not follow self-imposed discipline. Consequently, traffic congestions, accidents, problems of noise pollution have got intensified threatening peace and calmness.

With the above scenario, Kurnool city is thought to be a fit case for the study of noise levels at certain strategic locations during peak hours and analyzing the data for suggesting remedial methods to save it from noise pollution.

2. Methodology

Studies have mentioned that periodical noise study is most appropriate and less expensive. Of course continuous noise study is desirable but not necessary and is more expensive. The level of Noise Pollution is monitored at different places of Kurnool City. The first step of the study was to select the main streets and roads in the city. In

order to determine the measurement points, motor vehicular traffic prone sites of the city were surveyed before the study. These are Bellary Chowrasta, New Bus Stand, Siri Nobel Hospital, RajVihar, Old control room, C-camp which are representatives of entire urban areas. All these sites have their unique characteristics i.e. having a typical road width, roadside building pattern, traffic flowing pattern in different directions. The noise levels were monitored with the help of sound meter. The standards of noise level were compared with that of the standards prescribed in Environmental Protection Rules, 1986 and standards of CPCB.

Identified locations for the Field Study:-

Location name	Geographical location(Latitude, Longitude)
Bellary Chowrasta	(15.824994, 78.024105)
Raj Vihar	(15.828673, 78.038367)
New Bus stand	(15.824769, 78.027744)
C-camp	(15.806698, 78.046648)
Siri Nobel hospital	(15.840481, 78.033614)
Old control room	(15.831888, 78.045066)

3. Data Collection Procedure:

Sites selected for survey have road side residences, offices, organizations, etc., which are at variable distances depending on the location of the building from the center of the road. At each selected spot, the measurements were taken at different times during the day time and night time. Continuous monitoring of noise level was done for a span of 90 minutes at six different time slots in a day. Range of noise level in decibels, frequency of maximum value attained are noted for every 10minutes.The parameters measured were **Lmax, Lmin** and **F**

Lmax-Maximum noise level in particular 10minutes interval.
Lmin-Minimum noise level in particular 10minutes interval.
F-Frequency of maximum noise level in particular 10minutes interval.
Db- Decibel.
Various graphs were plotted between these parameters and conclusions were drawn.

3.1 Instrument Details:

The noise measurement was done by using Integrating Sound Level Meter (model SL-210).

3.2 Measurement Uncertainty:

Uncertainty at 95% confidence level (k=2)
+/-3.4% Acoustic (0.3dB)
+/-1.4%AC Voltage, +/-0.1%DC Voltage

4. Concept of Noise Pollution

The term noise pollution has been defined as a sound without agreeable musical quality or as an unwanted or undesired sound. Noise is no less a pollutant than the toxic chemicals in the environment. As a result of increasing mechanization, the use of increasingly voluminous and complicated machinery and equipment and the stepping up of the pace of production, the noise is becoming an increasingly wide-spread and serious source of discomfort and danger. Definition given in the ILO convection no. 148 is that the term noise covers all the sound, which can result in hearing impairment or be harmful to health or otherwise dangerous. In most of the countries comparatively very little attention has been rewarded to the noise phenomena. In spite of its importance in the urban and industrial sectors, it has been observed that people residing in the urban areas and many occupationally exposed workers develop severe hearing losses. There is much to suggest that noise hazard is gradually more prejudicing social life and in some instances hearing capacity. The prevention of noise induced hearing loss therefore should be accorded top priority. Sudden and unexpected noise has been observed to produce marked changes in the body, such as increase in the blood pressure, increase in heart beat and muscular contractions, and the flow of saliva and gastric juices will be decreased.

Because the changes are so marked, repeated exposure to unexpected noise should obviously be kept to minimum. These changes fortunately wear off as a person becomes accustomed to the noise (Broadbent, 1957). Kiernan (1997) found that even relatively low levels of noise effects human health adversely. It may cause hypertension, disrupt sleep and hinder cognitive development in children. The effects of excessive noise could be so severe that either there is permanent loss of memory or a psychiatric disorder (Bond 1996). This calls the correct assessment of the noise problem and application of various administrative, engineering and medical control measures. The major sources of the noise pollution in the advanced and developing countries include industry, energy sector, transport and community activities. A common instrument used to measure the magnitude of noise fluctuations include sound level metres, dosimeters, sound scopes, noise integrators, graphical recorders etc. (Agarwal and Jagetia, 2001). The noise is commonly measured as sound intensity that is determined in terms of

pressure of sound waves on the eardrums, and the scale is logarithmic. Loudness of sound corresponds to the degree of sensation depending on the intensity of the sound and the sensitivity of the ear (Garg et. Al., 2007).The unit of sound intensity measurement is decibel (db) and each decibel rise depicts ten-fold increase in sound intensity.

Objectives of the study:

The objective of this study is as follows:

1. To show the adverse impact of noise on the basis of response and respondents.
2. To find out the suitable solutions for abatement of noise pollution.

5. Effects on human health:

The impact of noise on human health is a matter of great concern. Noise pollution can affect us in several ways, some of which are listed below:

5.1 Hearing Problems

Exposure to noise can damage one of the most vital organs of the body, the ear. Hearing impairment due to noise pollution can either be temporary or permanent. When the sound level crosses the 70 db mark, it becomes noise for the ear. Noise levels above 80 decibels produce damaging effects to the ear. When ear is exposed to extreme loud noise (above 100 decibels) for a considerable period of time, it can cause irreparable damage and lead to permanent hearing loss.

5.2 Poor Cognitive Function

With regular exposure to loud noise, the ability to read, learn and understand decreases significantly over time. Problem solving capabilities and the ability to recall may also decline due to frequent bombardment of noise. Noise pollution can also increase the margin of error as well as hamper your productivity at office. Research has proved that children studying in noisy environment tend to show relatively low cognitive function. For instance, the cognitive status of children sent to schools that are in the close proximity of highways is less in comparison to those learning in quieter surroundings.

5.3 Cardiovascular Issues

A noisy environment can be a source of heart related problems. Studies have shown that high intensity sound cause a dramatic rise in blood pressure as noise levels constrict the arteries, disrupting the blood flow. The heart rate (the number of heart beats per minute) also increases. This was evident in one study wherein the heart rate of children staying in noisy surroundings was measured. It was found to be more than the heart rate of children living in less noisy environment. These sudden abnormal changes in the blood increase the likelihood of cardiovascular diseases in the long run.

5.4 Sleep Disturbances

Difficulty in sleeping due to exposure to high decibel noise can deter your overall well-being. It is a known fact that noise can interrupt a good night's sleep, and when this occurs, the person feels extremely annoyed and uncomfortable. People deprived of uninterrupted sleep show a sharp dip in their energy levels which often results into extreme fatigue. This can considerably decrease a person's ability to work efficiently.

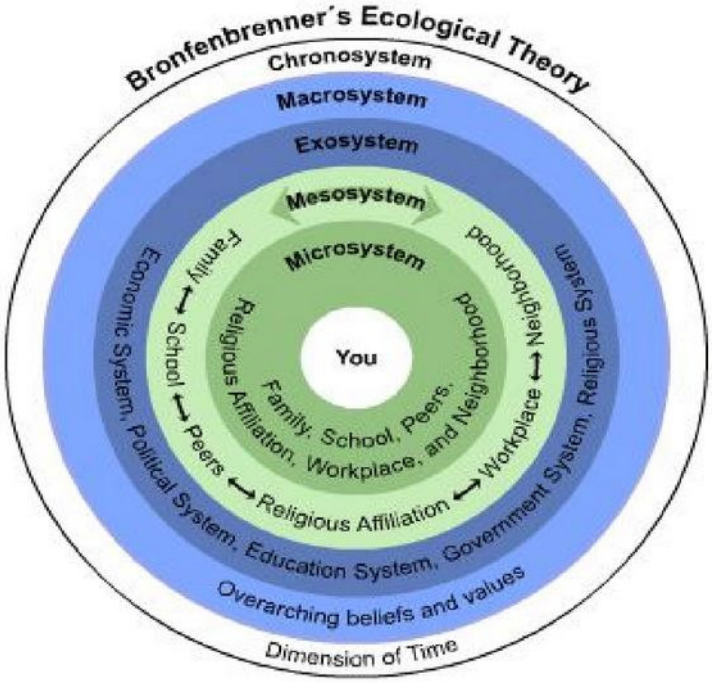
5.5 Trouble Communicating

A noisy environment that produces more than 50-60 decibels simply does not allow 2 people to communicate properly. Interpreting the speech of a second person becomes quite difficult and may lead to misunderstandings.

5.6 Mental Health Problems

Exposure to loud sound can lead to elevated stress levels as well as stimulate violent behavior. A constant noise in the vicinity can also trigger headaches, make people tense and anxious and disturb emotional balance.

6. System approach to the effect of noise pollution



Bronfenbrenner's ecological systems theory has been used to illustrate the effects of noise pollution on an individual. In this context, we study the changes in social, economic, physical, psychological and cultural conditions of people. Change in one system causes change in every system. Each system is related to one another either directly or indirectly. This relationship is represented diagrammatically as follows.

Individual is considered at the centre and encircled by five systems namely micro systems, meso system, exo system, macro system and environment. Micro system consists of the people with whom an individual is in close contact like family, colleagues etc. Meso system is a system of Microsystems. The exo system comprises of the linkages and prouses taking place between two or more settings, at least one of which doesn't contain the developing person, but in which events occur that indirectly influence processes within the immediate setting in which the developing person lives. The macro system consists of the overarching pattern of micro-, meso-, and exo systems characteristic of a given culture or sub culture, with particular reference to the belief systems, bodies of knowledge, material resources, customs, life-styles, opportunity structures, hazards and life course options that are embedded in each other of these broader systems. A chrono system encompasses change or consistency over time not only in the characteristics of the person but also of the environment in which that person lives.

Let us illustrate clearly by moving from the innermost system to the outside one. Humans possess a super computer called brain which has ability to think, create, adapt etc. Due to this ability of thought, humans are developing technology to satisfy their comforts. Development of technology made an individual to habituate to comforts. Let us consider an example to understand this perspective effectively.

To reduce the difficulty of transport, humans invented vehicles. An individual buys a vehicle. Family which is in direct contact feels happy, and comfortable. The social status of the person is increased. Colleagues, peer group also want to buy a vehicle. These are the changes that occur in micro system. Coming to the meso system, as the sales of vehicles is increased; the entrepreneur has to manufacture more vehicles. With increase in demand, the entrepreneur hires more people, and families of those people are influenced indirectly. Exo system consists of governmental organizations, social environment. New laws on vehicular traffic are built, construction of roads, traffic rules, traffic police departments RTO etc came into existence. Macro system consists of cultures, sub cultures etc. Due to modernization, people are leading mechanical lives in which they do not find time to perform their ancient, ecofriendly practices daily. So they are adopting modern techniques, which bring a great change in culture of people. An individual is harming his own environment without practicing ecofriendly techniques. This shows its adverse effects on the chrono system which is made of environment. Vehicles produce air and noise pollution. Noise pollution has become a major pollutant. These pollutants influence the health of an individual adversely.

Noise pollution is responsible for disturbed sleep, irritation, temporary and permanent deafness, high blood pressure, cardiovascular diseases, psychiatric disorder, imbalance of endocrine responses, abortions during pregnancy, lack of concentration, fatigue, retardation in growth and development among new born babies etc. An individual experiences bad health and it also distracts his psychological behavior. A person may not give valuable

time to his family, colleagues, peers etc. Lack of concentration, excessive leaves in job may lead to the person's socio-economic imbalance. This deeply has its influence on the industries, workers etc and new governmental organizations have come into existence. Pollution board is one of such organization. Government is allocating funds to such departments for control of pollution.

With increase of lack of concentration, tiredness, laziness, bad health among people, some ancient eco-friendly activities are becoming extinct. For example, an ancient practice in India is the application of turmeric powder on threshold of houses. It is believed that turmeric acts as an anti-biotic and prevents the entry of microorganisms into the house. But now-a-days instead of turmeric powder, yellow paint is being used. This shows the change in culture of people. When such eco-friendly activities are not practiced environment is affected. This cycle is never ending.

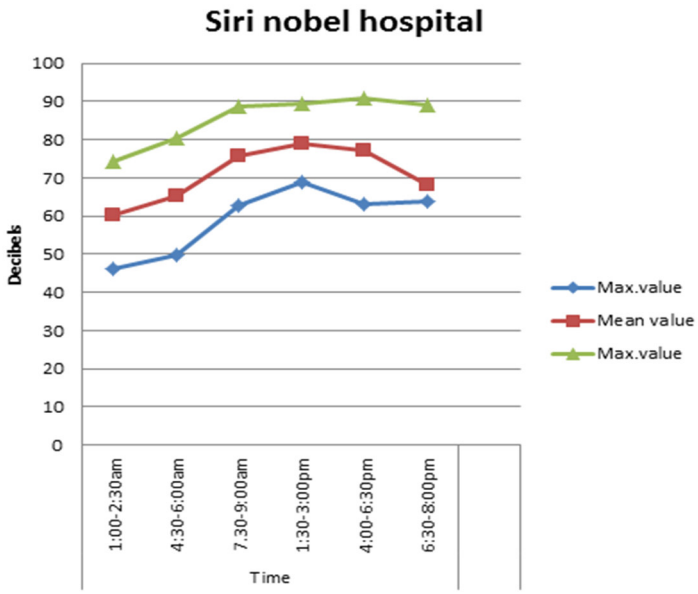
7. Results and discussions:

7.1 Siri Noble Hospital:

Siri Noble Hospital is one of the most important places of Kurnool. It is situated at the out skirts of the city connecting it to other important places and villages. The grim situation of tremendous increase in number of vehicles is generating multiple problems in the city such as air and the noise pollution, encroachment, poor condition of roads etc. This location is on the banks of river Tungabhadra; a school and a degree college are located opposite to this. Railway Bridge, wide roads, considerable amount of greenery are present in its vicinity.

A brief description of various monitored Noise levels at this site is shown in table below:

Time	Min.value	Mean value	Max.value
1:00-2:30am	46.333	60.278	74.222
4:30-6:00am	49.777	65.166	80.555
7.30-9:00am	62.666	75.611	88.565
1:30-3:00pm	68.777	79.111	89.444
4:30-6:30pm	63.111	77	90.88
6:30-8:00pm	64	68.222	89.111



7.1.1 Results:

Maximum noise was observed during 4:30 to 6:00pm.The higher levels of noise are observed during school and college timings and when the train passes through the bridge. Maximum noise pollution is mainly due to heavy vehicular traffic.

7.1.2 Conclusions:

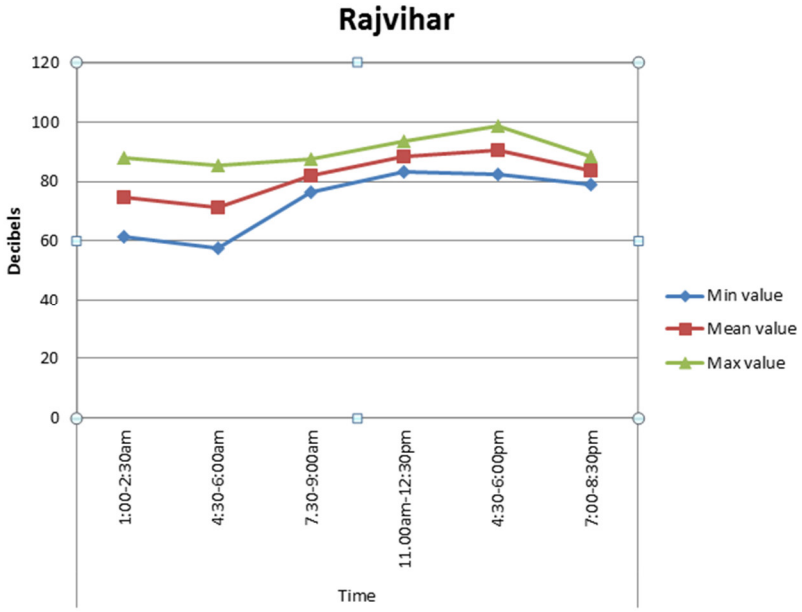
Being a silent zone, this area should have noise level in a range of 40db to 50db. But data shows that noise levels are alarming. Sand trafficking during 4:30am – 6:00am creates more noise. Heavy vehicles should not be allowed in peak hours.

7.2 Raj Vihar:

Raj vihar is the busiest place in Kurnool. It is one of the major polluted areas in Kurnool where noise level is very high. In and around the Raj Vihar there are many shopping malls, restaurants, markets and theaters etc. During the school and college timings noise is higher. There are neither water bodies nor greenery to absorb the noise. When

vehicles are stopped near the traffic signals noise due to vibrations will be more.

Time	Min value	Mean value	Max value
1:00-2:30am	61.553	74.7222	87.888
4:30-6:00am	57.444	71.444	85.444
7.30-9:00am	76.556	82.111	87.6666
11.00am-12:30pm	83.111	88.333	93.555
4:30-6:00pm	82.444	90.5	98.555
7:00-8:30pm	79.111	83.777	88.444



7.3 Old Police Control Room

The main aim of selecting the areas such as control room is bring into limelight how the levels of noise pollution are making the lives of people more complex. Control room is one of the polluted areas in Kurnool. It is almost central part of the city and is near to Konda Reddy Fort, a tourist spot. This road connects the biggest commercial area of the city. The Latitude on which Old Control room Road is present is 17.3080^0. The Longitude on which Old control room Road is present is 78.4323^0. But one of the major advantages is the roads are wider in this region. Hence there is continuous flow of traffic.

Time	Min value	Mean value	Max value
1:00-2:30am	44.555	58	71.444
4:30-6:00am	47.888	60.611	73.33
7.30-9:00am	81.222	89.8222	98.755
11.00am-12:30pm	79.333	88.35	97.366
4:30-6:00pm	78	85.333	92.666
7:00-8:30pm	76	85	94

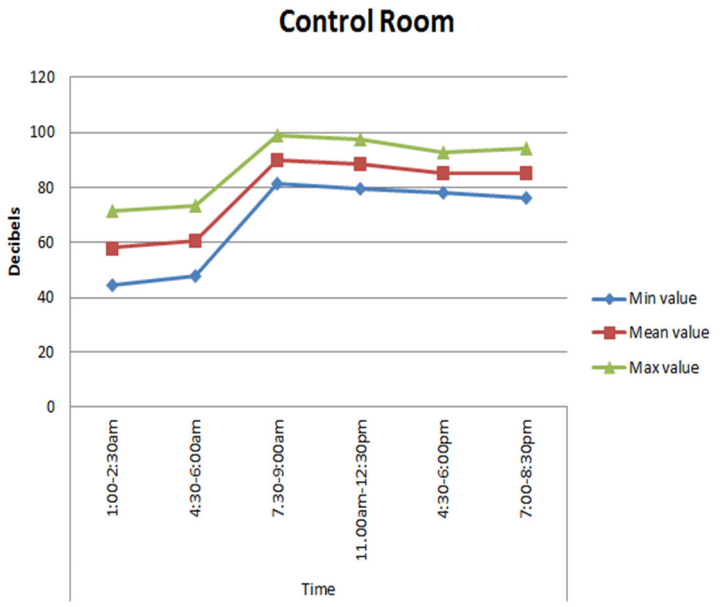
7.3.1 Results:

Maximum values are recorded during 7:30 to 9:00am.

7.3.2 Conclusion:

a) More trees should be grown.

b) Push carts and petty shops should not be allowed.



7.4 Bellary Chowrasta:

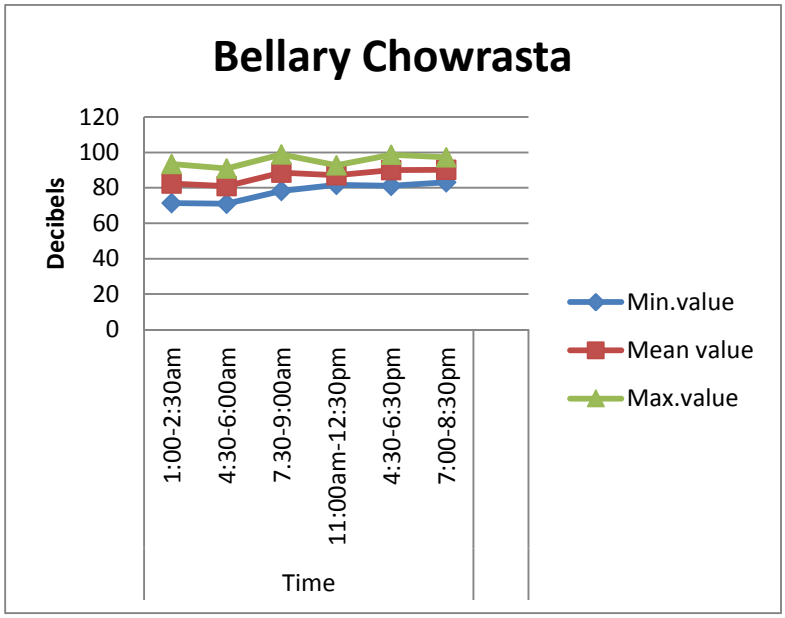
The geographical location can be given by 15.8247, 78.0211 or 15°49'29.0"N, 78°01'16.2"E. this place is locally called as Bellary chowrasta or just chowrasta. This point is a four way junction. The national highways NH7 and NH18 intersect at this point. There is also a flyover along the NH7 road.

We can say that there is very little or almost no greenery in this location. The traffic intensity from the east side of the road is more due to the presence of a bus stand. Another factor that can affect the sound is that the sound produced underneath the flyover echoes and intensifies the noise.

There are a number of buildings on either sides of the road and also the width of the road is not sufficient considering the traffic congestion at all times. There is lot of disturbance to the public due to the frequent traffic jams whenever a bus or a heavy vehicle tries to switch roads.

The footpath vendors also have their part in this because they have occupied almost quarter of the road and because of this, the vehicles are parked on the road itself. All this further decreases the width of road available for the ongoing vehicles.

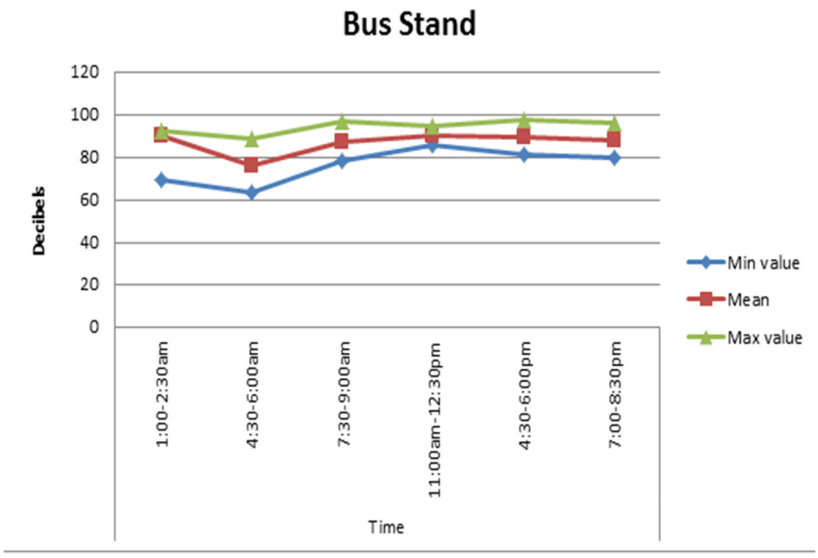
Time	Min.value	Mean value	Max.value
1:00-2:30am	71.44	82.44	93.44
4:30-6:00am	71.11	81	90.89
7.30-9:00am	78.22	88.555	98.89
11:00am-12:30pm	81.67	87.17	92.67
4:30-6:30pm	81.22	90	98.78
7:00-8:30pm	83.22	90.22	97.22



7.4.1 Results:
In this area, noise pollution is at alarming level. Immediate action must be taken.
7.4.2 Conclusion:
a) Prohibiting road side parking.
b) Not allowing push carts and petty shops.
c) More trees should be grown.

7.5 New Bus Stand:
Kurnool city has roadways which connects the capitals of other states. Hundreds of busses pass by every day. Road network which connects the highways and bus stand is narrow. Commercial buildings have been developed around this place. Greenery is not adequate. On one side, it is surrounded by Hundri River which does not have water throughout the year instead bushes and plants are naturally grown. This area shows maximum noise levels recorded even during nights. A fly over bridge had been constructed within 500 meters which reduces the heavy vehicle traffic to some extent.

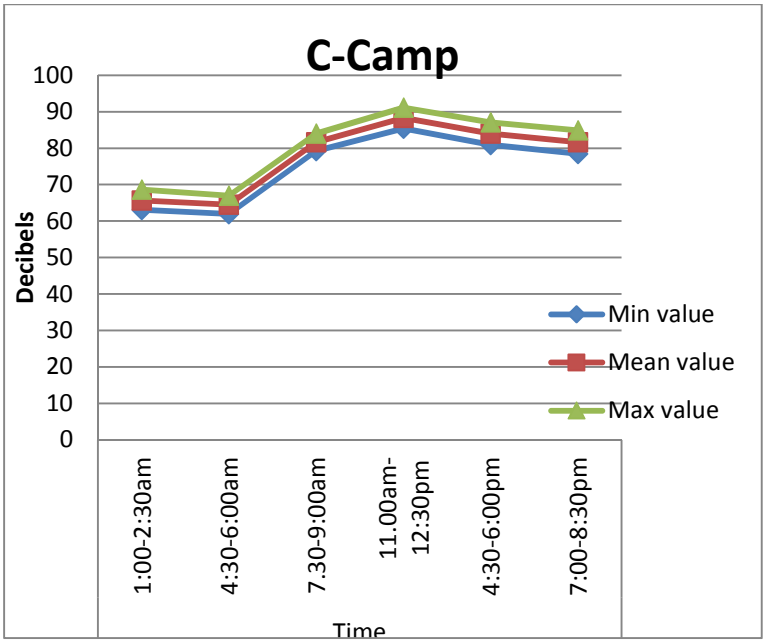
Time	Min value	Mean	Max value
1:00-2:30am	69.444	89.888	92.333
4:30-6:00am	63.667	76.166	88.666
7:30-9:00am	78.33	87.3888	96.44
11:00am-12:30pm	85.889	90.27	94.67
4:30-6:00pm	81.22	89.222	97.22
7:00-8:30pm	79.88	87.888	95.988



7.5.1 Results:
Noise is recorded more at all the times of the day.
7.5.2 Conclusion:
This is a very serious consequence. Measures should be taken immediately. Trees should be grown on either sides of the road. Road side parking should be prohibited. Push carts should not be allowed. Commercial vehicles like lorries and tractors should not be allowed.

7.6 C-camp:
It is one of the busiest places of Kurnool city. It is surrounded by commercial buildings, market, community halls, school, government offices, bus stops etc. This place has more greenery compared to other places chosen for study. There are no water bodies in this place.

Time	Min value	Mean value	Max value
1:00-2:30am	63.111	65.6111	68.666
4:30-6:00am	62	64.5	67
7.30-9:00am	79.222	81.611	84
11.00am-12:30pm	85.444	88.2777	91.111
4:30-6:00pm	80.888	84	87.111
7:00-8:30pm	78.444	81.667	84.888



7.6.1 Result:
From the observations, we can conclude that noise levels are recorded more during 11:00am – 12:30 pm. In spite of adequate amount of greenery, higher level of noise is observed.
7.6.2 Conclusion:
a) Avoiding goods carrying vehicles during peak hours.
b) Completely prohibiting road side parking.
c) Not allowing push carts and petty shops.
d) Constructing fly over.

8. Special Occasions

Special occasions like festivals, religious gatherings, processions, political issues, and political gatherings are frequently observed in developing countries like India. Contribution of these occasions to noise pollution is more. Some of these situations are based on the mythological beliefs of the people which are sensitive to restrict. One of such occasions is a festival known as Diwali. Diwali is one of the important festivals celebrated by Hindus. This is a festival of lights and celebrated with bursting of fire crackers. There is concern over increased noise and air pollution caused due to bursting of the fire crackers. The fire crackers bursting cause high noise levels typically more than 100 db. The important air pollutants generated during the fire cracker bursting are SO2, NOx and smoke or dust containing suspended particulates. As per the restrictions of the government, crackers producing noise more than 125db are prohibited. Some people report that they get pleasure from the sound of burning crackers. Some people make a series of crackers and light them where as some people place the crackers in metal tins and burst them. These activities produce more unwanted sound. The data on Diwali day is much higher. Data is as follows.

The problems of pollution due to fire crackers can be tackled by creating public awareness. Enforcement of the rules alone would not be sufficient. Noise made by musical band in marriages varies from 80db to 108 db. Political and religious gatherings also give similar results.

9. Results

From the statistical analysis, it is found that noise levels exceeded permitted limits in all places. A person is continuously exposed to a range of 60db – 80db which results in adverse permanent effects on health. The effects of noise pollution are auditory and non-auditory. According to the environmental protection rules 1986, commercial areas should have noise of 65db in day time and 55db in night time. At every place chosen for study, highest noise levels are recorded during 11:00am to 12:30pm and 4:00pm to 6:30 pm. 1:00am to 2:30am being the ideal time shows the values between 40db to 50db.Heavy vehicular traffic is observed at this time. During the period 4:30am to 6:00am the data recorded is between 40 db to 70 db. Interesting thing observed at this time is milk vendors and paper boys are on their duty. On them street dogs are observed barking. The noise produced when 4-6 dogs are found barking is between 70db to 75db. This kind of situation is reported at every location. Noise levels above 90db are observed due to horn from vehicles. In some cases more than 100db of noise is repeated more than 10 times in a span of 10 minutes.

Another interesting point of study is the noise produced during the special occasions like festivals, religious gatherings, political issues, political gatherings etc. On the evening of the Diwali day, noise levels recorded are more than 90db. Noise made by musical band in marriages varies from 80db to 108 db. In a movie theatre a person is continuously prone to a sound of 90db. In movie theatre parking areas noise levels are recorded approximately 80db. Noise levels below the under bridge are recorded 83db without horn.

10. Conclusion

The study revealed that noise levels in Kurnool city are at an alarming level. Monitoring total noise emissions from all the noise sources regularly and taking remedial measures immediately. Vegetation buffer zones must be created in different parts of the city. Efforts should be made for roadside plantations. In peak hours, commercial vehicles including tractors should be restricted. Echo free town layout should be planned in newly developing areas. Traffic noise can be reduced by using proper fuel, good tyres, roads and by discouraging the use of sound amplifiers. Controlling the inconsistency and vibration by the preventive protection, dropping the structure borne transmission by isolation of the source, regulating the noise sources by a sound reducing structure that resents air borne transmission, maintaining the spacing between noise sources and operators. Kurnool being a fast developing city has an urgent need to solve this problem. If this is over looked, this results in drastic changes on human health.

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