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Measurements of Environmental Noise Levels and the Creation of a Unique Geographical Information System (GIS) Layer Map for Environmental Noise Pollution in Chanchaga Local Government Council, Minna, Niger State

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Abstract

Environmental noise is a nuisance that we have to put up with from day to day. Environmental noise has been recognised as a form of pollution. This study will help prepare the framework for a noise pollution database for Chanchaga Local Government Council, Minna, as well as to help build the nucleus for an environmental awareness advocacy campaign to be funded and executed by the Niger State Government. Also, this study will help prepare the framework for a noise pollution database for Chanchaga Local Government Council. Stations of interest that were identified were appropriately geo-referenced and marked in the conventional way. The stations were re-visited with the noise level equipment whence information about the sources of environmental noise and the corresponding values of noise were logged progressively from one point to the next. The result of this exercise shows that all of the stations occupied in the course of this investigation suffer from relatively high levels of noise (i.e. above the threshhold of 70dB for environmental noise). Further, by use of the Geographical Information System (GIS) platform, a noise pollution layer for Chanchaga Local Government Council has been created, a novelty in itself. It can be deduced from the pollution map produced for this project work that, overall, the noise level regime over Barkin-Sale, Minna Central, Soje and Tunga neighbourhoods are quite high because a significant number of households and business locations use alternative power sources when the central power supply is cut. This GIS pollution layer map could now serve as a veritable urban development tool that would assist public health officials and town planners recommend appropriate action to be taken to safeguard the health of the citizenry.
Keywords: Environment; noise; pollution, geo-referencing, GIS, layer-map

Introduction

Over the last couple of decades, interest has been centred on environmental pollution and climate change issues all over the world. Thus it is fitting and proper that, in fulfillment of one of its founding charters, the Federal University of Technology, Minna, should be able to make its contribution to the field of environmental pollution, especially as it affects the local communities.

To this end, this project has been designed and executed such that an appropriate town-gown synergy advocacy could be evolved, as well as the production of a unique Geographical Information System (GIS) pollution map for Minna. Environment is the pysical and biotic habitat which surrounds us; that which we can see, hear, touch, smell and taste. Pollution can be defined as an undesirable change in the physical, chemical or biological characteristics of the air, water or land that can harmfully affect the health, survival or activities of humans or other living organisms (Henry and Heinke, 2004). Environmental pollution is the contamination of the earth's environment with materials that has an interference with the environment and are hazardous to human health or living organism. It has been classified into various categories that includes air pollution, water pollution, soil pollution, noise pollution and electromagnetic radiation. Electric motors, electric transmission lines, and appliances such as toasters, electric blankets and computers, all produce electromagnetic fields (EMFs) that are hazardous to human health. Nevertheless, several studies have concluded that children exposed to EMFs from power lines have an increased risk of contracting leukemia, lymphomas and nervous system cancers (Botkins and Keller, 1995). Noise is produced by sources vibrating with no fixed frequency or by several sources producing an unpleasant mixture of sounds. At home and at work, we often hear noise from ventilation or heating systems that is hardly noticeable because it has no prominent features. The noise never stops and has no tone, but if the fan suddenly stops or starts to whine, the change may disturb or even annoy us. Our hearing recognises information in the sounds that we hear. Information we do not need or want is noise. Noise features that make us listen and take notice are tones or changes in sound level. The more prominent the tone and the more abrupt the change in sound level, the more noticeable the noise. When measuring noise, we need to know the type of noise so that we can choose the parameters to measure, the equipment to use, and the duration of the measurement. Often we need to use our ears to pinpoint the annoying features of the noise, before making measurements, analysing and documenting them.

The word noise comes from a Latin word "nausea", meaning seasickness (www.en.wikipedia.org). It has been defined as unwanted sound, a potential hazard to health and communication dumped into the environment with regard to the adverse effect it may have on unwilling ears (www.hc2.humanclick.com). Sound is what human ear hear which is produced by vibrating objects and reaches the listener's ear as pressure waves in air or other media. When the amount of

sound becomes uncomfortable or annoying, it means that the vibration in air pressure near the ear have reached too high an amplitude (www.pollutionengineering.com).

Noise pollution is unwanted sound or vibration from a plethora of sources (www.bksv.com) or is a type of energy pollution in which distracting, irritating or damaging sound are freely audible. As with other forms of energy pollution (such as heat and light pollution), noise pollution contamination are not physical particles, but rather waves that interfere with naturally occuring waves of a similar type in the same environment. Thus, the definition of noise pollution is open to debate, and there is no clear border as to which sound may constitute noise pollution. In the most adverse effect wildlife, human activity, are all capable of damaging physical structures on a regular, repeating basis. In the broadest sense of the term, a sound may be considered noise pollution if it disturbs any natural process or causes human harm, even if the sound does not occur on a regular basis (www.what-is-what.com/what_is/noise_pollution.html).

We have come to understand that the exposure to high level of noise over a long period of time has a negative resultant effect on human health in the form of gradual hearing loss, irritation, attention deficiency syndrome, high blood pressure, restlessness, discomfort, pains, annoyance(s) and certain unpleasantries etc. This environmental effect of noise depend not only on the total energy of high level of noise but also on sounds' pitch, frequency, time pattern and length of exposure (Botkins and Keller, 1995).

Noise health effects are both health and behavioral in nature. Noise can damage physiological and psychological health. Noise pollution can cause annoyance or agression, hypertension, high stress levels, tinnitus, hearing loss, sleep disturbance, etc. Furthermore, stress and hypertension are the leading causes of health problems, whereas tinnitus can lead to forgetfulness, severe depression and at times panic attacks. Chronic exposure to noise may cause noise-induced hearing loss. Older males exposed to significant occupational noise demonstrate significantly reduced hearing sensitivity than their non-exposed peers, though differences in hearing sensitivity decrease with time and the two groups are indistinguishable by age 79 (www.geogise.com and www.wikipedia.com).

Noise has always been with the human civilization but it was never so obvious, so intense, so varied and as pervasive as it is seen in the last century. Noise pollution makes men more irritable. The effect of noise pollution is multifaceted and interrelated. The effects of noise pollution on human beings, animals, and properties are as follows (www. Legalserviceindia.com):

It decreases the efficiency of a man: Regarding the impact of noise on human efficiency there are number of experiments which point out the fact that human efficiency decreases with noise reduction.

Lack of concentration: For better quality of work there should be concentration. Noise causes lack of concentration. In big cities, mostly all the offices are on main road. The noise of traffic or the loud speakers of different types of horns divert the attention of the people working in offices.

Fatigue: Because of noise pollution, people cannot concentrate on their work. Thus they have to give their more time for completing the work and they feel tiring

Abortion is caused: Sudden noise causes abortion in females.

It increases blood pressure: Noise pollution is recognised as major contributing factors in accelerating blood pressure or mental illness.

Temporary or permanent deafness: The effect of nose on audition is well recognised. Mechanics, locomotive drivers, telephone operators, etc., all have hearing. impairment as a result of noise at the place of work. Physicists, physicians & psychologists are of the view that continued exposure to noise level above 80 to 100 dB is unsafe. Loud noise causes temporary or permanent deafness.

Effect on vegetation (poor quality of crops): It is now well known that plants respond to high levels of noise in much the same way as man.

Effect on animals: Noise pollution affects the nervous systems of animals.

Effect on properties: Loud noise is very dangerous to buildings, bridges and monuments. It creates waves which struck the walls and endangers the buildings.

Noise affects species by changing the delicate balance in predator/prey detection. Acoustic over-exposure can lead to temporary or permanent loss of hearing. Noise also makes species communicate louder, which is called Lombard vocal response. Scientist and researchers have conducted experiments that show whales song length is longer when submarine detectors are on. Zebra finches become less faithful to their partners when exposed to traffic noise. These effects could alter a population's evolutionary trajectory by selecting traits, sapping resources normally devoted to other activites thereby leading to profound genetic and evolutionary consequencies (Young and Freedman, 2004).

In 2008 Jonah *et al.* carried out a study the noise level signatures over Bida town, Niger State, Nigeria. The core objective of that study was to quantify the levels of noise at strategic locations in Bida town in relation to the internationally-recognised tolerable level of 70dB so that a pattern of noise pollution in these areas could be established. Measurements were taken from over one hundred stations of interest on the ground whence it was noticed that nearly all of these points suffer from high ambient levels of noise pollution at peak activity periods. In each case, the loudest contributor to environmental noise pollution was the electric milling machine. The noise level corresponding to the electric milling machine was found to be 97.06 dBA in Cadastral Sheets 14 and 22; in Cadastral Sheet 16 the noise level was peaked at 102.2 dBA. All of the principal sources of noise in the three sheets considered for investigation can be appropriately termed "noisy".

Stansfeld *et al.* (2000) studied environmental noise and mental health. They found out that exposure to high environmental noise was associated with mental health symptoms such as depression and anxiety but not with impaired psychological functioning. They pointed out that environmental noise and mental health should be accompanied by more accurate and detailed measurement of noise exposure and consideration of impact of other environmental stressors. According to Dube et al (2008), noise has been shown to interfere with the healing process and can disrupt the patients' experience. The study assessed patients and staffs perceptions of noise levels and sources in the hospital environment and identify intervention to reduce the noise level. The study reported that existing structure processes to identify noise sources and standardization of noise measurement methods can improve the patient hospital experience. They found out that the process of delivering patients care in a hospital often generates noise. Examples include

discussions of patient care or treatment requirements among healthcare team members, industrial floor cleaners, and even footsteps from persons wearing hard-soled footwear.

The problem of noise pollution was examined by Singh and Davar (2004) in the wake of its ill effect on the life of the people. A cross-section survey of the population in Delhi showed that the main sources of noise pollution are loudspeakers and automobiles. However, they discovered female population are affected by religious noise a little more than male population. Major effects of noise pollution include interference with communication, sleeplessness, and reduced efficiency. The extreme effects e.g deafness and mental breakdown were neither ruled out. Generally, a request to reduce or stop the noise is made out by the aggrieved party. They suggested public education to be the best method as suggested by the respondents.

Raza (1995) says that Karachi in India is one of the worst affected cities due to unchecked and uncontrolled noise pollution. He formulated a hypothesis that says the high level of noise is associated with the geographical agglomeration of land use and traffic volume, which results in high incidence of noise related diseases and people working near those areas are on vulnerable risk. The prime goals of his study was to modulate the information that pertains to noise pollution and its adverse effects on human health and to find their spatial patterns all over Karachi. The study covered different parameters: assessment of land cover land use, human settlement growth, temporal traffic patterns, population distributions, current levels of noise, health implications, physicians and public perception. He pointed out that spatial variations within metropolis have been largely ignored mainly due to less comprehension, under estimation of spatial techniques as well as difficulties in collecting, processing and analyzing the data at micro geographic scales. Remote sensing technology has been providing multi-dimensional information, which is utilised in various environmental investigations while Geographical Information System (GIS) have been accepted as a turnkey solution for the complex world due to its magnanimous breath of functionalities and cost effectiveness. The developed GIS evaluation combined the data sets, various analyses and the resultant maps with the capability to integrate further parameters for future risk assessments. Multi attribute decision analysis was successfully employed. Micro-geographic appraisals of the metropolis were performed by considering 58 zones outlined by the local development authority. Each regional assessment included area, population density, distribution of land cover, split of land use, and frequency of noise induced diseases, their

prevalence scenario and temporal variations in noise levels within the zone. Multiple regression models for predicting noise level at the olden regions of Karachi metropolis have been formulated in which traffic and land use parameters act as independent variables. The most unique feature of his study is the unification of engineering techniques with that of human behavioral sciences to trace down the manifestations of noise pollution. It is hoped that in future, more analogous mult-disciplinary researches would be conducted on emerging mega cities of the third world.

On noise measurements, Abumere *et al.* (1999) carried out a study to investigate noise pollution within Port-Harcourt City. Their study concluded that noise exposure limits in Port-Harcourt City exceeds the value recommended by the International Environmental Protection Agency (IEPA), i.e. 70dB. They suggested some strategies for limiting noise levels in Port-Harcourt city. Menkiti (1976) highlighted the fact that the incidence of impaired hearing in Nigeria could be blamed on exposure to noise (Abumere *et al.*, 1999). Onuu and Menkiti (1993) have analyzed the spectra of road traffic noise for parts of southeastern Nigeria and they concluded that this type of noise dominates the low frequency range, 500-800Hz (Abumere *et al.*, 1999).

Shi (1971) comments that noise is a complex sound that has little or no periodicity and the essential characteristic of noise is its undesirability. Thus, noise could be defined as any annoying or unwanted sound. In recent years, the rapid increase of noise level in our environment has become a national public health hazard. Noise affects man's state of mental, physical, and social well-being. The problem forms a special type of air pollution. Noise study is a rather new subject among other branches of science. The transition from art to near-science started before World War II. The work was an attempt to arrive at an understanding of the general situation on the problem of noise. The survey consists of four major parts: the present status of noise pollution, its sources, its effects, and the control. Finally, lists of terminology and a bibliography relating to noise pollution problems were included.

Objectives of Study

The principal objectives of this project work are as follows:

i. To help prepare the framework for a noise pollution database for Chanchaga Local Government Council, Minna, as part of a larger contiguous environmental pollution studiies of other major towns of Niger State.

ii. To help build the nucleus for an environmental awareness advocacy programme to be funded and executed by the Niger State Government.

Methodology

Co-ordinate Identification: Co-ordinate identification for this project exercise was facilitated by the use of hand-held Global Positioning System (GPS) units. A GPS unit measures the geographical location (and elevation) of a place in terms of its longitude and latitude in units of degrees, minutes and seconds as well as the Universal Traverse Mercator (UTM) protocol. The operation of this device is done in open spaces, away from trees, tall buildings, and high tension cables which could be sources of interference of the signals transmitted to satellites in space. As soon as the device is switched on, signals are sent from the device to a special network of geostationary satellites. When at least three or four of these satellites are located, the location or elevation of any point on the surface of the earth could be fixed within an acceptable margin of error. A typical GPS device is shown in Fig.1.

Fig. 1. Typical GPS device

Field Equipment: Sound level meters are instruments used to measures *sound pressure level* and are commonly used in noise pollution studies for the quantification of almost any noise, but especially for industrial, environmental and aircraft noise. However, the reading given by a sound level meter does not correlate well to human-perceived loudness; for this a loudness meter is needed. The current international standard for sound level meter performance is IEC 61672:2003 and this mandates the inclusion of an *A*-frequency-weighting filter and also describes other frequency weightings of *C* and *Z* (zero) frequency weightings. The older *B* and *D* frequency-weightings are now obsolete and are no longer described in the standard. A typical sound level meter device is shown in Fig.2.

Fig. 2. Typical sound level meter

The equipment that was used for this study was the standard Xtech A-weighted noise level meter.

Data Collection Procedure: Stations of interest that were identified for this survey were appropriately geo-referenced and marked in the conventional way. The stations were re-visited with the noise level mwter whence information about the sources of environmental noise and the corresponding values of noise were logged progressively from one point to the next. The different neighbourhoods of Chanchaga Local Government Council are the following, viz: Emir's Palace, F-Layout, Agwan Kaje, 123 Quarters, David Mark Road Environ, Mobil, Barkin-Sale, Broadcasting Road Environ, Tunga Market Territory, Soje (A and B), Tunga (Mr. Biggs and Top Medical Environs), Tunga (Farm Center), and Sauka Kahuta.

Dataset of Study: About 2526 households strations were occupied for this study. These stations were the points of interest that suffer from high noise levels. The dataset collected from the field are usually presented in conformance with the Geographic Information System (GIS) protocol in terms of single static source representing a point shape, their numerical IDs, latitude, longitude, conventional locations on the ground noise emission sources, rated output of sources, and the presence or absence of noise (determined from a comparison of the measured value with the threshold value). An abridged form of the dataset is presented as Table 1.

Table 1: Abridged form of dataset of study

Shape	**ID**	**Coordinates**		**Location**	**Source**	**Rating**	**Noise Level**	**Pollution Status**
Point	1	37'21.8"	33'00.4"	Stadium Road	Studio Loudspeaker/Aiwa	2000W	100.9	PRESENT
Point	2	37'21.4"	33'00.9"	Stadium Road	Welding driiller/Power plus	Nil	88	PRESENT
Point	3	37'21.0"	33'01.0"	Stadium Road	Motor Cycle/ Suzuki	Nil	97.5	PRESENT

Point	4	37'20.6"	33'01.4"	Stadium Road	Yamaha EF4000	4000W	79.5	PRESENT
Point	5	37'20.6"	33'01.9"	Stadium Road	Motor cycle/ Honda	Nil	81.4	PRESENT
Point	6	37'20.8"	33'02.0"	Stadium Road	Electric grain miller	Nil	97	PRESENT
Point	7	37'18.8"	33'06.0"	Stadium Road	petrol generator/ Tiger	Nil	91	PRESENT
Point	8	37'18.4"	33'07.1"	Stadium Road	Home stereo player	Nil	82.6	PRESENT
Point	9	37'18.1"	33'07.4"	Stadium Road	Vulcaniser /Viking	1.5kW/220V/50Hz	93.3	PRESENT
Point	10	37'17.9"	33'07.9"	Stadium Road	Generator repair/ Suzuki	7.5kW/220V/50Hz	86.5	PRESENT
Point	11	37'17.7"	33'08.2"	Stadium Road	Barbing saloon stereo player	Nil	72.2	PRESENT
Point	12	37'17.4"	33'08.5"	Stadium Road	Electric miller vegetable	Nil	98.4	PRESENT
Point	13	37'17.0"	33'09.1"	Stadium Road	Diesel generator/Imex	7.5kW/220V/50Hz	86.2	PRESENT
Point	14	37'33.0"	33'10.1"	Stadium Road	Electric miller grian	3.7kW/220V/50Hz	106.5	PRESENT
Point	15	37'32.9"	33'12.2"	Stadium Road	Welding filling mach./Bolts	1.2kW/220V/50Hz	103.1	PRESENT

Point	16	37'32.4"	33'12.5"	Stadium Road	Studio recorder	Nil	98.4	PRESENT
Point	17	37'32.1"	33'12.9"	Stadium Road	Motor cycle/Hunda	Nil	95.8	PRESENT
Point	18	37'31.8"	33'13.1"	Stadium Road	Vulcaniser/Viking	1.5kW/220V/50Hz	99.3	PRESENT
Point	19	37'31.5"	33'13.5"	Stadium Road	Home stereo player	Nil	94.3	PRESENT
Point	20	37'31.1"	33'13.8"	Stadium Road	Wood mach. Router/Siemens	1.2kW/220V/50Hz	84.4	PRESENT
Point	21	37'20.5'	33'02.4"	Stadium Road	Electric miller vegetable	Nil	96.8	PRESENT
Point	22	37'20.3"	33'03.6"	Stadium Road	Petrol generator/Honda	11.5kW/220V/50Hz	86.1	PRESENT
Point	23	37'20.2"	33'04.8"	Stadium Road	Motor cycle/Jincheng	Nil	87.5	PRESENT
Point	24	37'20.1"	33'05.7"	Stadium Road	Barbing saloon stereo player	Nil	88.1	PRESENT
Point	25	37'19.8"	33'05.5"	Stadium Road	Generator repair/ Heman	7.5kW/220V/50Hz	93.6	PRESENT
Point	26	37'19.6"	33'05.3"	Stadium Road	Electric miller grian	Nil	81.5	PRESENT
Point	27	37'19.4"	33'06.9"	Stadium Road	Motor cycle/Jinchen	Nil	98.5	PRESENT

Point	28	37'19.3"	33'05.6"	Stadium Road	Wood mach. Router/Siemens	1.2kW/220V/50Hz	98.5	PRESENT
Point	29	37'19.2"	33'06.6"	Stadium Road	Studio recorder	Nil	74.6	PRESENT
Point	30	37'19.0"	33'07.1"	Stadium Road	Home stereo player	Nil	75.4	PRESENT
Point	31	37'29.8"	33'14.0"	Stadium Road	Electric miller vegetable	Nil	87.4	PRESENT
Point	32	37'29.6"	33'14.2"	Stadium Road	Motor cycle/Suzuki	Nil	73.1	PRESENT
Point	33	37'29.4"	33'14.6"	Stadium Road	Vulcaniser/Viking	1.5kW/220V/50Hz	78.1	PRESENT
Point	34	37'29.0"	33'14.9"	Stadium Road	Petrol generator/Tiger	11.5kW/220V/50 Hz	94.5	PRESENT
Point	35	37'28.7"	33'15.6"	Stadium Road	Small generator/Yamaha	Nil	98.3	PRESENT
Point	36	37'28.3"	33'15.8"	Stadium Road	Diesel generator/ Imex	7.5kW/220V/50Hz	94.9	PRESENT
Point	37	37'27.0"	33'16.0"	Stadium Road	Generator repair/Heman	7.5kW/220V/50Hz	98.3	PRESENT
Point	38	37'27.8"	33'16.3"	Stadium Road	Yamaha EF2000	2000W	91.2	PRESENT
Point	39	37'27.5"	33'16.8"	Stadium Road	Studio recorder	Nil	87.9	PRESENT

Point	40	37'26.0"	33'17.4"	Stadium Road	Barbing saloon stereo player	Nil	77	PRESENT
Point	41	37'26.8"	33'17.7"	Stadium Road	Electric miller grian	3.7kW/220V/50Hz	98	PRESENT
Point	42	37'26.5"	33'18.1"	Stadium Road	Vulcaniser/Viking	1.5kW/220V/50Hz	75.1	PRESENT
Point	43	37'26.3"	33'18.4"	Stadium Road	Yamaha EF6600E	6000W	76.9	PRESENT
Point	44	37'25.0"	33'18.9"	Stadium Road	Barbing saloon stereo player	Nil	95	PRESENT
Point	45	37'25.6"	33'19.4"	Stadium Road	Electric miller vegetable	Nil	85.8	PRESENT
Point	46	37'25.2"	33'19.8"	Stadium Road	Barbing saloon stereo player	Nil	85.2	PRESENT
Point	47	37'24.8"	33'20.4"	Stadium Road	Home stereo player	Nil	76.2	PRESENT
Point	48	37'24.2"	33'20.9"	Stadium Road	Motor Cycle/ Suzuki	Nil	96.9	PRESENT
Point	49	37'20.5"	32'57.2"	Stadium Road	Barbing saloon stereo player	Nil	98.5	PRESENT
Point	50	37'20.1"	32'56.8"	Stadium Road	Barbing saloon stereo player	Nil	76.1	PRESENT
Point	51	37'19.8"	32'56.4"	Stadium Road	Electric miller vegetable	Nil	91.8	PRESENT

Point	52	37'19.5"	32'56.1"	Stadium Road	Electric miller grian	Nil	95.6	PRESENT
Point	53	37'19.0"	32'55.8"	Stadium Road	Motor cycle/Elepaq	Nil	85.9	PRESENT
Point	54	37'20.0"	32'55.5"	Stadium Road	Wood mach. Router/Siemens	1.2kW/220V/50Hz	95.8	PRESENT
Point	55	37'21.1"	32'55.3"	Stadium Road	Welding driiller/Power plus	Nil	73.1	PRESENT
Point	56	37'22.7"	32'55.0"	Stadium Road	Generator repair/ Tiger	7kW/220V/50Hz	91.4	PRESENT
Point	57	37'23.4"	32'54.7"	Stadium Road	Studio recorder	Nil	84.7	PRESENT
Point	58	37'19.8"	32'54.3"	Stadium Road	Motor cycle/ Jinchen	Nil	86.7	PRESENT
Point	59	37'19.6"	32'54.4"	Stadium Road	Small generator/Tiger	11.5kW/220V/50Hz	75.9	PRESENT
Point	60	37'19.2"	32'54.6"	Stadium Road	Electric miller vegetable	Nil	95.2	PRESENT
Point	61	37'18.0"	32'54.7"	Stadium Road	Motor cycle/Hunda	Nil	74.2	PRESENT
Point	62	37'17.7"	32'54.9"	Stadium Road	Motor cycle/Suzuki	Nil	81.6	PRESENT
Point	63	37'17.4"	32'53.8"	Stadium Road	Vulcaniser/Viking	1.5kW/220V/50Hz	93.8	PRESENT

Point	64	37'19.5"	32'53.4"	Stadium Road	Wood mach. Router/Siemens	1.2kW/220V/50Hz	96.3	PRESENT
Point	65	37'20.8"	32'53.0"	Stadium Road	Barbing saloon stereo player	Nil	85.2	PRESENT
Point	66	37'21.8"	32'53.1"	Stadium Road	Home stereo player	Nil	70	PRESENT
Point	67	37'22.9"	32'53.2"	Stadium Road	Welding driiller/Power plus	Nil	96.2	PRESENT
Point	68	37'23.4"	32'53.3"	Stadium Road	Generator repair/Hunda	7.5kW/220V/50Hz	86.1	PRESENT
Point	69	37'25.2"	32'53.4"	Stadium Road	Electric miller grian	Nil	101.5	PRESENT
Point	70	37'27.9"	32'57.4"	Stadium Road	Studio recorder	Nil	75.7	PRESENT
Point	71	37'25.7"	32'53.8"	Stadium Road	Generator/Yamaha	Nil	84.2	PRESENT
Point	72	37'29.2"	32'54.1"	Stadium Road	Home stereo player	Nil	98.2	PRESENT
Point	73	37'28.1"	32'56.5"	Stadium Road	Vulcaniser/Viking	1.5kW/220V/50Hz	76.8	PRESENT
Point	74	37'28.2"	32'25.4"	Stadium Road	Electric miller vegetable	Nil	75.2	PRESENT
Point	75	37'27.9"	32'24.8"	Stadium Road	Motor cycle/Suzuki	Nil	95.2	PRESENT

Point	76	37'27.4"	32'24.3"	Stadium Road	Wood mach. Router/Siemens	1.2kW/220V/50Hz	86.7	PRESENT
Point	77	37'27.0"	32'23.0"	Stadium Road	Electric miller vegetable	Nil	103.4	PRESENT
Point	78	37'26.6"	32'23.7"	Stadium Road	Electric miller grian	3700kW/220V/50Hz	77.8	PRESENT
Point	79	37'26.3"	32'28.1"	Stadium Road	Barbing saloon stereo player	Nil	88.1	PRESENT
Point	80	37'26.0"	32'28.6"	Stadium Road	Petrol generator/Elepaq	7.5kW/220V/50Hz	75.9	PRESENT
Point	81	37'25.7"	32'29.1"	Stadium Road	Welding filling mach./Bolts	1.2kW/220V/50Hz	81.8	PRESENT
Point	82	37'25.3"	32'29.4"	Stadium Road	Studio recorder	Nil	93.2	PRESENT
Point	83	37'24.9"	32'29.9"	Stadium Road	Motor cycle/Jinchen	Nil	82.5	PRESENT
Point	84	37'24.6"	32'30.2"	Stadium Road	Electric miller vegetable	Nil	95.8	PRESENT
Point	85	37'24.0"	32'30.8"	Stadium Road	Vulcaniser/Viking	1.5kW/220V/50Hz	93.5	PRESENT
Point	86	37'23.7"	32'31.3"	Stadium Road	Generator repair/Hunda	11.5kW/220V/50Hz	78.8	PRESENT
Point	87	37'23.4"	32'31.5"	Stadium Road	Studio recorder	3600W	92.8	PRESENT

Point	88	37'23.7"	32'31.8"	Stadium Road	Electric miller grian	Nil	90	PRESENT
Point	89	37'22.8"	32'32.4"	Stadium Road	Motor cycle/Jinchen	Nil	84.5	PRESENT
Point	90	37'22.5"	32'32.6"	Stadium Road	Barbing saloon stereo player	Nil	82.1	PRESENT
Point	91	37'22.1"	32'33.2"	Stadium Road	Home stereo player	Nil	74.5	PRESENT
Point	92	37'21.8"	32'33.7"	Stadium Road	Generator repair/Tiger	7.5kW/220V/50Hz	73.7	PRESENT
Point	93	37'21.6"	32'33.9"	Stadium Road	Motor cycle/Suzuki	Nil	95.1	PRESENT
Point	94	37'21.3"	32'34.2"	Stadium Road	Electric miller vegetable	Nil	86.9	PRESENT
Point	95	37'19.9"	32'35.4"	Stadium Road	Studio recorder	Nil	79.4	PRESENT
Point	96	37'19.4"	32'36.9"	Stadium Road	Wood mach. Router/Siemens	810W/220V/50Hz	70.9	PRESENT
Point	97	37'18.7"	32'37.5"	Stadium Road	Welding filling mach./Bolts	1.2kW/220V/50Hz	86.5	PRESENT
Point	98	37'18.2"	32"40.1"	Stadium Road	Electric grain miller	3.7kW/220V/50Hz	84.6	PRESENT
Point	99	37'21.6"	33'00.4"	Stadium Road	Barbing saloon stereo player	Nil	74.6	PRESENT

Point	100	37'20.0"	33'04.1"	Stadium Road	Home stereo player	Nil	70.1	PRESENT

Creation of a Unique GIS Layer of Noise Pollution Level Map for Minna

Concept of GIS: A geographic information system (GIS) is a computer-based tool for mapping and analysing geographic phenomenon that exist, and events that occur, on Earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualisation and geographic analysis benefits offered by maps. These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies. Map making and geographic analysis are not new, but a GIS performs these tasks faster and with more sophistication than do traditional manual methods. Today, GIS is a multi-billion-dollar industry employing hundreds of thousands of people worldwide. GIS is taught in schools, colleges, and universities throughout the world. Professionals and domain specialists in every discipline are become increasingly aware of the advantages of using GIS technology for addressing their unique spatial problems. We commonly think of a GIS as a single, well-defined, integrated computer system. However, this is not always the case. A GIS can be made up of a variety of software and hardware tools. The important factor is the level of integration of these tools to provide a smoothly operating, fully functional geographic data processing environment. In general, a GIS provides facilities for data capture, data management, data manipulation and analysis, and the presentation of results in both graphic and report form, with a particular emphasis upon preserving and utilising inherent characteristics of spatial data. The ability to incorporate spatial data, manage it, analyse it, and answer spatial questions is the distinctive characteristic of geographic information systems.

Digitisation of Analogue Map of Study Area

Introduction: Digitisation is a simplification process that converts all spatial data to a point (e.g., a well), a line (e.g., a stream), a polygon formed by a closed, complex line (e.g., a lake), or a grid

cell. Digitisation reduces all spatial entities to these simple forms because they were easy to store in the computer. A GIS database cannot readily recognize features or entities as human map users do. For example, we cannot enter the entity "lake" into a GIS. Rather, we entered the spatial data coordinates for the lake's shoreline as a polygon. Later, the attributes of the lake will be entered into the GIS database and will be associated with the polygon. Following the digitization of map features, the user completes the compilation phase by relating all spatial features to their respective attributes, and by cleaning up and correcting errors introduced as a result of the data conversion process. The end results of compilation was a set of digital files, each accurately representing all of the spatial and attribute data of interest contained on the original map manuscripts. These digital files contained geographic coordinates for spatial objects (points, lines, polygons, and cells) that represent mapped features. Although we conceptualize the GIS as a set of registered map layers, the GIS actually stores these data at a much more primitive level.

Practical Digitisation Procedures: A folder was created for the analogue map in the GIS ArcView 3.3 environment; the analogue map in ArcView 3.3 is shown in Fig.3. After activating the ArcView3.3 menu, the folder was called up. Thence all spatial data on the analogue map were converted to points, lines, and polygons, thus ensuring that digitization was complete. The digitised map in ArcView3.3 is shown in Fig.4. The ditgitised map exported to the Microsoft Word platform is shown in Fig.4.

Fig.3. Analogue map/ data view of study area (Chanchaga council) in ArcView3.3

Fig. 4. Digital map/ layout view for Chanchaga council in ArcView3.3

Fig.4. Digitised map of study area in Microsoft Word environment

Naming of Locations on Digitised Map

The attributes were named using the text tools on the ArcView menu. From the theme and edit icons, the text mode was enabled in order that locations on the map could be named. Shown in Fig.5 are the major and minor dialogue boxes as well as the digitised map of the study area.

Fig.5. Major and minor dialogue boxes as well as the digitised map of the study area

Creation of a Database on ArcView Platform

The conventional database contains rows and columns, geographical coordinates of the locations of noise, sources of noise, rating, noise level, and pollution status (see Table1). This same dataset on the ArcView3.3 is shown in Fig.6.

Shape	ID	Cordinates	Location	Source	Rating	Noise Level	Pollution Status
Point	0	37'21.8" / 33'00.4"	Stadium Road	Studio Loudspeak	2000W	100.9	PRESENT
Point	2	37'21.4" / 33'00.9"	Stadium Road	Welding driller	Nil	88	PRESENT
Point	3	37'21.0" / 33'01.0"	Stadium Road	Motor Cycle/ Suz	Nil	97.5	PRESENT
Point	4	37'20.6" / 33'01.4"	Stadium Road	Yamaha EF4000	4000W	79.5	PRESENT
Point	5	37'20.6"/ 33'01.9"	Stadium Road	Motor cycle/ Hon	Nil	81.4	PRESENT
Point	6	37'20.8" / 33'02.0"	Stadium Road	Electric miller	Nil	97	PRESENT
Point	7	37'18.8" / 33'06.0"	Stadium Road	petrol generator	Nil	91	PRESENT
Point	8	37'18.4" / 33'07.1"	Stadium Road	Home stereo play	Nil	82.6	PRESENT
Point	9	37'17.7 / 33'07.4"	Stadium Road	Vulcaniser /Viki	1.5kw/220v/50Hz	93.3	PRESENT
Point	10	37'17.4" / 33'07.9"	Stadium Road	Generator repair	7.5kw/220v/50HzN	93.3	PRESENT
Point	11	37'17.7" / 33'08.2"	Stadium Road	Barbing saloon s	Nil	86.5	PRESENT
Point	12	37'17.4" / 33'08.5"	Stadium Road	Electric miller	Nil	72.2	PRESENT
Point	13	37'17.4" / 33'08.5"	Stadium Road	Diesel generator	7.5kw/220v/50Hz	98.4	PRESENT
Point	14	37'17.4" / 33'08.5"	Stadium Road	Electric miller	3.7kw/220v/50Hz	86.2	PRESENT
Point	15	37'17.4" / 33'08.5"	Stadium Road	Welding filling	1.2kw/220v/50Hz	106.5	PRESENT
Point	16	37'17.4" / 33'08.5"	Stadium Road	Studio recorder	Nil	103.1	PRESENT
Point	17	37'17.4" / 33'08.5"	Stadium Road	Motor cycle/Hund	Nil	98.4	PRESENT
Point	18	37'17.4" / 33'08.5"	Stadium Road	Vulcaniser/Vikin	1.5kw/220v/50Hz	95.8	PRESENT
Point	19	37'17.4" / 33'08.5"	Stadium Road	Home stereo play	Nil	99.3	PRESENT
Point	20	37'17.4" / 33'08.5"	Stadium Road	Electric miller	1.2kw/220v/50Hz	94.3	PRESENT
Point	21	37'17.4" / 33'08.5"	Stadium Road	Petrol generator	Nil	84.4	PRESENT
Point	22	37'17.4" / 33'08.5"	Stadium Road	Motor cycle/Jinc	11.5kw/220v/50Hz	96.8	PRESENT
Point	23	37'17.4" / 33'08.5"	Stadium Road	Barbing saloon s	Nil	86.1	PRESENT
Point	24	37'17.4" / 33'08.5"	Stadium Road	Generator repair	Nil	87.5	PRESENT
Point	25	37'17.4" / 33'08.5"	Stadium Road	Electric miller	7.5kw/220v/50Hz	88.1	PRESENT
Point	26	37'17.4" / 33'08.5"	Stadium Road	Motor cycle/Jinc	Nil	93.6	PRESENT
Point	27	37'17.4" / 33'08.5"	Stadium Road	Wood mach. Route	Nil	81.5	PRESENT
Point	28	37'17.4" / 33'08.5"	Stadium Road	Studio recorder	1.2kw/220v/50Hz	98.5	PRESENT
Point	29	37'17.4" / 33'08.5"	Stadium Road	Home stereo play	Nil	98.5	PRESENT
Point	30	37'17.4" / 33'08.5"	Stadium Road	Electric miller	Nil	74.6	PRESENT
Point	31	37'17.4" / 33'08.5"	Stadium Road	Motor cycle/Suzu	Nil	75.4	PRESENT
Point	32	37'17.4" / 33'08.5"	Stadium Road	Vulcaniser/Vikin	Nil	87.4	PRESENT
Point	33	37'17.4" / 33'08.5"	Stadium Road	Petrol generator	1.5kw/220v/50Hz	73.1	PRESENT
Point	34	37'17.4" / 33'08.5"	Stadium Road	Small generator/	11.5kw/220v/50Hz	78.1	PRESENT
Point	35	37'17.4" / 33'08.5"	Stadium Road	Diesel generator	Nil	94.5	PRESENT
Point	36	37'17.4" / 33'08.5"	Stadium Road	Generator repair	7.5kw/220v/50Hz	98.3	PRESENT
Point	37	37'17.4" / 33'08.5"	Stadium Road	Yamaha EF2000	7.5kw/220v/50Hz	94.9	PRESENT

Fig.6. Dataset of study group on the ArcView3.3

The database was inputted and hot-linked to the spatial data (map and coordinates). Red dots on the map are representative of the spots where environmental noise levels are above the threshold of 70dB. Fig.7 shows how the spatial information was linked with the attributes database; this is usually called hot-linking. The resulting noise pollution status map on ArcView3.3 is shown in Fig.8.

Fig.7. Hot-linking attribute data with spatial information

Fig.8. Pollution status map on ArcView3.3.

Query Procedures and Presentation of Pollution Layer

The query was performed on ArcView3.3 by ensuring that the entire menu themes were active. The Query Builder allows for easy selection of features based on their attributes. Inside the dialog box, under Fields, the first step involved double-clicking on “Point”. The points that comprised of geo-reference points, locations, sources, rating, and noise levels as well as pollution status appeared in the box at the bottom of the dialog. To find specific attributes, the = sign was chosen by clicking on it once. An attribute name from the point list was selected by double-clicking to add it to the expression, and then “New Set” was selected. By default, ArcView highlighted the

queried selection in red. The attributes that were queried were highlighted in red on the map. Fig.9 shows location query for the study area.

Fig.9. Location query for the study area

Fig.10 shows sources of noise query for the study area

Fig.10. Sources of noise query for the study area

Fig.11 shows power rating of sources of noise query for the study area

Fig.11. Power rating of sources of noise query for the study area

Fig.12 shows noise pollution status query for the study area

Fig.12. Noise pollution status query for the study area

The noise map in Microsoft Word is shown in Fig.13.

Fig.13. Noise map in Microsoft Word

Results and Conclusion

All the stations occupied for this survey (about 2526 households) indicate noise levels greater than the internationally-recommended safe threshold of 70dB. Station occupation was biased in favour of households that have high noise levels. The predominant sources of noise are common household generators. Others are grain milling machines, metal milling machines, and music store loudspeakers. The GIS tool has been employed in the analysis of the full body of the dataset acquired for this project work with the core objective of producing a noise pollution layer for Chanchaga Local Government Council of Niger State. This unique GIS layer is the first of its kind anywhere in Nigeria. Thus at the click of a mouse, information about the noise pollution signature for Chanchaga Local Government Council of Niger State can readily be assessed. From the noise pollution map of Fig.13 it is observed that the Barkin-Sale, Minna Central, Soje and Tunga neighbourhoods have high red dot densities, whilst the dot densities for Sabon Gari and Sauka Kahuta neighbourhoods are sparsely distributed.

It can be deduced from the pollution map produced for this project work that, overall, the noise level regime over Barkin-Sale, Minna Central, Soje and Tunga neighbourhoods are quite high because a significant number of households and business locations use alternative power sources when the central power supply is cut. Because of the homestead densities of these neighbourhoods, without appreciable lots or spaces between homes, milling machines easily constitute nuisances. The more developed a neighbourhood is, the greater the noise dot density. This GIS pollution layer map could now serve as a veritable urban development tool that would assist public health officials and town planners recommend appropriate action to be taken to safeguard the health of the citizenry.

Recommendation

From the result of this study it is recommended that there should adequate and safe clearance between power generating units and homesteads when these units are in use. Householders should switch to the purchase of low-noise generator brands from reputable manufacturers. Further, efforts should be made by householders to explore the possibility of alternative power generating sources like solar units since their initial cost of installation are not prohibitively expensive anymore. The result of this study is actually futuristic in its outlook, thus it is strongly recommended that a GIS host platform for Minna be created so that the interactive nature of the

noise pollution map of Fig.13 can be fully exploited. It is also recommended that novelty studies of this kind be replicated in the major towns and cities of Nigeria.

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