SPATIAL ANALYSIS AND GEOGRAPHIC INFORMATION SYSTEM (GIS) MAPPING OF NOISE POLLUTION IN BOSSO LOCAL GOVERNMENT COUNCIL, NIGER STATE, NIGERIA

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Abstract

This study was designed and executed such that a noise pollution profile for Bosso Local Government Council of Niger State would be successfully presented. The aim and objective of this study is the application of the knowledge of spatial analysis and Geographic Information System mapping to contribute towards the preparation of a framework for a noise pollution database for Bosso Local Government Council. Data collection was facilitated by both the use of the hand-held GPS units and the sound level meter. Stations of interest were appropriately geo-referenced and marked in the conventional way. The stations were re-visited with the noise level equipment and information about the sources of environmental noise, the corresponding values of noise, and the status of noise pollution were logged sequentially from one point to the next. Further, by the use of the Geographic Information System (GIS), a noise pollution layer for Bosso Local Government Council was created. It can be deduced from the pollution map produced by this project work that, overall, the noise level regime over Tudun Fulani, Maikunkele, Bosso, Maitumi, and Chanchaga 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 decibel layer map could now serve as a veritable urban development tool that would assist public health officials and town planners recommend appropriate actions to be taken to safeguard the noise-related hazard of the citizenry.

Keywords: Noise, pollution, GIS, geo-referencing

1.0 Introduction

Environmental noise is a nuisance that we have to live with from day to day, and it has been recognized as a form of pollution. Over the last couple of decades interest has been centred on environmental pollution and climate change issues all over the world. Thus, 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 study has been designed and executed such that, in addition to creating a unique database of environmental noise pollution, an appropriate town-gown synergy advocacy could be evolved.

1.1 Environmental Pollution Aspects of Noise: The word noise is derived from the Latin term "nausea". It has been defined as an unwanted sound, a potential hazard to health and communication dumped into the environment (Miglani, 2003). It is a well known fact that exposure to high levels of noise over a long period of time has negative resultant effects on human health; these may manifest in form of gradual hearing loss, irritation,

high blood pressure, etc. Noise pollution affects quality of life and has been linked to health problems. The Environmental Noise Directive (END) aims to manage noise and preserve quiet areas by engaging the public, local authorities and operators (Parliamentary Office of Science and Technology, 2009). Environmental noise is unwanted or unpleasant outdoor sound generated by transport and industry. The European Community's Green Paper on Future Noise Policy of 1996 recognized that environmental noise is "one of the main local environmental problems in Europe" but that it has had a lower priority than other environmental problems, such as air or water pollution. It also recognized that, despite significant reductions in the noise produced by individual sources, total exposure to environmental noise has not changed significantly. For example, the introduction of quieter vehicles has been offset by an increase in traffic. Environmental noise in the United Kingdom (UK) is controlled by numerous laws, guidelines and standards covering planning, transport, the environment and compensation. To provide a common approach to noise management, the European Union introduced the Environmental Noise Directive (END) in 2002.

Environmental noise rarely reaches the sound pressure levels associated with hearing impairment. However, noise can cause annoyance, is commonly blamed for sleep disturbance and has been linked by researchers to less obvious effects, such as cardiovascular and mental health problems and reduced performance at work or school. The ways in which noise affects health are not clear (Parliamentary Office of Science and Technology, 2009). It has been estimated that 55% of the UK population live in dwellings where the outdoor environmental noise level exceeds the guideline value suggested by the World Health Organisation (WHO). On average, annoyance increases as the measured sound level increases but, individual attitudes to the same noise source can vary. Evidence on the links between noise exposure and sleep quality is complex. The WHO recommends that sound levels should be kept below an average level of 30dB(A) in the bedroom, or a maximum of 45dB(A) for a single event. Higher sound levels have been related to reduced quality of sleep and awakenings. It appears that the majority of people will get used to common background noises at higher average sound levels and sleep will not be disturbed. However, the full restorative effects of sleep may be reduced even if people are not awakened. Unusually loud noises cause elevated heart rates and blood pressure, which quickly return to normal once the noise stops. The effects of longer term exposure are not well understood, but it has been linked to a slightly increased likelihood of hypertension, heart disease and heart attack. Separating the effects of noise from other confounding factors, such as air pollution, body mass index, age and smoking is difficult. Noise has been shown to affect the performance of adults and children in cognitive tasks. The EC sponsored RANCH study investigated the link between children's health and noise in the UK, the Netherlands and Spain. It found that chronic exposure to aircraft noise can impair children's reading comprehension and memory to some extent. No link was found between road noise and performance. It was suggested that aircraft noise may be more disruptive than road noise due to its "variability and unpredictability". However, previous studies at higher

noise exposure levels had found a link between road noises and perform. Certain groups of people are more vulnerable to environmental noise. High background noise levels make conversation more difficult for the hearing impaired. Studies have linked a range of psychological symptoms to environmental noise, including anxiety, stress, irritability and mood change. There is no evidence that noise directly causes mental illness, but research suggests that people who are prone to certain psychiatric disorders may be more sensitive to environmental noise. The European Federation for Transport and Environment (T&E) believes that environmental noise unfairly affects poorer people. A study in Birmingham found that socially deprived populations experienced slightly higher exposure to night time noise. Poorer people may be less able to afford houses in quieter areas. However, some people will choose to pay more to live in noisy areas for better access to amenities (Parliamentary Office of Science and Technology, 2009).

1.2 Aim and Objectives of Study:

The aim and objectives of this study are the following, viz:

(i) The application of the knowledge of spatial analysis and Geographic Information System (GIS) mapping to noise pollution study.

(ii) To contribute towards the preparation of a framework for a noise pollution database for Bosso Local Government Council using the Geographic Information System (GIS); this project will be the substratum upon which subsequent studies would be built.

(iii) As a result of (ii) above, the eventual inauguration of a public health education programme on the prevalence and effects of noise pollution. Such a programme could be funded and executed by the Niger State Government. In this case, an effective town-gown synergy would have been implemented.

2.0 Area of Study

The area selected for this project is Bosso Local Government Council of Niger State; the area of study lies between latitude 9^0 38^1 N; longitude $6^0 28^1$E and latitude 9^0 41^1 N; longitude $6^0 31^1$E. Bosso Local Government Council has an effective area of 6,606.14m^2. The area is bounded to the north and northeast by Shiroro Local Government Council, to the northwest by Wushishi Local Government Council, to the southeast by Paikoro Local Government Council, to the south by Katcha Local Government Council, and to the southwest by Gbako Local Government Council. The climate of Bosso Local Government Council is the tropical (hot and dry) type. The mean annual rainfall is about 1293mm spread over 190 – 200 days with the highest monthly record around July and September. The mean maximum monthly temperature is 29.8^0C, occurring around the month of March and the mean minimum temperature is about 25^0C in September. The average annual sunshine duration is about 7.2 hours. The annual potential evaporation is about 1429.6mm whilst the relative humidity is above 60% in the rainy season. The area is influenced by the northeast trade wind, which brings cool and dry harmattan wind in dry season and the southwest monsoon wind which brings a warm wet wind in the rainy season. The map of the study area is shown in Fig.1.

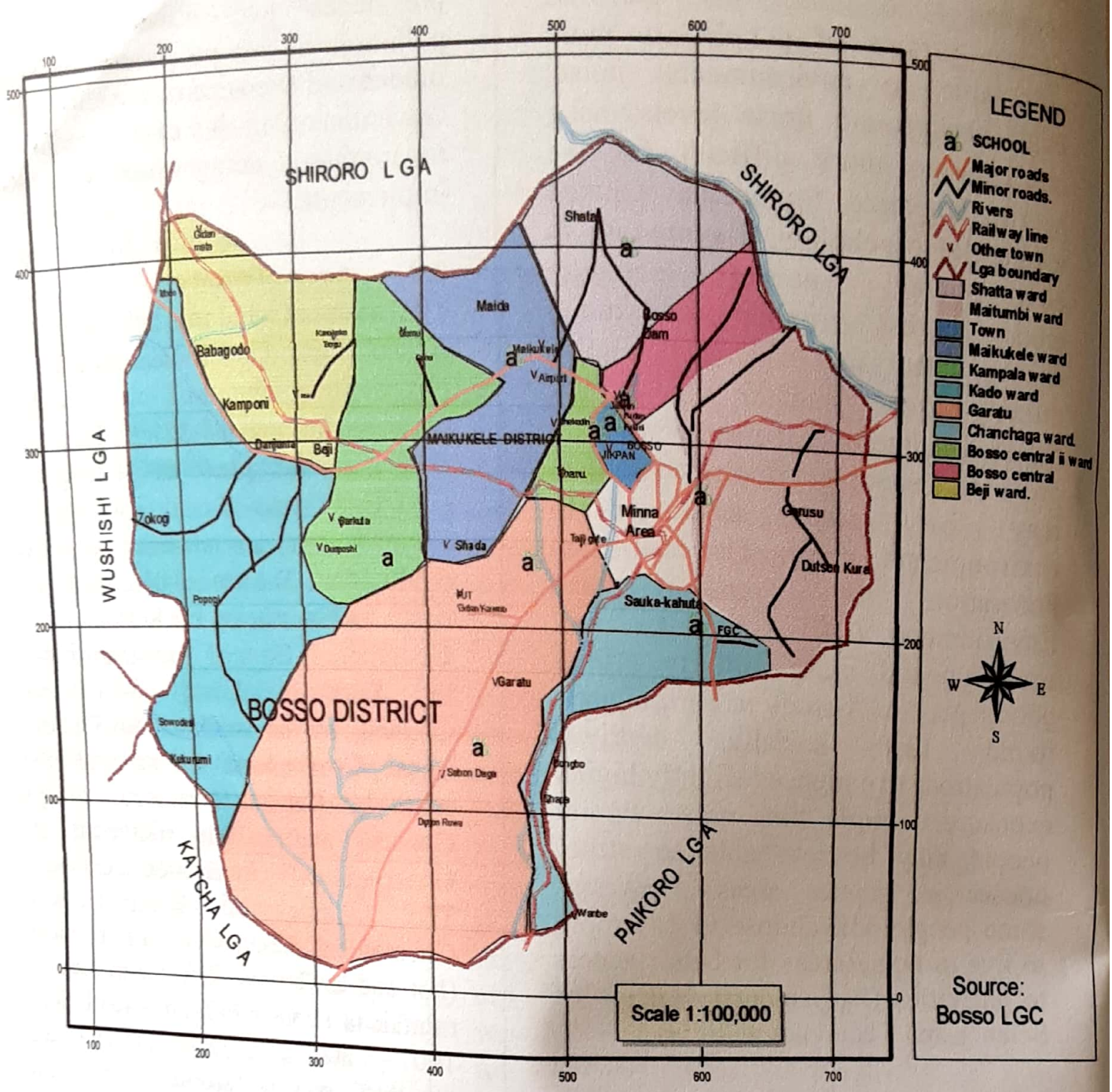


Fig.1. Map of study area

3.0 Problem Statement

The absence of a noise pollution database for Minna and environs was a source of embarrassment for the Niger State Government when an international development agency requested to be granted access to that type of dataset. Representatives from the Niger State Ministry of Environment duly contacted the Federal University of Technology, Minna, in order to help solve what was obviously a critical problem. For this exercise Bosso L.G.C. was considered a province of Minna.

The absence of noise pollution information for the major urban centres of Niger State will always frustrate the state's government efforts at effective co-ordination of mitigation measures. More likely than not the citizens will always demand proofs that the ambient noise levels they encounter daily is actually above the safe threshold.

4.0 Scope and Limitation of Study

The study was designed to cover all of the developed areal extent of Bosso Local Government Council, more of a house-to-house coverage scheme.

5.0 Justification of Project Work

This study is predicated on the following, viz:

(i) One of the founding charters of the Federal University of Technology, Minna, i.e. the deployment of academic resources to solve critical community needs (the town-gown synergy concept).

(ii) Recommendation of Jonah et al (2008)

(iii) Recommendation of Jonah et al (2009)

(iv) Recommendation of Jonah et al (2010)

6.0 Literature Review

Barma et al (2009) said that no one on earth can escape the sounds of noise. They defined noise as a disturbance to the human environment that is escalating at such a high rate that would become a major threat to the quality of human lives. They also pointed out that in the past thirty years, noise in all areas, especially in urban areas, has increased rapidly.

The effect of noise on intrapersonal behavior has long been of interest to general experimental and physiological psychologists, and the publication of a number of volumes on this topic (e.g., Broadbent, 1971; Kryter, 1970; Welch & Weleb, 1970) attests to the significance that these issues are accorded. Public concern over "noise pollution," congressional legislation dealing with permissible noise exposure levels in industrial settings, and work such as that of Cameron et al (1972), suggesting that noise may be associated with the incidence of heroine and acute illness, provide further impetus for research of this sort. Investigations of the interpersonal impact of ambient noise, however, are much less in evidence though Glass and Singer (1972) have provided a nice bridge between these two complementary focuses, and there has been work on the relationship between noise and conformity (Dustin, 1968), aggression (Geen and O'Neal, 1969; Geen and Powers, 1971), and verbal disinhibition (Holmes and Holzman, 1966).

Shi (1971) in a literature survey on noise pollution suggests that physically, noise is a complex sound that has little or no periodicity. However, the essential characteristic of noise is its undesirability. Thus, noise can 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 is 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 are included.

Butterfield (2006) reported that more stringent noise at work regulations developed by Health and Safety Executive after public consultation, came into force for general industry on 6 April 2006. Also music industry was granted a two year period to develop

sector specific guidance on compliance, but should meanwhile comply with existing noise regulations. Local Authorities also have issues concerning monitoring and compliance. Following a period of debate, it was agreed that Capita Symonds Ltd (CS) would complete a noise study to assess the current noise exposure of groups of people within the industry and would then report back on the impact of the proposed legislation on 'live' music concerts. This report contains details of the personal exposures of a cross section of staff working at twelve events throughout the year. It explores the adequacy of any control measures in place and makes recommendations for improvements. The calculated daily personal exposures LEP,d ranged from 80dB(A) to 104 dB(A) and the measured LC, peak values ranged from 122 dB to 146 dB. They also was found that generally the use of hearing protection and noise control was inadequate. Because of the high noise levels it is recommended that all areas front of house and at the side of the stage should be designated as hearing protection zones and marked accordingly and all non-essential staff excluded. All persons working within the hearing protection zone should wear suitable hearing protection at all times.

According to the investigations of Cohen et al. (1973) reading and math's scores of third grade students in noise abated classrooms were higher than those in classrooms with higher noise levels. Cohen et al. (1973) also determined that elementary school students living for at least 4 years in the lower floors of an apartment complex near heavy traffic show greater impairment of reading ability than children living on higher floors away from the traffic. In the studies, indoors sound levels varied from 66-dB on the lower floors of an apartment to 55-dB on the higher floors. In a U.S. EPA classification, "noisy residential areas" averaged 58-dB and were rated low socio-economic, while "quiet residential" averaged 38-dB and were rated affluent neighborhoods. These, of course, were outdoors sound levels. With indoor levels of 55-66-dB, concentration, the ability to pay attention, may well be difficult to nonexistent. If that is true, it may be pertinent to ask why far more children are not reading impaired.

An update from *Info Note HS-14-Noise Pollution & Your Environment, 2004/2005,* (www.sjshire.wa.gov.au) describes noise as unwanted sound. It can originate from numerous sources, such as commercial and industrial activities, machinery, swimming pools and other recreational influences such as amplified music. It was also reported that the impact of noise can vary depending on the location of your house and source of the noise. The following measures were recommended to owners/occupiers on how the impact of noise on neighbourhood can be reduced:

- Give prior warning in writing to neighbours about parties and/or social gatherings, which may have an affect of level of noise. This gives neighbours time to accommodate your needs.
- Only operate outside power tools, including lawn mowers and edger's for a maximum of 2 hours per day and only as often as is reasonable, between the hours of :*7am to 7pm Monday to Saturdays 9am to 7pm Sundays and Public Holidays*

- Musical instruments should not be played in practice for more than one hour in any day and only between the hours of : *7am to 7pm Monday to Saturdays 9am to 7pm Sundays and Public Holidays*

  Ensure your car, truck, motorcycle and lawn mowers have effective mufflers fitted.
- Shut windows and doors when playing music inside.
- Avoid operating bores outside the hours of:*7am to 7pm Monday to Saturdays 9am to 7pm Sundays and Public Holidays.*
- Ensure that when purchasing an air conditioning or generator unit that its location will not cause annoyance to neighbors. Air conditioner noise must comply with the Environmental protection (Noise) Regulations 1997. Ask the installer for confirmation of this.

Peterson and Northwood (1981) of the University of the Miami School of Medicine appeared to demonstrate in rhesus monkeys that moderate levels of realistic noise can produce sustained elevations in blood pressure without significant alterations in the auditory mechanism. The unique aspect of this investigation was the finding that changes in auditory sensitivity did not necessarily follow changes in such physiological parameters as blood pressure.

Sudden and unexpected noise has been observed to produce marked changes in the body, such as increased blood pressure, increased heart rate, and muscular contractions. Moreover, digestion, stomach contractions, and the flow of saliva and gastric juices all stop. Because the changes are so marked, repeated exposure to unexpected noise should obviously be kept to a minimum. These changes fortunately wear off as a person becomes accustomed to the noise (Broadbent, 1957). However, even when a person is accustomed to an environment where the noise level is high, physiological changes occur. The fact that noise has psychological effects is undoubted. The question is how these effects can be assessed and whether they lead to damage. No clear case has been made thus far for psychological damage caused by moderately high levels of noise, the levels that would cause hearing damage to only a small fraction of the people exposed. Indeed, fears have been expressed that ". . . over emphasis on damage may backfire when people come to realize that the truth of the matter seems to be simply that people can express violently their dislike about being disturbed by noises.

7.0 Methodological Approach

7.1 Data Acquisition

Co-ordinate Identification: Co-ordinate identification for this study was facilitated by the use of hand-held Global Positioning System (GPS) units. A preliminary reconnaissance survey of the area of study was carried out to identify the locations on ground (principally households) that are exposed to continuous high noise levels, especially over a given 24-hour period. These locations were duly geo-referenced.

7.2 Data Collection Procedure: The A weighted sound level meter was used to determine the noise decibel levels at the various locations identified during the reconnaissance survey.

7.3 Sample Dataset of Study: About 2500 households were visited for this study. These households, or stations of interest, were the locations on ground that are affected by high

noise levels. The field data were presented in conformity 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 showing the first 54 points is presented as Table 1.

Table 1: Abridged form of dataset of study

Shape	ID	Coordinates North	East	Location	Pollution Sources/Type	Rated Output	Noise Level (dB)	Pollution Status
Point	1	9.6491	6.5263	Bosso	Studio recorder	Nil	87	PRESENT
Point	2	9.6489	6.5263	Bosso	Barbing saloon stereo player	Nil	99.1	PRESENT
Point	3	9.6484	6.5264	Bosso	Electric miller grian	3700w/220v/50Hz	87.3	PRESENT
Point	4	9.6486	6.5265	Bosso	Vulcaniser/Viking	1.5kw/220v/50Hz	77	PRESENT
Point	5	9.6486	6.5267	Bosso	Tiger-EP2500A	2500W	73.5	PRESENT
Point	6	9.6485	6.5269	Bosso	Small generator/Yamaha	ET950W	92.4	PRESENT
Point	7	9.6488	6.527	Bosso	Heman Generator	EF6600W	91.3	PRESENT
Point	8	9.6488	6.5272	Bosso	Electric miller grian	Nil	85.9	PRESENT
Point	9	9.6489	6.5273	Bosso	Motor cycle/Jinchen	Nil	70	PRESENT
Point	10	9.6518	6.5298	Bosso	Wood mach. Router/Siemens	1200w/220v/50Hz	73.9	PRESENT
Point	11	9.6517	6.5296	Bosso	Studio recorder	Nil	72.5	PRESENT
Point	12	9.6515	6.5295	Bosso	Home stereo player	Nil	90.2	PRESENT
Point	13	9.6515	6.5264	Bosso	Electric miller vegetable	Nil	81.6	PRESENT
Point	14	9.6514	6.5292	Bosso	Motor cycle/Suzuki	Nil	87.9	PRESENT
Point	15	9.6513	6.5292	Bosso	Vulcaniser/Viking	1.5kw/220v/50Hz	70.3	PRESENT
Point	16	9.6512	6.5291	Bosso	Petrol generator/Tiger-EP1500A	5000W	74	PRESENT
Point	17	9.6509	6.5291	Bosso	Small generator/Yamaha	Nil	80	PRESENT
Point	18	9.6505	6.5286	Bosso	Diesel generator/ Imex	4500W	78.9	PRESENT
Point	19	9.6504	6.5288	Bosso	Studio recorder	7.5kw/220v/50Hz	91.4	PRESENT
Point	20	9.6502	6.529	Bosso	stereo player	1.5kw/220v/50Hz	83.5	PRESENT
Point	21	9.6498	6.529	Bosso	Electric miller grian	Nil	73	PRESENT
Point	22	9.6497	6.5289	Bosso	Vulcaniser/Viking	1.5kw/220v/50Hz	79.8	PRESENT
Point	23	9.6496	6.5289	Bosso	Generator/stereo player	Nil	77	PRESENT
Point	24	9.6496	6.5288	Bosso	Electric miller vegetable	Nil	76.3	PRESENT
Point	25	9.6495	6.5287	Bosso	stereo player	Nil	70.1	PRESENT
Point	26	9.6493	6.5286	Bosso	Home stereo player	Nil	90.5	PRESENT
Point	27	9.6491	6.5284	Bosso	Motor Cycle/ Suzuki	Nil	95	PRESENT
Point	28	9.649	6.5283	Bosso	Wood mach. Router/Siemens	1200w/220v/50Hz	83.6	PRESENT
Point	29	9.6488	6.5281	Bosso	Studio recorder	Nil	87.2	PRESENT
Point	30	9.6487	6.528	Bosso	Home stereo player	Nil	88.8	PRESENT
Point	31	9.6486	6.5279	Bosso	Welding filling mach./Bolts	1200w/220v/50Hz	91.4	PRESENT
Point	32	9.6485	6.5277	Bosso	FG Wilson Diesel	80KVA	99.3	PRESENT
Point	33	9.6483	6.5277	Bosso	Vulcaniser/Viking	1.5kw/220v/50Hz	88	PRESENT
Point	34	9.6482	6.5276	Bosso	Home stereo player	Nil	87.1	PRESENT
Point	35	9.6482	6.5274	Bosso	Electric miller	Nil	97.3	PRESENT

					vegetable			
Point	36	9.6479	6.5271	Bosso	Motor cycle/Suzuki	Nil	72	PRESENT
Point	37	9.6479	6.5169	Bosso	Vulcaniser/Viking	1.5kw/220v/50Hz	71.5	PRESENT
Point	38	9.6475	6.5166	Bosso	Tiger-EC3500A	3.5kw/220v/50Hz	78.6	PRESENT
Point	39	9.6477	6.5166	Bosso	Motor cycle/Jincheng	Nil	79.1	PRESENT
Point	40	9.6477	6.5165	Bosso	Barbing saloon stereo player	3500W	82.4	PRESENT
Point	41	9.6479	6.5164	Bosso	Generator/Heman	1.2kw	83	PRESENT
Point	42	9.6479	6.5163	Bosso	Electric miller grian	Nil	99	PRESENT
Point	43	9.6481	6.5162	Bosso	Small generator/Yamaha	650W	91.2	PRESENT
Point	44	9.6482	6.5161	Bosso	Diesel generator/ Imex	7.5kw/220v/50Hz	96.8	PRESENT
Point	45	9.6481	6.5161	Bosso	Motor cycle/Jinchen	Nil	87.4	PRESENT
Point	46	9.6484	6.5158	Bosso	Generator repair/Heman	7.5kw/220v/50Hz	96.3	PRESENT
Point	47	9.6484	6.5158	Bosso	Yamaha Gen-EF6600E	6600W,27.5amps,240v	77	PRESENT
Point	48	9.6483	6.5155	Bosso	Vulcaniser/Viking	1.5kw/220v/50Hz	71	PRESENT
Point	49	9.6482	6.5154	Bosso	Petrol generator/Tiger	5000W	73.5	PRESENT
Point	50	9.6479	6.5151	Ungwan Biri	Motor cycle/Jincheng	Nil	76.8	PRESENT
Point	51	9.6477	6.5149	Ungwan Biri	Wood mach. Router/Siemens	1200w/220v/50Hz	78.3	PRESENT
Point	52	9.6476	6.5149	Ungwan Biri	Generator/Heman	1.2kw	79	PRESENT
Point	53	9.6474	6.5153	Ungwan Biri	Electric miller grian	Nil	84	PRESENT
Point	54	9.6474	6.5154	Ungwan Biri	Motor cycle/Jinchen	Nil	86.2	PRESENT

8.0 Presentation of Result

8.1 Creation of a GIS Layer of Noise Pollution Level Map for Minna: From the analogue map of the study area (see Fig.1), all non-spatial data were converted to points, lines, and polygons by transferring the scanned analogue map onto the ArcView3.3 platform. Then the "Themes" icon was invoked whence points were selected, the boundary line dialogue was opened, and the appropriate settings applied. The digitised map for the study area is shown in Fig.2.

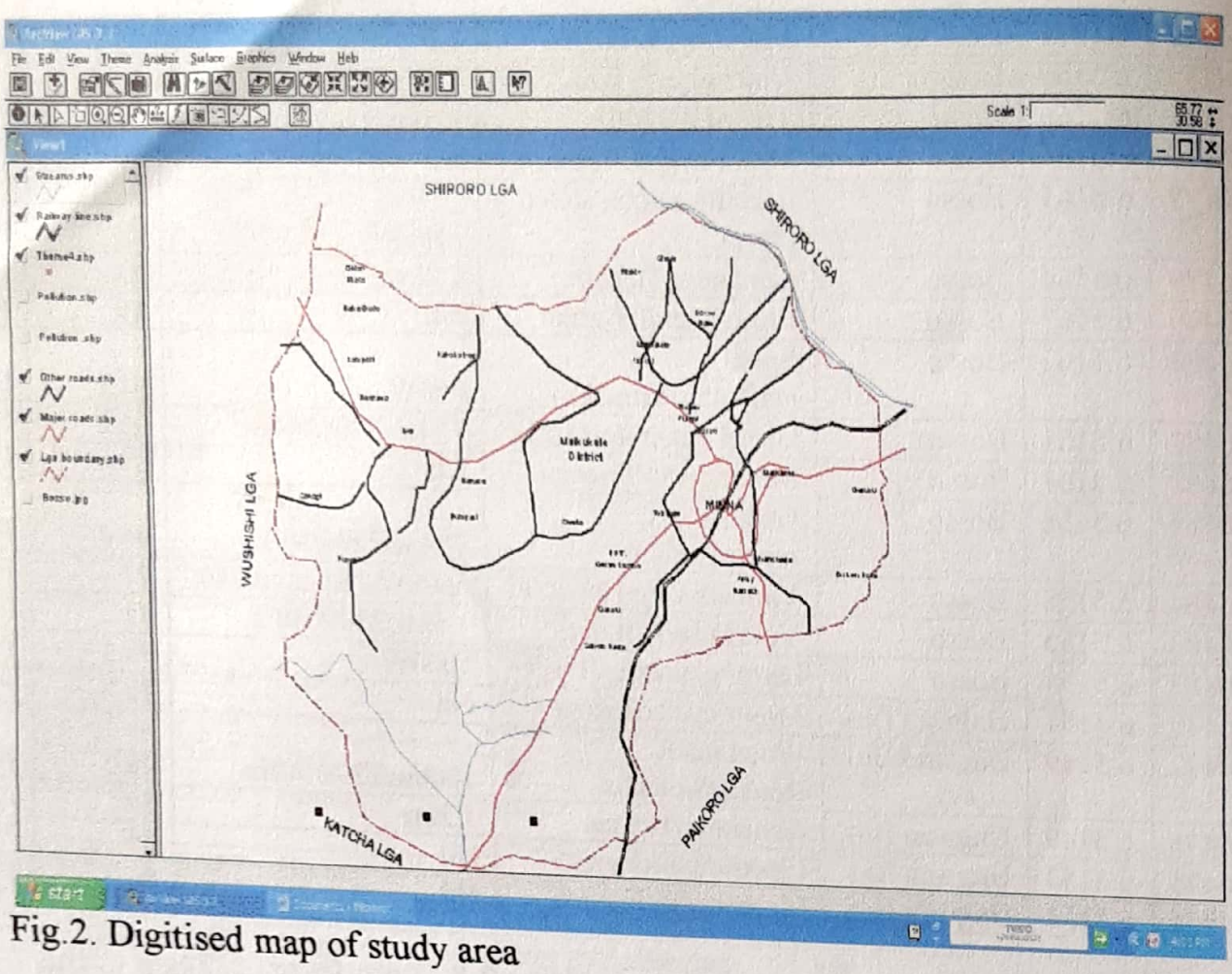
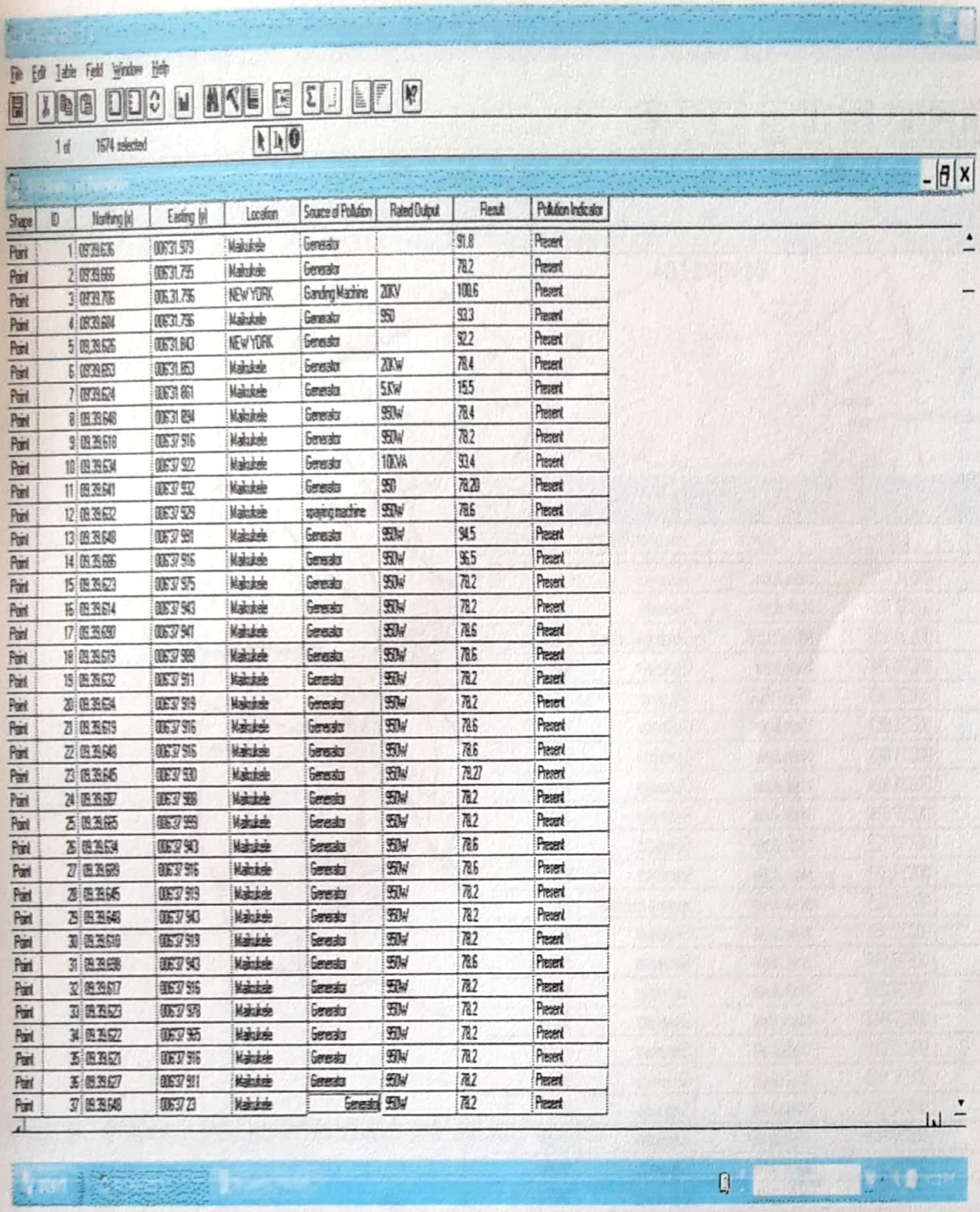


Fig.2. Digitised map of study area

8.2 Database Development: From the non-spatial (attribute) data which shows the conventional location, sources of pollution, physical characteristics of sources, values of pollution, and pollution status, a link was created with the spatial dataset in order to develop a database for the study area, see Fig. 3.



Shape	ID	Northing (y)	Easting (x)	Location	Source of Pollution	Rated Output	Result	Pollution Indicator
Point	1	09°39.636	006°31.979	Maiduguri	Generator		91.8	Present
Point	2	09°39.665	006°31.735	Maiduguri	Generator		78.2	Present
Point	3	09°39.706	006.31.756	NEW YORK	Grinding Machine	20KV	100.6	Present
Point	4	09°39.684	006°31.756	Maiduguri	Generator	950	93.3	Present
Point	5	09.39.625	006°31.843	NEW YORK	Generator		92.2	Present
Point	6	09°39.653	006°31.853	Maiduguri	Generator	20KW	78.4	Present
Point	7	09°39.624	006°31.661	Maiduguri	Generator	5.KW	15.5	Present
Point	8	09.39.648	006°31 894	Maiduguri	Generator	950W	78.4	Present
Point	9	09.39.618	006°37 916	Maiduguri	Generator	950W	78.2	Present
Point	10	09.39.634	006°37 922	Maiduguri	Generator	10KVA	93.4	Present
Point	11	09.39.641	006°37 932	Maiduguri	Generator	950	78.20	Present
Point	12	09.39.632	006°37 929	Maiduguri	spraying machine	950W	78.6	Present
Point	13	09.39.648	006°37 991	Maiduguri	Generator	950W	94.5	Present
Point	14	09.39.686	006°37 916	Maiduguri	Generator	950W	96.5	Present
Point	15	09.39.623	006°37 975	Maiduguri	Generator	950W	78.2	Present
Point	16	09.39.614	006°37 943	Maiduguri	Generator	950W	78.2	Present
Point	17	09.39.630	006°37 941	Maiduguri	Generator	950W	78.6	Present
Point	18	09.39.619	006°37 989	Maiduguri	Generator	950W	78.6	Present
Point	19	09.39.632	006°37 911	Maiduguri	Generator	950W	78.2	Present
Point	20	09.39.634	006°37 919	Maiduguri	Generator	950W	78.2	Present
Point	21	09.39.619	006°37 916	Maiduguri	Generator	950W	78.6	Present
Point	22	09.39.648	006°37 916	Maiduguri	Generator	950W	78.6	Present
Point	23	09.39.645	006°37 930	Maiduguri	Generator	950W	79.27	Present
Point	24	09.39.687	006°37 988	Maiduguri	Generator	950W	78.2	Present
Point	25	09.39.685	006°37 999	Maiduguri	Generator	950W	78.2	Present
Point	26	09.39.634	006°37 943	Maiduguri	Generator	950W	78.6	Present
Point	27	09.39.699	006°37 916	Maiduguri	Generator	950W	78.6	Present
Point	28	09.39.645	006°37 919	Maiduguri	Generator	950W	78.2	Present
Point	29	09.39.648	006°37 943	Maiduguri	Generator	950W	78.2	Present
Point	30	09.39.618	006°37 919	Maiduguri	Generator	950W	78.2	Present
Point	31	09.39.638	006°37 943	Maiduguri	Generator	950W	78.6	Present
Point	32	09.39.617	006°37 916	Maiduguri	Generator	950W	78.2	Present
Point	33	09.39.623	006°37 978	Maiduguri	Generator	950W	78.2	Present
Point	34	09.39.622	006°37 985	Maiduguri	Generator	950W	78.2	Present
Point	35	09.39.621	006°37 916	Maiduguri	Generator	950W	78.2	Present
Point	36	09.39.627	006°37 911	Maiduguri	Generator	950W	78.2	Present
Point	37	09.39.648	006°37 23	Maiduguri	Generator	950W	78.2	Present

Fig.3. Merged database on the ArcView3.3 platform

8.3 Production of Noise Pollution Map

Each of the point identified in Fig.3 was now linked (hot-linking) to the spatial map for the production of the noise pollution map. Prior to this a colour (red) was selected on the Arcview platform to represent the designated point sources, see Fig.4.

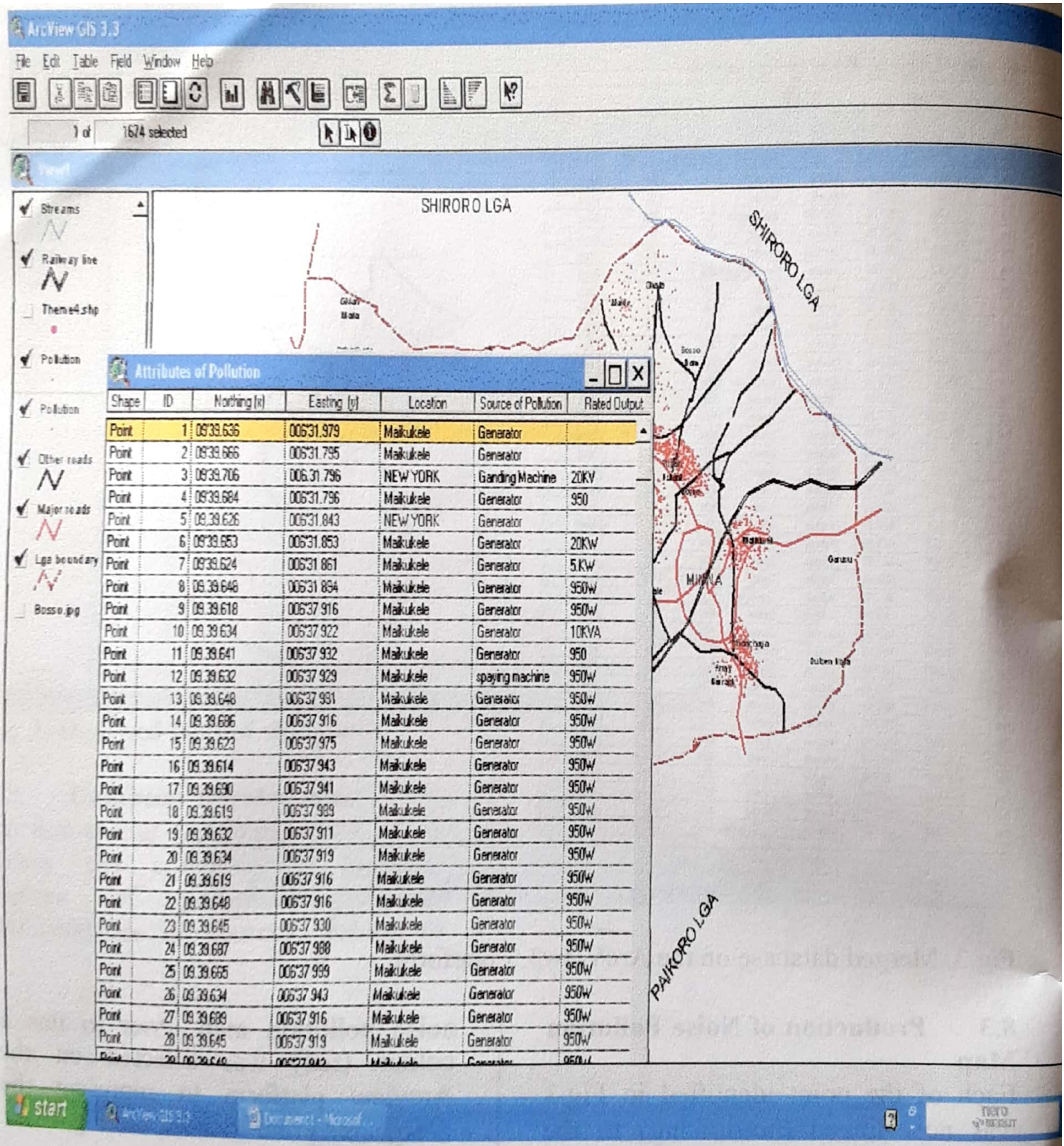


Fig.4. Hot-linking merged database with spatial map on the ArcView3.3 platform

The resultant noise pollution map is shown in Fig.5.

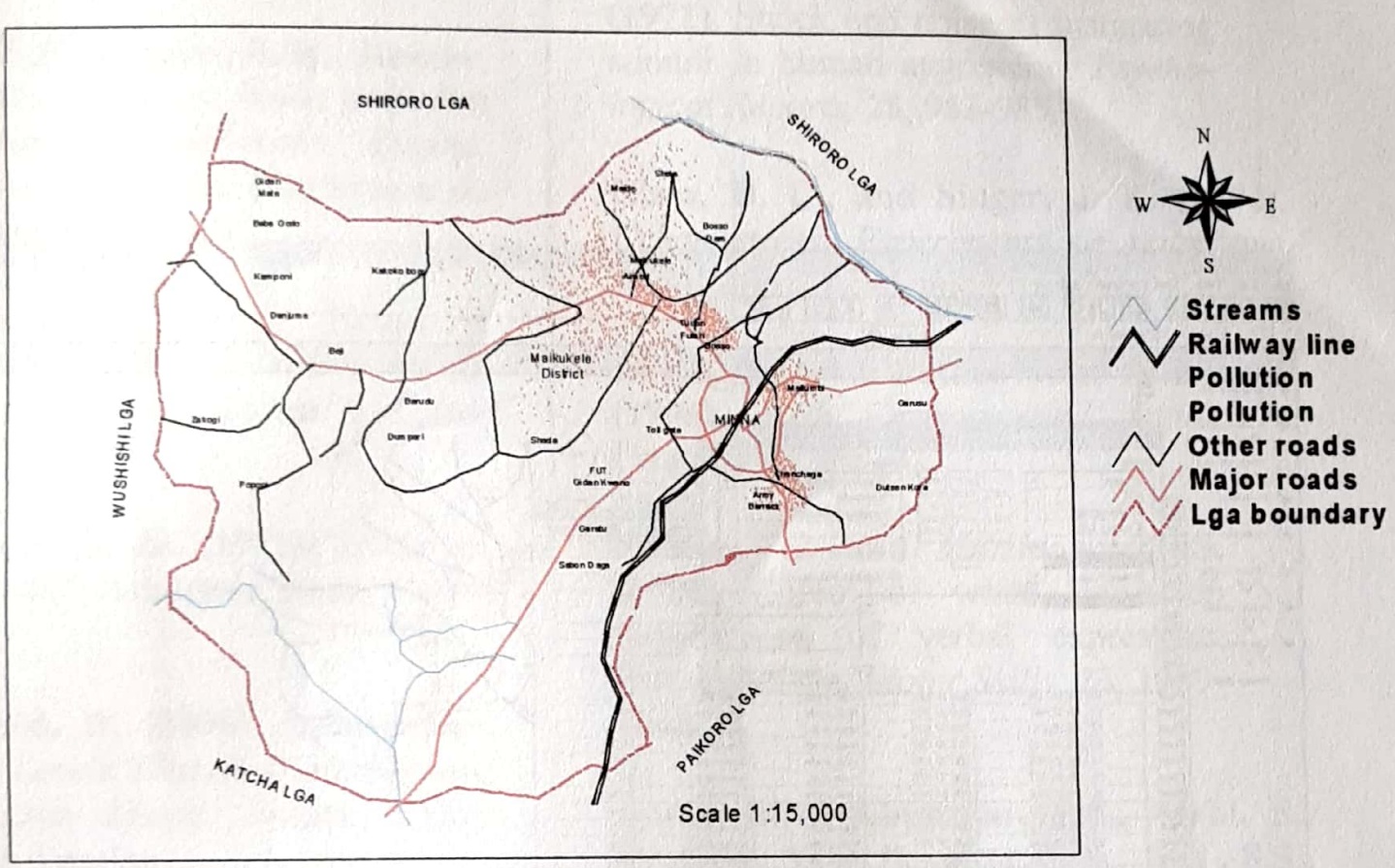


Fig.5. Noise pollution map of study area

The red dotted points on the map show sources of noise pollution with values greater than 70dB.

8.4 Query Procedure 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 the geo-referenced 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.6 shows location query for the study area.

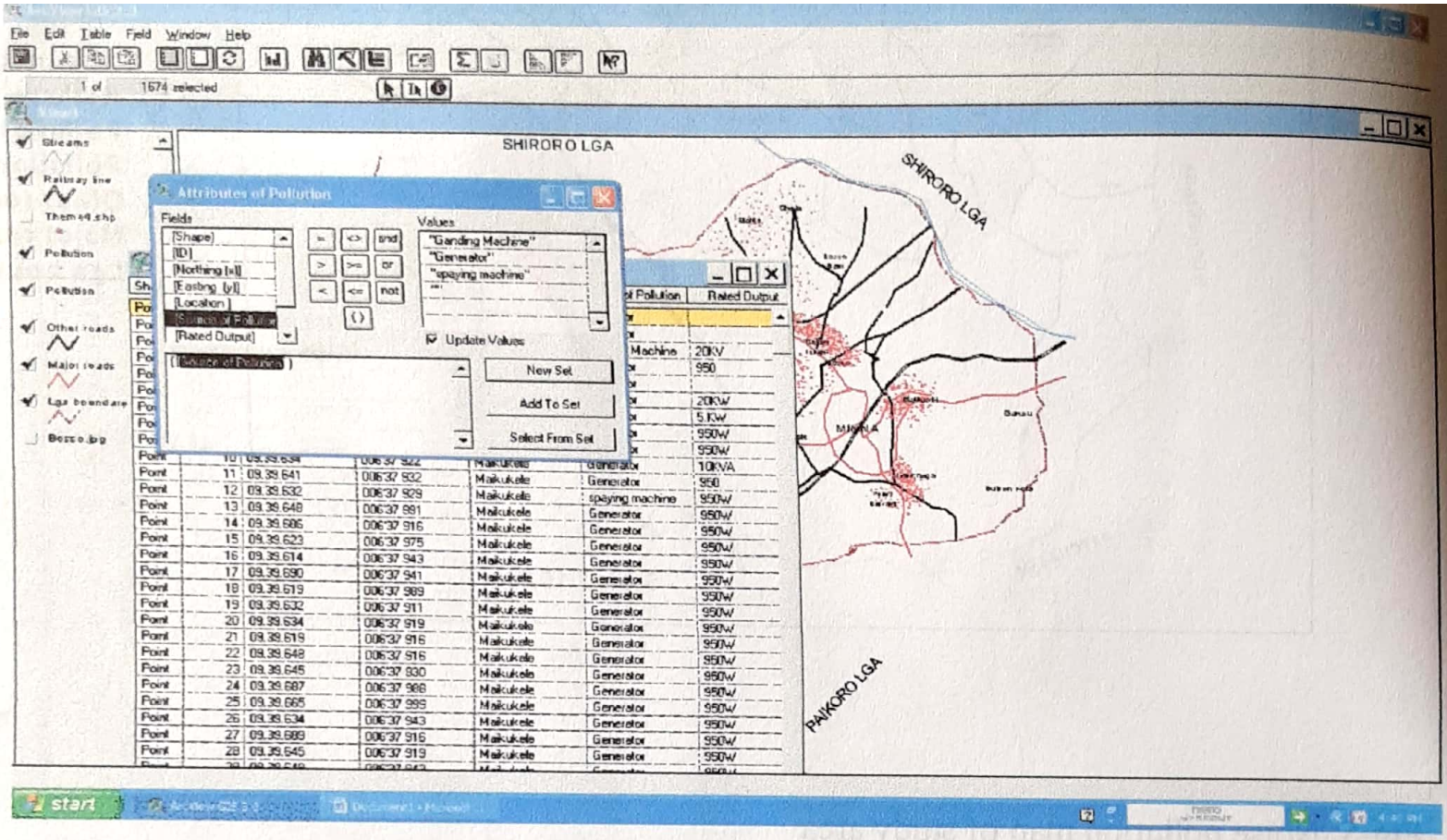


Fig.6. Location query of study area

9.0 Result

ambient noise levels at 2500 households in Bosso Local Government Council. In all of the points visited, the value of the ambient noise is greater than the safe threshold of 70dB(A). By the properly geo-referencing these households, the GIS tool was used to create an interactive noise pollution layer for Bosso Local Government Council.

10. Conclusion

The creation of the decibel level map of Fig.5, in interactive mode, for Bosso Local Government Council will allow easy access to information regarding areas affected by high noise levels, the sources of noise, etc. These key indicators would be useful to town planners and public health educators.

This study correctly determined the

11. Recommendation

From the result of this study it is recommended that there should adequate and safe clearance between electricity generators, welding machine installations, electric millers, etc., and homesteads when these units are in use. Households should switch to the purchase of low-noise generator brands from reputable manufacturers. Further, efforts should be made by households to explore the possibility of alternative power generating sources like solar units since their initial cost of installation are no longer prohibitively expensive. It is also recommended that studies of this kind be replicated in the major towns and cities of Nigeria.

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