SPATIAL MAPPING OF NOISE EXPOSURE ZONES DERIVED FROM RELIGIOUS ACTIVITIES AND PERCEPTIONS IN RESIDENTIAL NEIGHBOURHOODS: THE CASE OF ASHAIMAN MUNICIPALITY, GHANA.

THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MPHIL ENVIRONMENTAL SCIENCE DEGREE

BY

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DECLARATION

I, Rachel Ngmenkyogr Zakpala declare that, this work is the result of my own field research except for the specific references I made from several authors on the subject matter. I also wish to state that I have not submitted this document either in part or whole for any other degree.

…….. .....

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ABSTRACT

Religious noise pollution is gradually becoming rampant and a nuisance in most residential areas in Ghana. This study set out to assess the levels of religious noise produced in some selected communities in the Ashaiman Municipality. A Geographical Positioning System (GPS) was used to obtain the coordinates of the churches and mosques and the distances of 50 m, 100 m, 150 m and 200 m away from the churches/mosques. Noise exposure zones were then mapped using ARCGIS 10.1 software and surface interpolation of the point data was carried out using Kriging technique and classified into classes of exposure levels. The perceptions of the residents in the respective communities regarding noise levels as well as the relevant actions and strategies taken by the communities that had high exposure to religious noise levels were also determined. The results showed that all of the churches and mosques sampled produced high levels of religious noise which far exceeded the permissible noise levels of EPA, Ghana; that is, 55dB for day (0060 – 2200h) and 48dB for night (2200 – 0060h). A few communities were within the Extremely High noise exposure zones but most were within the Moderately High and Very High noise exposure zones. Majority of the respondents (64.1%) did not regard the noise as a nuisance including those within the Extremely High noise exposure zones. However, 35.9% of the participants considered the noise as a nuisance. Education of the public on the harmful effects of noise on individuals and enforcement of noise guidelines in residential neighbourhoods are highly recommended.

DEDICATION

I dedicate this work to my lovely mum, Ms. Leocadia Zakpala. Thanks for always being there for me.

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To God be the glory!

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LIST OF ABBREVIATIONS/ACRONYMS

ASHMA	ASHAIMAN MUNICIPAL ASSEMBLY
dB	DECIBEL
dB(A)	A-WEIGHTED DECIBEL
EPA	ENVIRONMENTAL PROTECTION AGENCY
EU	EUROPEAN UNION
GIS	GEOGRAPHIC INFORMATION SYSTEMS
GPS	GLOBAL POSITIONING SYSTEM
HUD	HOUSING AND URBAN DEVELOPMENT
LAeq	A-WEIGHTED EQUIVALENT SOUND PRESSURE
LAi	AVERAGE A-WEIGHTED SOUND PRESSURE LEVEL
TWEPA	TAIWAN ENVIRONMENTAL PROTECTION ADMINISTRATION
WHO	WORLD HEALTH ORGANISATION

CHAPTER ONE

INTRODUCTION

1.1: Background

Noise pollution is an environmental problem. It is described by the Environmental Protection Agency (EPA) of Ghana as both a silent killer and a sleeping volcano of environmental issues lagging behind air and water pollution on the political agenda (EPA, 2008).

Noise is known as any unwanted, unpleasant sound (Chiras, 2001). It comes from the Latin word "nausea" implying "unwanted sound" or sound that is loud, unpleasant or unexpected (Singh and Davar, 2004). It is also regarded as an irritant and an environmental stressor (Stansfeld and Matheson 2003; Dratva *et al*. 2010). At the International Seminar on Children and Noise[1], it was proposed that noise be defined as sound with any kind of negative effect on human health and well-being.

Sound on the other hand, may be defined as any pressure variation that the human ear can detect (Brüel and Kjaer, 2000). According to Sinha *et al*., (2005), sound is produced by the vibration of an object and transmitted in the form of waves- alternating increase or decrease in pressure.

Noise can be described as continuous, intermittent or impulsive (Brüel and Kjaer, 2000). Continuous noise is produced in the same mode without any interruption. Intermittent noise is produced when equipment operate in cycles or when vehicles or aero planes

[1] The seminar was held on the19–20 June 2000 in Copenhagen, Denmark on children and noise: health effects, perceptions of risk and definitions of noise.

pass by, the noise produced increases and decreases rapidly. Impulsive noise is as a result of impacts or explosions, for example, a gunshot. It is brief and abrupt, and its startling effect causes greater annoyance than would be expected from a simple measurement of sound pressure level (Brüel and Kjaer, 2000).

There are various variables that determine what any individual considers as noise: among them are one's background, mood and occupation. Location and hearing ability are also important determinants, as are time of the day, the duration and volume of a sound and other factors. A sound may be considered to be noisy when it is loud but pleasant when it is soft; or it may also be acceptable when it is generated by oneself but unbearable when someone else does it. As sound gets louder the more annoying it becomes and the more likely people are to describe it as noise (Chiras, 2001).

According to Kumar (2005), there are three broad categories of noise namely: Transport noise, Occupational noise and Neighbourhood noise. The focus in this study falls within the category of neighbourhood noise induced by religious activities. Religious noise may be defined as any unwanted, unpleasant sound that emanates from religious activities. Religious noise includes: mosque call or call to prayer, ringing of bells, clapping of hands, loud prayers, chanting, singing, itinerant preaching, drumming in churches and the misuse of sound amplification equipment in mosques and churches.

Noise level is measured using sound level meters and noise meters. Ambient noise level is the background noise and it is measured in dB (A). dB (A) is known as A-weighting and is the

universally accepted and the commonly used frequency weighting which provides results usually denoted as dB (A), this conforms approximately to the response of the human ear. The EPA of Ghana has guidelines on the permissible Ambient Noise Level which will be presented later.

There are various effects of noise which can either be auditory or non-auditory effects (Reuter, 2010). Research has shown that exposure to noise can cause physical as well as mental harm to the body. The auditory effects of noise are auditory fatigue and hearing loss or a deterioration of hearing. Noise-induced hearing loss generally occurs over a long time. By the time it is obvious, it may be too late. Tinnitus (a persistent noise in the ear) and muffled hearing are usually early warning signs. Tinnitus occurs as a result of damage of the hair cells in the inner ear due to noise exposure. A temporary hearing loss known as Temporary Threshold Shift (TTS) occurs when a person is exposed to loud noise. The hearing loss can be reversed after a few hours in a quiet place. Permanent Threshold Shift (PTS) is permanent hearing loss that develops after months or years of continual noise damage. The damage builds up until it affects the everyday life of the individual. It is irreversible (Reuter, 2010) and according to Chira (2001) continuous long-term exposure to noise levels as low as 55dB can cause PTS in people exposed on a regular basis.

The non-auditory effects may be physiological and psychological changes in human beings. Some of these changes are a disruption of sleep which leads to chronic fatigue. Noise is also linked to a variety of ailments, ranging from nervous tension headaches to neuroses. It may also cause blood vessels to constrict (which reduce the blood flow to key body parts) thereby increasing blood pressure and sometimes causes seizures in epileptics. It also interferes with conversation, concentration, relaxation and leisure (Smith and Enger, 1998). According to

Murthy (2008), noise can affect developing embryos and impair the development of the central nervous system of unborn babies. It also causes dilation of the eye pupil, defective eyesight and defective colour vision. Berglund *et al*., 2000; Sobotova 2010 also states that noise causes an increase in heart rate.

In Ghana, the Environmental Protection Agency (EPA) receives complaints of noise almost daily. According to the EPA 2011 Annual Report, noise constituted 71% of all complaints and out of which about 64 % was from religious activities (EPA, 2011). As a result of alarming proportions of noise levels, the EPA has produced anti-noise jingles which are aired on some radio stations to educate the Ghanaian public on how to reduce noise. It also observes Noise Awareness day once every year during which campaigns are organised to educate the public on the harmful effects of noise.

According to the Ghana Criminal Code of 1960 Act 29. Section 296, numbers 7 and 8 as amended under the Criminal offences Act 792, 2009 noise is a criminal offence. "Whoever does any of the following acts shall be liable to a fine not exceeding GH¢20. 00 namely:

(7) in any town wilfully or wantonly, and after being warned to desist, makes any loud or unseemly noise howsoever caused to the annoyance or disturbance of any person; or

(8) in any town, without a license in writing from the Minister or a local authority beats or plays any drum, gong, tom-tom, or other similar instrument of music between eight o'clock at night and six in the morning".

In addition, there is a noise bye-law specifically on the conduct of religious services from the Ashaiman Municipal Assembly (Local Government Act 1993) which proscribes the prohibition of the play of music when conducting religious service so loudly so as to cause a nuisance to the public and residents of the area. Whoever contravenes this provision of the bye-law commits an offence liable to a fine of GH¢33.00 (ASHMA, 2008).

This thesis looks at spatial noise mapping which is a graphic representation of the sound level distribution existing in a given region for a defined period. Noise maps are regarded as tools that help to improve or to maintain the quality of the environment as far as noise pollution is concerned. Noise maps also perform the following functions:

- ✓ serve as excellent tools for urban planning.
- ✓ present visual information about the acoustic action of a geographic area either in a specified moment.
- ✓ they are helpful in understanding noise and for the determination of the main sources of noise.
- ✓ assist in developing policies for managing noise and enforcing the control of noise.
- ✓ help in the draft of a cost-benefit plan to assist districts desiring to reduce noise levels.
- ✓ adopt theory to examine the effect of environmental improvement plans.
- ✓ observe changing trends in environmental noise and provide a research platform for studying the effects of noise on the human body (DEFRA, 2001; Tsai *et al*., 2009).

1.2: Problem Statement and Justification

Globally, noise pollution is becoming a problematic issue (Lang, 1999; Sandberg, 1999). Recent noise studies have indicated that noise pollution as an environmental problem is not reserved for the developed countries but the developing countries as well (Mehdi *et al*., 2010). Reports have further noted that 70% of the world's urban population lives in developing countries (Cohen, 2006; Mehdi *et al*., 2010). Much of these urban dwellers are vulnerable to the health and psychological effects of noise pollution, particularly religious noise in residential areas.

In Ghana, religious noise has been reported to be not only high, but a nuisance in most residential neighbourhoods with the increasing development of religious activities. Professor Brigid Sackey addressed the issue of religious noise and its impact on health in her inaugural lecture. She analysed how urbanity and religion cause serious health hazards and the lack of political will to deal with it[2]. Also at a recent conference on Law and Religion in Africa, a keynote speaker Samuel Date-Bah, who is a judge of the Supreme Courts of Gambia and Ghana as well as Chairman of the Council of the University of Ghana, was concerned about noise generated by churches sited in residential areas in Ghana as it has adverse effects on health[3]. A study conducted in some parts of the Cape Coast Metropolis also indicated that, 77% of the churches and mosques produced noise above the permissible noise levels set by the EPA of Ghana namely: 55dB(A) for day (0060 – 2200h) and 48dB(A) for night (2200 – 0060h). Only 23% of the churches and mosques produced noise within the permissible level (Armah *et al*.,

[2] The inaugural lecture took place at the University of Ghana Great Hall on the 3rd of February, 2011.

[3] Conference on Law and Religion in Africa: Comparative Practices, Experiences and Prospects. Faculty of Law, University of Ghana, Legon, January 14-15, 2013.

2010). The EPA of Ghana as a result of the high numbers of noise complaints it receives daily has produced noise jingles. These jingles are aired on some radio stations in Accra the capital city of Ghana, to educate the public on the harmful effects of noise.

Although the problem of noise pollution has attracted the attention of policy makers and the international communities, little attention has been given to religious noise which is becoming rampant especially in residential neighbourhoods. Perhaps, this is because there are few studies that report on how severe religious noise is, not only in Ghana but other developing countries as well.

Communities with high noise exposure have not been identified neither have the effects of religious noise been well documented. But since the noise levels generated could be injurious to the health of persons constantly exposed to them, there is thus the need to control the noise levels produced hence the need for noise maps. Therefore, this study on spatial mapping of noise exposure zones derived from religious activities and perceptions in residential neighbourhoods: the case of Ashaiman Municipality, Ghana, will:

i. assess the levels of religious noise produced in these neighbourhoods
ii. analyse the perceptions of residential households in the Ashaiman Municipality about religious noise and
iii. construct noise maps.

In this study, residential neighbourhoods refer to areas consisting of private housing rather than offices or factories though in Ghana people tend to denote “posh” rich areas as residential. The

Ashaiman Municipal Assembly defines residential neighbourhood as an area with first class roads, well-engineered drains, organised or uniform structures and social amenities such as schools, markets, community centres, libraries among others (ASHMA, 2013). Residential areas are classified into: First, Second and third classes (ASHMA, 2013). Each of these classes attract different property rates and thus, first class residential areas tend to be less noisy than others.

The results of this study will contribute to existing knowledge and also provide information aimed at informing environmentalists, policy makers and other stakeholders on religious noise exposure. This will facilitate the development of effective policies for controlling religious noise in Ghana. It will also recommend for the location of churches and mosques in environments that will not pose noise nuisance. That is, churches and mosques should be sited far away from residential neighbourhoods.

1.3: Research Objectives

The overall objective of this study is to provide information to inform decisions for managing religious noise produced in the selected neighbourhoods in the Ashaiman Municipality.

Specifically, the study seeks to do the following:

- To measure the levels of religious noise produced in the Ashaiman Municipality.
- To construct noise maps indicating the exposure zones in residential neighbourhoods of the Ashaiman Municipality.

- To assess the perception of residential households about religious noise in the Ashaiman Municipality.
- To determine the relevant actions taken to reduce religious noise in the neighbourhoods within the high exposure zones.

1.4: Research Questions

The study seeks to answer the following questions:

- What are the levels of religious noise produced in the Ashaiman Municipality?
- Which parts of Ashaiman are more prone to noise?
- What are the perceptions of the respective communities regarding the noise levels?
- What are the relevant actions and strategies taken to reduce noise in the communities within the high exposure zones?

1.5: Scope of the study

This study focuses on spatial mapping of noise exposure zones derived from religious activities and people's perceptions in residential neighbourhoods within the Ashaiman Municipality. Significantly, the purpose of the research is to assess the levels of noise produced and to ascertain if the noise is produced within the permissible levels of the EPA and the legal stipulations of Ghana. As well as generate a noise map indicating the noise exposure zones within the study area. The target areas will revolve around the churches and mosques. The study covers selected communities in the Ashaiman Municipality namely Christian Village, Zongo Laka, Roman Down, Market Square, Taifa, Taboo Line, New Town, Jericho and Night Market.

These communities were selected from the settlement patterns of planned and unplanned communities in Ashaiman. The selection was also based on the density of religious activities.

1.6: Limitations of the study

Although religious noise is perceived as a nuisance, most people in Ghana do not complain about it. This could be attributed to the notion that anything related to religion is unquestionable, and that questioning noise emitted during religious activities would incur the wrath of God. These views are made evident by some examples cited by Sackey (2006) which will be discussed later.

From my research, I noticed that the use of just one sound level meter for measuring the noise from the source and the various distances is another limitation of the study. This is so because, the volume could be decreased or increased as the song being sung is ended or changed but this may not be detected by the researcher as she moves the various distances from the source. Two or more sound level meters placed at the source of the noise and the various distances would measure the noise being produced simultaneously.

1.7: Organisation of the study

The study is organised into six chapters. Chapter one is the Introduction and it includes the Background of the study, Problem statement and justification, Research objectives, Research questions, Scope of the study, Limitations of the study and Organisation of the study. Chapter two deals with Literature review including a Conceptual framework of the thesis. Chapter three consists of the Methodology including a description of the study area and the various methods of data collection employed in the study. Chapter four analyses the Results generated through the

data collection. Chapter five examines the results indicating probable reasons for the results obtained. Chapter six contains the Summary, Conclusions of the study and Recommendations for further studies and policy makers.

CHAPTER TWO

LITERATURE REVIEW

2.1: History of Noise Maps

The concept of noise mapping has been in existence for a number of years. Noise mapping has mostly been done in European countries. For instance, Germany is said to have conducted relevant research for more than 25 years (Tsai *et al*., 2009)**.** The European Union (EU) passed a Directive in 2002 (EU Directive COM., 2002 cited in Tsai *et al*., 2009) that endorsed the evaluation and management of environmental noise. The directive made it imperative that, by July, 2008, all EU members should draw up noise maps for the main areas of population aggregation and primary road systems for public reference. England published the London Noise Map in 2004 and this was the first noise map to be produced by a national government. It served as a policy to inform London citizens on the need to avoid noise nuisances.

2.2: Studies on noise mapping

Various works have been done on noise mapping especially on environments considered as the main noise sources. Tsai *et al*. (2009) in a research indicated that according to the statistical data of the Environmental Protection Administration in Taiwan (TWEPA), resident petitions to reduce noise pollution were more common than those for air pollution. Noise levels were monitored during the morning (08:00 - 10:00h), afternoon (14:00 - 16:00h) and evening (20:00 - 22:00h) in summer and winter in each of Taiwan's eight (8) land use zones. The study employed the US Department of Housing and Urban Development HUD classification of noise exposure (Zannin *et al*., 2002 cited in Tsai *et al*. 2009) to investigate the exposed

populations. Geographic information systems (GIS) were used to analyse the monitoring data collected at 345 noise monitoring stations in the Tainan metropolitan area. Noise maps of the Tainan metropolitan area were produced to investigate its current noise distribution.

The overall results showed that more than 90% of the Tainan City's populations were exposed to unacceptable noise environments, urging that strategies for improving noise control were urgently needed.

A noise mapping study by Lee *et al*., (2008) stated that in previous environmental impact assessment in Korea, noise level prediction by distance-attenuation relation did not reflect the acoustic characteristics of the surroundings in detail. The study indicated the significance of noise maps in solving these problems stating that a noise map is more than the representation of the present sound levels, as it also provides the simulated future noise environment. The study further added that noise mapping does not only show the present noise level but also the increased noise levels due to planned construction works, with consideration given to acoustic phenomena like multi-reflections, diffractions and absorptions that arise due to the complex topographic configurations of the surrounding buildings. This method also helps to determine the main impact noise source and to identify areas where the noise levels exceed the legal limits.

Oyedepo and Saadu (2009) conducted a noise study in the Ilorin Metropolis, Nigeria. They used a precision-grade sound level meter (according to IEC 651, ANSI S1.4 type), 1/2-in. condenser microphone and 1/3-octave filter with frequency range and measuring level range of 31.5 Hz–8 KHz and 35–130 dB respectively to measure noise at street level road junctions, market centers, passenger loading parks and residential areas. The instrument was held carefully in the hand with

the microphone pointed at the suspected noise source at a distance not less than 1 m away from any reflecting object. LAi (which refers to the average A-weighted sound pressure level) measurements were recorded at intervals of 30 seconds for a period of 30 minutes, giving 60-m readings per sampling location. This procedure was carried out for morning (7:30–8:00 a.m.), afternoon (1:00–1:30 p.m.), evening (4:00–4:30 p.m.), and night (8:30–9:00 p.m.) measurements. The results of the study also revealed that noise levels at 30 of 42 measurement points exceeded the recommended limit of 82 dB (A) by values of 1–27 dB (A). Thus, the issue of noise pollution in the Ilorin Metropolis posed a severe health risk to the residents. The discomfort and irritation caused by the pollution could drastically reduce productivity, both in public service and private sectors.

The authors were quick to add that the most valuable step to decrease noise pollution in a big city like Ilorin was the preparation of noise maps. The authors also suggested that noise maps be developed for every big city in Nigeria to serve as a noise control measure.

A study on noise mapping was conducted by Armah *et al*., (2010) in the Cape Coast Metropolis, Ghana. The study was carried out in residential neighbourhoods in ten suburbs of Cape Coast where the density of places of worship was high. The areas sampled were Amamoma, Apewosika, Kokoado, Kwaprow, Chapel Square, Royal Lane, Antem, Abura, Esuekyir and Kakumdo. The communities were selected based on parameters such as density of religious activities, human density, location and socio-demographics. In this study, a Garmin Etrex hand-held global positioning system (GPS) was used to obtain the coordinates of the residence of the respondents and the churches and mosques within each community. A sound level meter was used to record sound pressure level at intervals of 30 seconds for a period of 30 minutes.

Qualitative data were collected by administering a semi-structured questionnaire (designed to obtain demographic and noise perception-related information) to individuals living within a 100 m radius of a church or mosque. The results showed more than three-fourths (77%) and approximately four-fifths (86 per cent) of the sampled locations recorded noise exposures above the Ghana EPA maximum permissible ambient noise limit for day and night, respectively. However, noise exposure for day was generally higher than that for night. Noise exposure correlated with level of annoyance of residents, except that the location that recorded the highest noise exposure did not correspond to a high annoyance of residents within the vicinity.

2.3: Perception of noise

Annoyance is one of the most commonly studied effects of environmental noise (Berglund *et al*., 1999) and is also as a well-being issue (Dratva *et al*., 2010). According to the WHO (1999) annoyance can be defined as a feeling of resentment, displeasure, discomfort, dissatisfaction or offence which occurs when noise interferes with thoughts, feelings or activities. Stansfeld and Matheson (2003) in a study hypothesised that noise exposure creates annoyance, which then leads on to more serious psychological effects.

In terms of religious noise, annoyance is subjective and is based on the acoustic characteristics of the noise and a wide range of non-acoustic factors of social, psychological or economic nature. Guski (1999), Job (1999) and Vastfjall (2002) indicate that non-acoustic factors such as sensitivity to noise and attitude to the noise source (that is fear of the source or feeling that annoyance is preventable) have a large impact on annoyance.

The acoustic factors causing annoyance were indicated by Kastka *et al*., (1995), Brink *et al*., (2008) and Hume *et al*., (2004). Kastka *et al*., (1995) in a distance-dependent annoyance reaction study found that road noise barriers produced high annoyance reduction at near sites but had only minimal effects beyond 150 m from the highway. The study however indicated that this was not stable over time and that correlations between annoyance of residents and their distance to the highway were lower 12 years after the erection of noise barrier than before the situation, while the relation between the distance and noise level remained relatively stable. The time of the day and seasonal dependent annoyance reactions to changed noise conditions were observed by Brink *et al*., (2008) and Hume *et al*., (2004). Hume *et al*., (2004) found that there were significant differences in the number of complaints per month, day-of-the-week and hour-of the-day before and after opening a new airport runway.

2.4: Gaps in Literature

The works of Tsai *et al*. (2009), Lee *et al*. (2008) and Oyedepo and Saadu (2009) looked at the mapping of noise from various sources but not religious noise. Empirical data on religious noise is limited except for the study conducted by Armah *et al*., (2010) which considered the perceptions of residents located within a small range of a 100 m radius of a church or mosque and also did not measure the background noise.

All the studies on the perception of noise were based on noise from other sources such as road traffic noise, aircraft noise and noise from railways and not from religious activities. This study is the first of its kind to be done in the Ashaiman Municipality and will assess the perceptions of residents located within the wide radii of 50 m, 100 m, 150 m and 200 m of a church or mosque

on noise from religious activities. It will also measure the background noise when there is no activity and the noise when there is an activity.

2.5: Conceptual Framework on perception of religious noise levels and effects

Many studies conducted have indicated that various factors influence how an individual perceives noise. Research by Babisch (2002) indicated that noise has a direct pathway and an indirect pathway. The direct pathway can lead to hearing loss and the indirect pathway can lead to annoyance. This study explores the religious noise exposure levels and perceptions of residents. In Figure 2.1 the diagram shows the direct and indirect pathways of the impacts of religious noise and the factors that influence people's perception about religious noise.

In the direct pathway, exposure to religious noise can elicit a stress response in the body. Acute noise exposures activate the autonomic and hormonal systems, leading to temporary changes such as increased blood pressure, increased heart rate and secretion of stress hormones. Prolonged exposure to noise may have the potential to affect the functional integrity of bodily organs (for instance the ear) and tissues especially in susceptible individuals (Jones, 2010). According to Babisch (2002), the direct pathway is relevant even at low sound levels especially during sleep, when the organism is at its lowest point of arousal.

The indirect pathway is the physiological effect as mediated by annoyance perception. The noise disturbance causes a stressor, impacting on behaviour (communication, concentration) and desired state (sleep and relaxation). This causes stress which leads to physiological effect in the long term. The annoyance (perception) of residents exposed to noise varies with both the

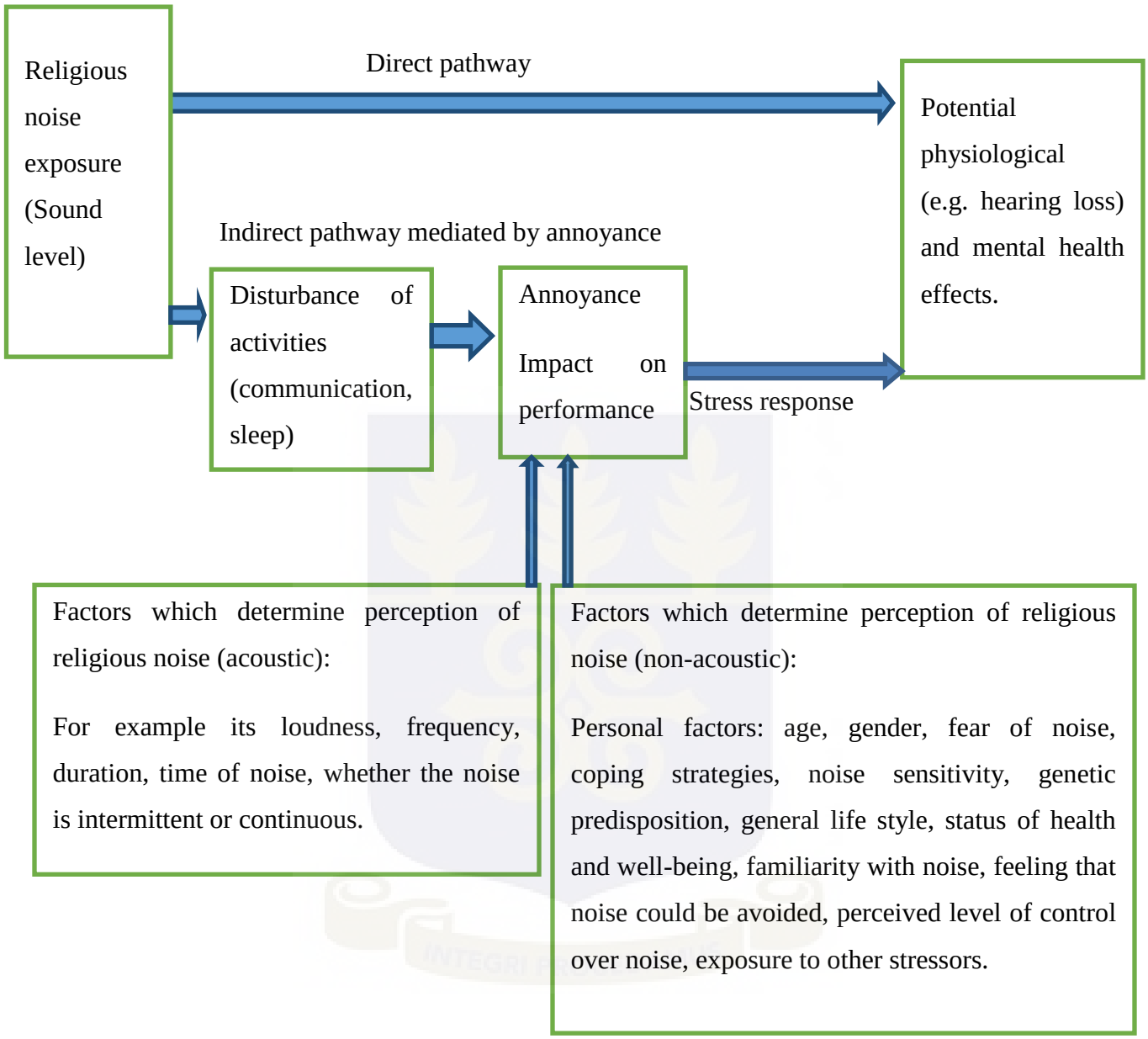
acoustical characteristics of the noise and with a range of non-acoustical factors of social, psychological or economic nature.

The acoustic factors are the characteristics of the religious noise for example: the loudness (based on the type of instruments used), frequency, duration, time of noise (time of day or day of the week that the noise occurs) and whether the noise is intermittent or continuous. A person's perception could be influenced by these factors. However, these acoustic factors could be masked by the type of building (whether the church or mosque has sound-proof property or not) as indicated by Fields (1993) or the interference of other buildings and the distance from the church or mosque as the noise could reduce with increasing distance from the noise source. It is also worth noting that these acoustic factors also lead to some physiological effects in persons exposed to them. For instance, the loudness could lead to immediate loss of hearing. The loudness together with the frequency and duration could also lead to annoyance which may be an important` mediator in causing other health effects such as cardiovascular diseases or stress responses (Jones, 2010).

The non-acoustic factors are the personal factors some of which are: age, ill health, education and type of occupation. These can also influence how an individual perceives noise exposure. Bluhm *et al*., (2004), Fields, (1992), (1993) and Miedema and Vos (1999) indicate that age accounts for how one perceives noise. The aged who may be less able to cope with high noise levels will perceive it as an annoyance as compared to younger individuals who may rather enjoy loud noise. In the same vein, those suffering from ill health may be annoyed by noise because it may inhibit their rest than those of sound health who would probably not need that much rest.

Individuals who are educated may know the harmful effects of noise and would thus feel that the noise could be avoided or reduced. This perception would lead to annoyance about it than those who are unaware of the harmful effects (Fields, 1993). Individuals constantly in noisy environments due to their occupation or life style may develop coping strategies and so have no problem with it (Fields, 1992).

Figure 2.1: Conceptual framework on perception of religious noise levels and effects



Source: Modified from Jones (2010).

CHAPTER THREE

METHODOLOGY

3.1: Study Area

The Ashaiman Municipality is one of the ten (10) districts in the Greater Accra Region of Ghana. Its capital is Ashaiman and was created in 2008. Ashaiman has coordinates 5° 42' North and 0° 01' West. It is located about four kilometers (4Km) to the north of Tema and about thirty kilometers (30Km) from Accra the capital city of Ghana. Ashaiman shares boundaries to the north and east with Katamanso Traditional Area, to the south with the Tema Township and to the west with Adjei Kojo, all within Tema Metropolitan Assembly. It has many communities some of which are planned and the rest are unplanned. The study however took a look at nine of these communities which have already been named in the text above.

Ashaiman lies within the Accra-Togo plains and therefore experiences a climatic condition that extends from the east coast of Ghana into Togo. The vegetation consists of savannah grass and shrubs due to the low rainfall regime. However, due to human activity the natural vegetation no longer exists. Rainfall in this area ranges from 730mm-790mm (ASHMA, 2011). The rainy season starts from April to July (the major season) and September to November (the minor season). Temperatures are high throughout the year. March to April is usually the hottest period with temperatures reaching 32ºC during the day and 27ºC at night. Cooler temperatures occur from May to September with a high of 27-29°C during the day and 22-24°C at night. Humidity varies with the seasons with a height of 60-80% in the wet season and less than 30% in the dry periods (ASHMA, 2011).

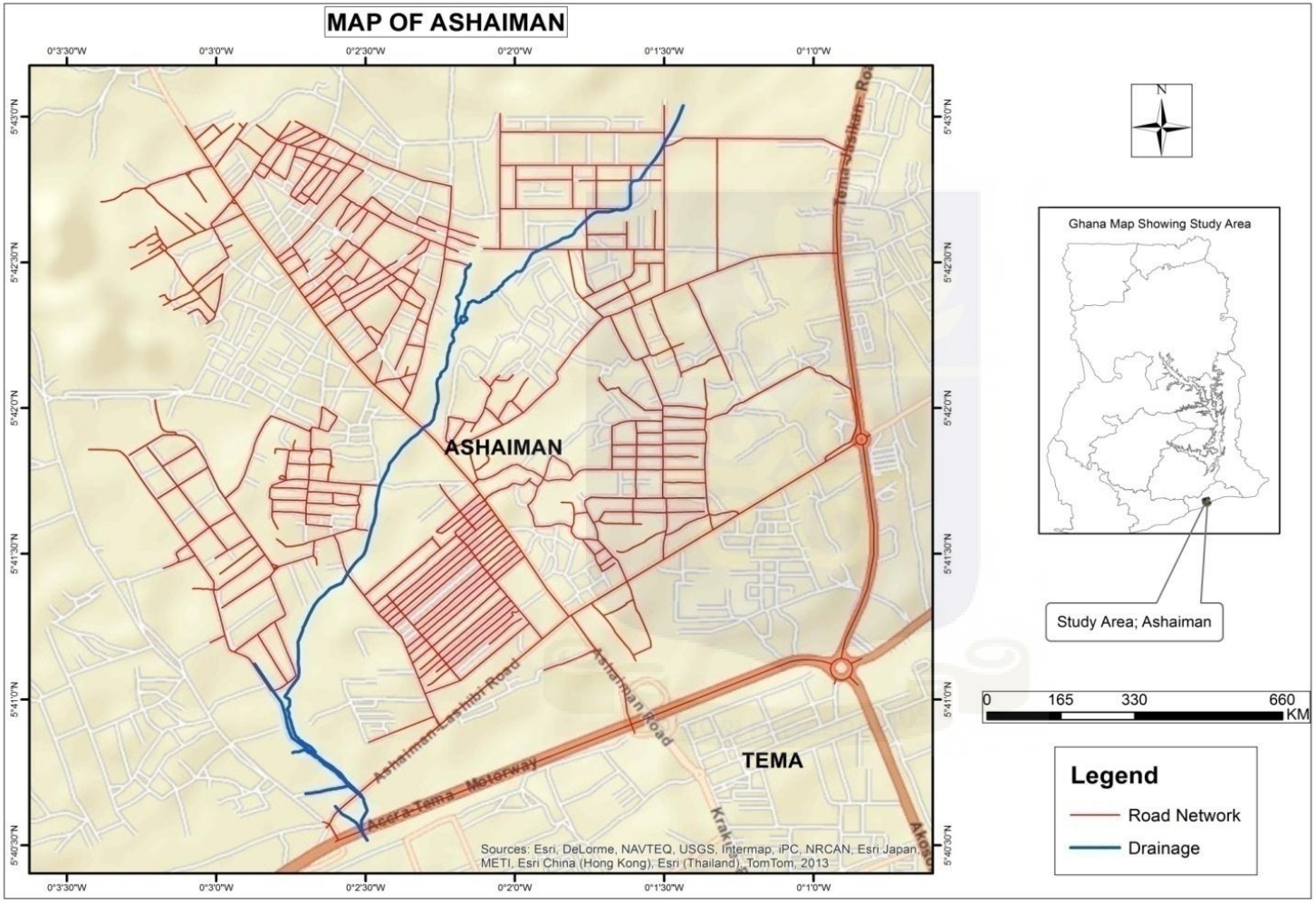
Founded by one Nii Amui, who migrated to the area from Tema in the 17th Century, he named his new settlement "Ashaiman" (or Ashai's town). He was later joined by two of his brothers (Nii Ashai and Nii Oko). The area where Nii Amui settled is presently called Mantseman, while Nii Oko's settlement is presently known as Moneomaanyi. Later, other migrants from the Ama area which is to the east of Tema came to settle in Ashaiman. The area where they settled is now called Lebanon-a suburb of Ashaiman (ASHMA, 2011).

Ewes from the Volta Region were among the earliest migrants who settled in the area. Currently, Ashaiman is home to people from many ethnic groups. It is estimated that there are over 50 different ethnic groups resident in Ashaiman. For this reason Ashaiman has a wide range of cultures but no distinct culture in particular. The construction of Tema harbour and the railway line in the 1950s, contributed to the migration of people to the area in search of jobs and who found residence in the cheap accommodation that Ashaiman provides (ASHMA, 2011).

According to the 2010 census, Ashaiman has 240,000 inhabitants of which 80% are Christians with majority of them (37.4%) belonging to the Pentecostal/Charismatic denomination. Nine percent (9%) Muslims and 11% either belong to the Traditional African religions or have no religion (ASHMA, 2011). Most of the inhabitants are into trading activities. Some inhabitants are engaged in the agriculture sector (crop farming, livestock rearing and fishing).

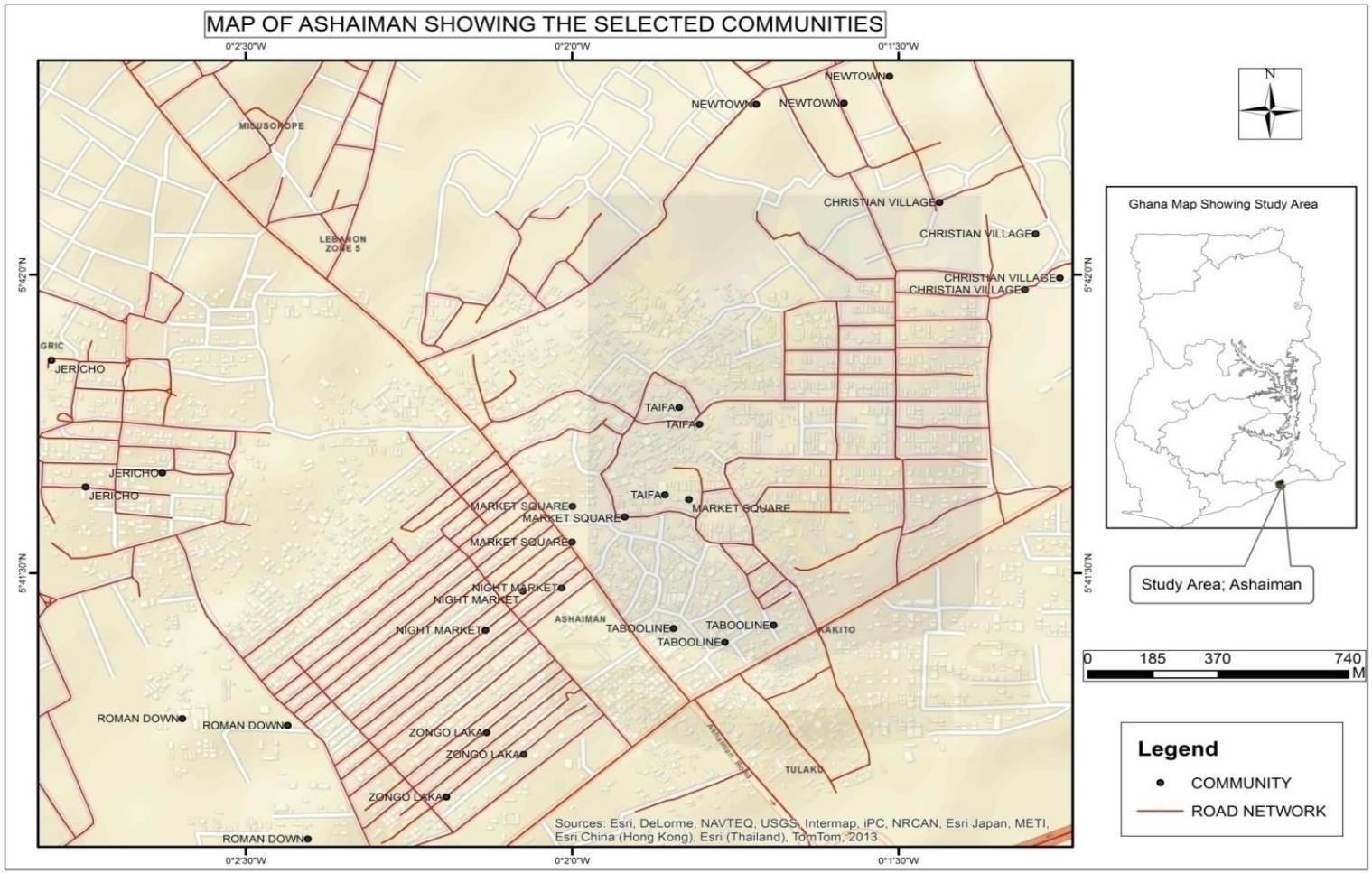
The Ashaiman Municipality was selected for this study based on parameters such as density of religious places of worship, human density, location and socio-demographics.

Figure 3.1: Map of the Ashaiman Municipality



Source: Generated by researcher and assisted by Tetteh (2013).

Figure 3.2: Map of the Ashaiman Municipality showing the selected communities



Source: Generated by researcher and assisted by Tetteh (2013)

3.2: Community Selection

The selection of communities was done using a stratified random sampling technique. The communities were stratified into the settlement patterns of planned and unplanned areas. The communities were then selected from the two groups to adequately represent Ashaiman. Three communities were selected from the planned settlements namely: Christian Village, Roman Down and New Town. Zongo Laka, Market Square, Taifa, Taboo Line, Jericho and Night Market were the other communities sampled from the unplanned areas.

Selection of houses of respondents was based on the various distances from the noise sources namely: 50 m, 100 m, 150 m and 200 m. This was based on the fact that intensity varies from the source outwards. The heads of each household was interviewed because of their capacity to provide accurate information about every member of the household. However, in the absence of the head of the household, any person available in the selected houses capable of providing authentic answers to the questions was interviewed.

3.3: Selection of Churches and Mosques

The churches and mosques were selected by purposive sampling technique. Selection of churches was done based on the following criteria: i. category of church: Orthodox churches, Pentecostal churches and Charismatic churches. ii. structure: only churches with permanent structures were considered. This was to ensure that the churches would always be there and not relocated. The number was however based on those that could be assessed effectively and efficiently and within the time, material and financial resource limit.

The churches and mosques sampled in the communities are shown in Table 1 below.

Table 1: Churches and mosques sampled in each community

NAME OF COMMUNITY	CHURCHES AND MOSQUES SAMPLED
TABOO LINE	Church of Jesus
	Voice of the Lord Evangelical Church
	Tribe of Judah Ministries International (Int'l)
MARKET SQUARE	Apostolic Church, Ghana
	Musama Disco Christo Church
	St. Peter Methodist Church
	Grace Assembly (Assemblies of God (AG))
TAIFA	Central Assemblies of God
	Green and Cream Mosque
	Unique Chapel International (Int'l)
NEW TOWN	Church of Pentecost
	Global Evangelical Church
	Liberty Centre Annex (Assemblies of God (AG))
CHRISTIAN VILLAGE	Presbyterian Church

	Church of Pentecost
	Christ Apostolic Church
	Evangelistic Fire Ministries International (Int'l)
ZONGO LAKA	Grace Chapel International (Int'l)
	White and Green Mosque
	Yellow Mosque
ROMAN DOWN	Church of Pentecost
	St. Augustine Catholic Church
	Christ Apostolic Church
JERICHO	Church of Pentecost
	Church of Christ
	Christ Apostolic Church
NIGHT MARKET	White and Green Mosque
	White Mosque (Uncompleted)
	Cream and Green Mosque

3.4: The Study Population

The study population included people of both sexes within the age brackets of under 18, 18 – 60 and those above 60 years. The participants who were within 18-60years and those above 60years were either heads of the families or not and were capable of providing authentic information for the study. In all 220 respondents were interviewed.

Table 2 shows the number of males and females interviewed in each of the nine communities.

Table 2: Total Number of people sampled in each community

COMMUNITY	**NUMBER OF RESPONDENTS**	
	MALE	**FEMALE**
1.CHRISTIAN VILLAGE	11	19
2. ZONGO LAKA	15	15
3. ROMAN DOWN	13	6
4. MARKET SQUARE	15	14
5. TAIFA	13	13
6. TABOO LINE	9	8
7. NEW TOWN	4	16
8. JERICHO	7	12
9. NIGHT MARKET	14	16
TOTAL	**101**	**119**

3.5: Noise Study

3.5.1: Sound level measurement

A precision-grade sound level meter RION NL-22 (Higashimotomachi, Tokyo, Japan) was used to measure the noise levels generated at the churches, mosques and the various distances of 50 m, 100 m, 150 m and 200 m away from the churches and mosques. The device conforms to International Electro technical Commission 61672-1:2002.

A Battery and calibration check was done on the sound level meter before and after it was used at each site. To avoid reflections from the body which could increase the noise level when measurements were being taken from the sound level meter scale, the meter was held at arm's length with the microphone pointed at the noise source. The meter was used to obtain the noise levels from both the churches and mosques and at the various distances. Thereafter, the noise level produced from these sources were compared with the ambient noise level guidelines of Environmental Protection Agency (EPA), Ghana as a standard check.

According to the guidelines on noise measurement by the Victoria Environmental Protection Agency (EPA), Policy N-l does not specify a measurement time, but it is recommended that the LAeq (which refers to the energy equivalent average sound pressure level measured using the A-weighting which is most sensitive to speech intelligibility frequencies of the human ear) be measured so it represents the LAeq over a 30 minute period. Noise emissions need to be observed for at least 30 minutes for the purpose of assessing a duration adjustment if the noise is steady over this period (that is, there is no observed rising or falling trend in the noise level either audibly or by sound-level meter inspection), a short measurement (say five minutes) should be

adequate to represent the 30minutes LAeq **(**EPA Victoria, 1991). Based on this, the noise readings were taken for ten minutes for the churches and five minutes for the mosques due to the variation in the duration of their activities. For each location, three different noise levels were taken for both day and night and the average noise level was computed. This was done in cognisance of the fact that noise is transient and that noise levels within localities will be varying all the time.

3.5.2: Global Positioning System (GPS)

A Garmin Etrex hand-held GPS was used to obtain the coordinates of the churches and mosques and the distances of 50m, 100m, 150m and 200m away from the church and mosque within each community.

3.5.3: Study on the perception of noise

The questionnaire comprised of 31 questions divided into two main sections. The first section contained general socio-demographic questions about the participant's age, gender, education, number of people in household, occupation, length of residence, home ownership, reason for choice of location and when the church or mosque was built.

The second section of the questionnaires included noise-related questions, in which noise annoyance caused by religious activities was measured using one international standardised scale, which was created following the International Commission on the Biological Effects of Noise (ICBEN) method: a five-point Likert scale (''extremely annoyed" = 5, ''very annoyed" = 4, ''moderately annoyed" = 3, ''slightly annoyed" = 2, and ''not at all annoyed" = 1) .

Only one person within the 50 m radius was interviewed, two, three and four persons were interviewed for the 100 m, 150 m and 200 m radii respectively. 247 respondents were initially contacted but 27 declined to be interviewed. Individuals who declined to be interviewed stated either a lack of interest or time. Thus, 220 respondents were interviewed. Those who were willing to answer the questionnaire on their own did so.

3.6: Data processing and analysis

Questionnaires were checked for completeness and internal consistency at the close of each day. Questionnaires were then sorted, numbered and data coded before entering data into SPSS (version 17) software. GPS noise locations and noise level readings per location were input in ARCGIS 10.1 software. Since noise is a continuous phenomenon in space, noise levels were converted into a continuous surface using Kriging technique of interpolation.

3.7: Data presentation

The data was categorised and presented in the form of tables, pie charts, bar graphs and noise maps.

CHAPTER FOUR

RESULTS

Majority of the participants (54.5%) interviewed were females and the remaining 45.5% were males. Almost seventy-nine percent (78.2%) were within the age brackets of 18-60years. This was followed by those less than eighteen years (13.2%) and those above sixty years of age (8.6%). Only about twelve percent (11.8%) had Tertiary education but most of them (34.5%) had Junior High education. The rest are: Senior High education (20%), Primary education (15.9%) and Non-formal education (17.7%). Over 40% of the respondents were owners of their dwellings and most of them were relatively old residents (living at the dwelling for 5 years and above). Almost 40% of the respondents were traders and most participants (72.3%) chose to live at Ashaiman because it was convenient for them (for instance: accommodation was relatively cheaper as compared to Tema, and Ashaiman is of close proximity to Tema and so it was also convenient for most workers who go to work at Tema). It is also worth mentioning that most of the churches and mosques were already present when participants moved in.

4.1: Noise levels produced in the Ashaiman Municipality

4.1.1: Day time noise levels at the various noise sources, 50 m and 100 m distances

The participants in all the communities were generally exposed to very high noise levels during the day and even at night. All the twenty-three(23) churches and six(6) mosques that were selected from the nine communities within the Ashaiman Municipality recorded higher noise levels during an activity than the background noise taken when there was no religious activity taking place. It can thus be said that the religious noise contributes to the overall noise recorded

in each of the communities. Noise levels produced at the churches and mosques and for the 50m and 100m distances are provided in Tables 3 and 4.

Table 3: Day time noise levels at the Churches, 50 m and 100 m distances

DAY TIME(0600 – 2200h) NOISE LEVEL(dB(A))				
CHURCH	**SOURCE**	**BACKGROUND NOISE AVERAGE**	**50 m**	**100 m**
TABOO LINE				
Church of Jesus	94.7	59.0	83.2	72.0
Voice of the Lord Evangelical Church	89.8	62.4	76.0	63.3
Tribe of Judah Ministries International	91.6	65.2	70.7	66.1
MARKET SQUARE				
Apostolic Church, Ghana	74.4	55.0	77.6	76.9
Musama Disco Christo Church	100.8	66.2	77.5	72.1
St. Peter Methodist Church	86.9	62.4	63.6	58.8
Grace Assembly (Assemblies of God)	66.2	60.0	75.4	74.7
TAIFA				
Central Assemblies of God	93.5	60.4	76.1	73.1
Unique Chapel International	95.8	67.0	84.9	73.1
NEW TOWN				
Church of Pentecost	92.9	59.8	79.0	68.0
Global Evangelical Church	93.1	57.0	83.1	74.5

Liberty Centre Annex(Assemblies of God)	88.3	52.8	76.5	64.3
CHRISTIAN VILLAGE				
Presbyterian Church	85.9	52.0	70.8	62.5
Church of Pentecost	98.5	55.0	84.7	70.6
Christ Apostolic Church	96.2	51.2	90.6	84.1
Evangelistic Fire Ministries International	96.6	61.4	90.6	70.4
ZONGO LAKA				
Grace Chapel International	90.8	65.0	73.1	65.3
ROMAN DOWN				
Church of Pentecost	83.7	64.2	64.5	69.4
St. Augustine Catholic Church	81.1	62.0	74.7	64.0
Christ Apostolic Church	94.1	64.0	83.9	75.0
JERICHO				
Church of Pentecost	82.7	52.0	71.1	63.4
Church of Christ	81.9	60.0	72.8	66.9
Christ Apostolic Church	101.3	55.8	94.9	82.9

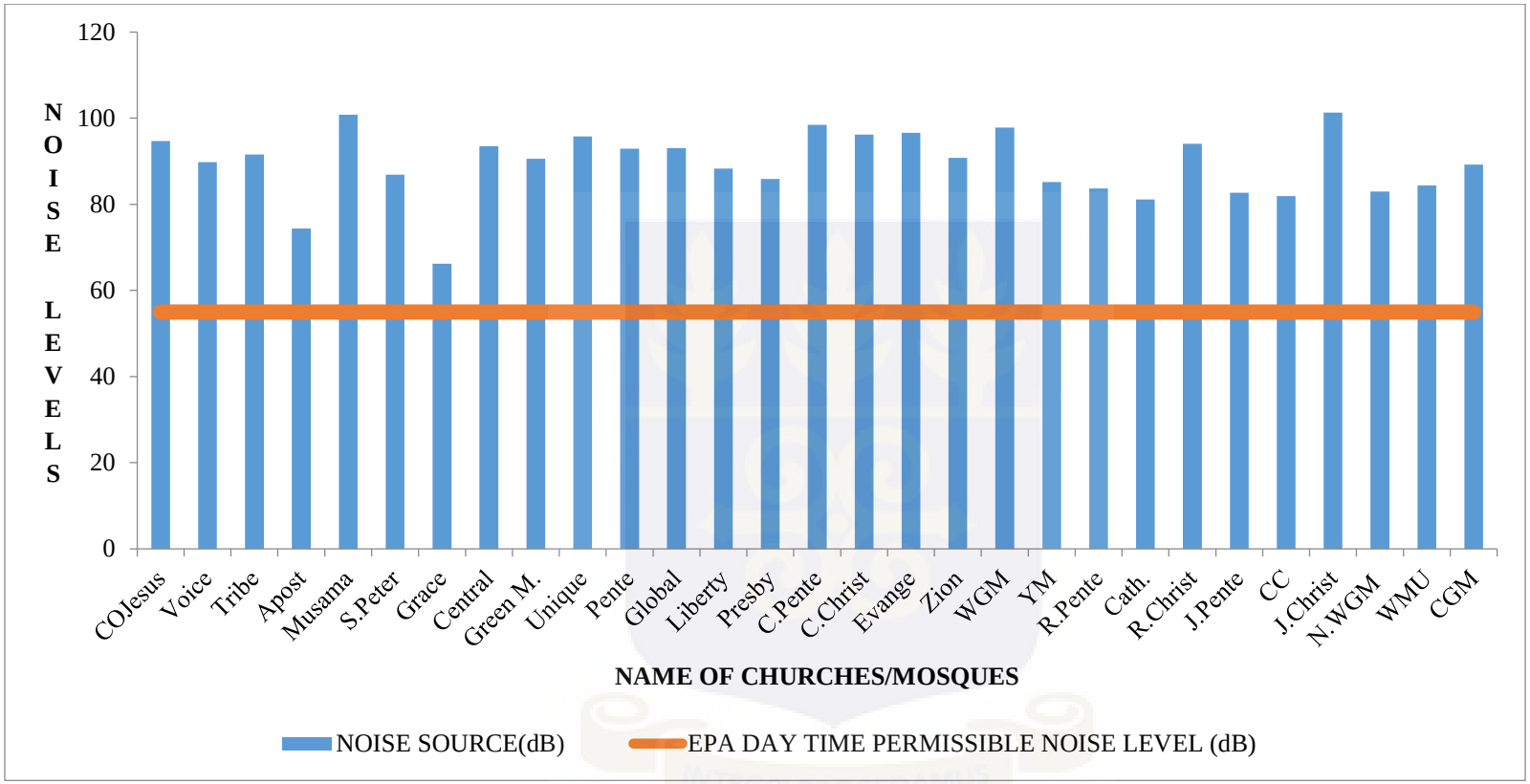
Table 4: Day time noise levels at the Mosques, 50 m and 100 m distances

DAY TIME(0600 – 2200h) NOISE LEVEL(dB(A))				
MOSQUES	**SOURCE**	**BACKGROUND NOISE AVERAGE**	**50 m**	**100 m**
TAIFA				
Green and Cream Mosque	90.6	63.0	69.0	64.6
ZONGO LAKA				
White and Green Mosque	97.8	61.0	85.4	75.8
Yellow Mosque	85.2	62.0	80.6	75.0
NIGHT MARKET				
White and Green Mosque	83.0	62.2	76.0	66.6
White Mosque (Uncompleted)	84.4	69.2	78.2	67.0
Cream and Green Mosque	89.2	72.6	75.0	66.6

Day time noise levels ranged from 66.2dB(A) to 101.3dB(A) and was recorded at Grace Assemblies of God at Market Square and Christ Apostolic church at Jericho respectively. At the 50 m distance, the lowest noise level recorded was 63.6dB (A) and the highest level was 94.9dB(A). These were recorded at the St. Peter Methodist church at Market Square and Christ Apostolic church at Jericho respectively. The 100 m distance recorded noise values between

58.8dB and 84.1dB from the St. Peter Methodist church at Market Square and the Christ Apostolic church at Christian Village respectively. It is worth nothing that all the religious noise levels recorded were higher than the background noise levels recorded when religious activities were not taking place.

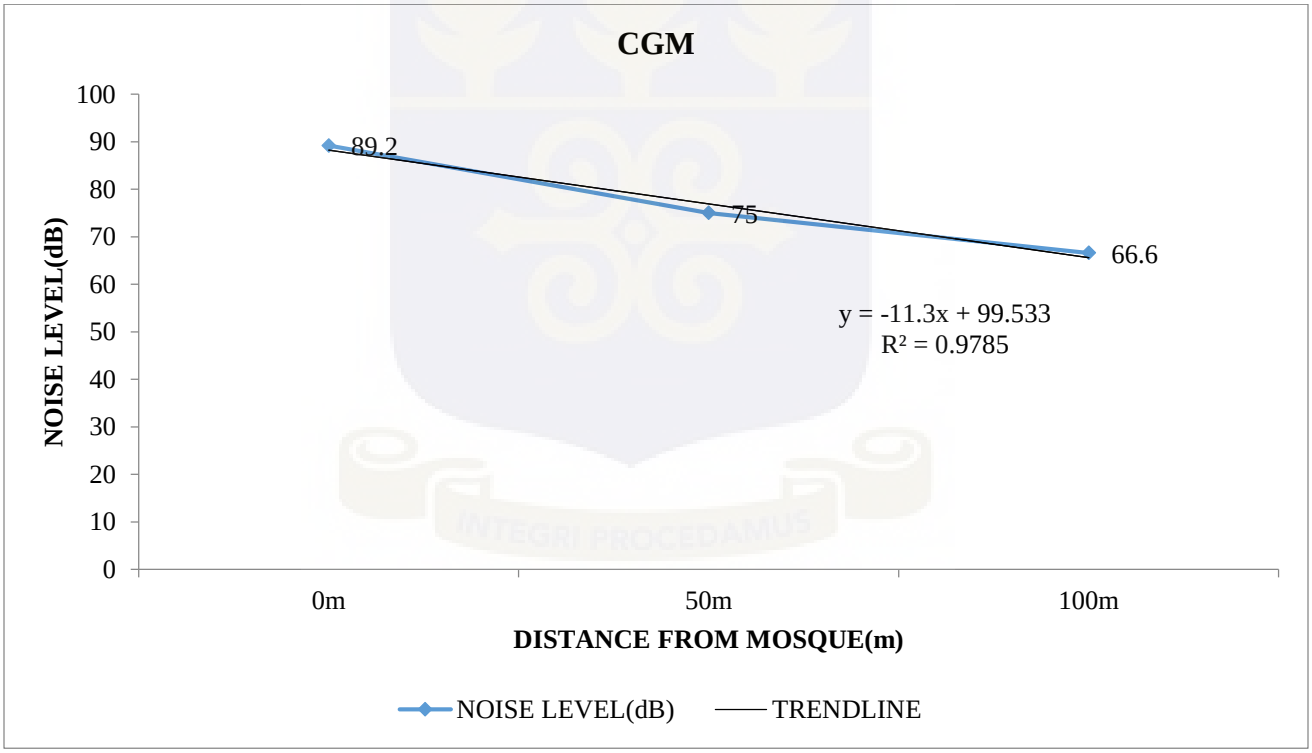
Figure 4.1: Day time noise levels at the churches and mosques



Source: Generated by the researcher through fieldwork (2013).

Figure 4.1 indicates that all the churches and mosques sampled produced noise above the permissible level of 55dB(A) for 0600 - 2200h, with Christ Apostolic church at Jericho recording the highest value of 101.3dB(A) and Grace Assemblies of God at Market Square recording the lowest value of 66.2dB(A). At the distances of 50 m and 100 m away from the noise sources, none of the churches or mosques produced noise within the permissible levels.

Figure 4.2: Noise distance relationship of Cream and Green Mosque (CGM), Night Market

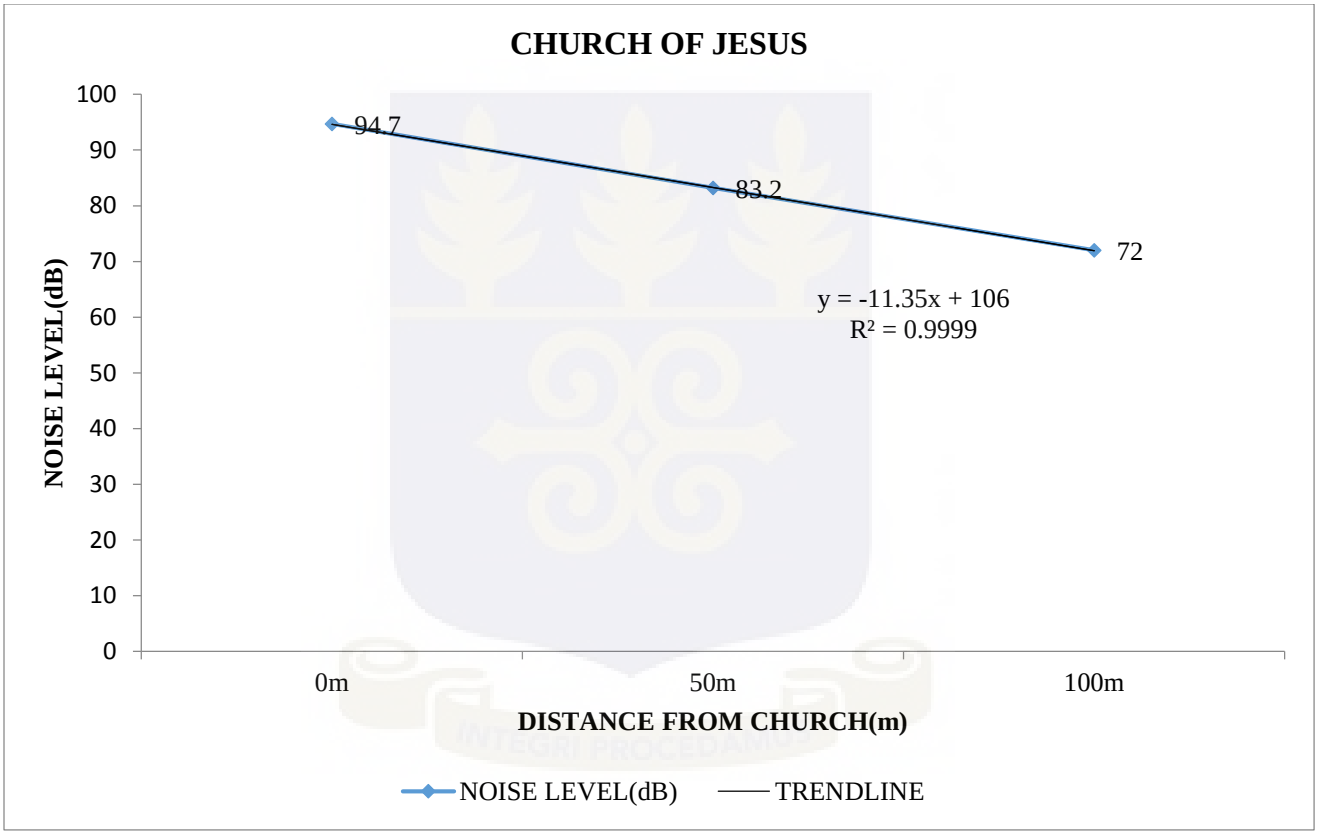


Source: Generated by the researcher through fieldwork (2013).

The equation y = -11.3x + 99.53 shows the change in noise level with an increase in distance away from the noise source (CGM). R^2 explains the extent to which distance affects the variation

in noise levels. In Figure 4.2 for instance, distance explains 97.8% of variation in noise level. Other factors account for only 2.2% change in the noise level. This indicates that the noise levels reduced with increased distance from the mosque.

Figure 4.3: Noise distance relationship of Church of Jesus, Market Square



Source: Generated by the researcher through fieldwork (2013).

The equation y = -11.35x + 106 in Figure 4.3 shows the change in noise level with an increase in distance away from the noise source (Church of Jesus). R^2 explains the extent to which distance affects the noise levels. Distance explains 99.9% of variation in noise level and 0.1% accounts

for other factors other than distance. The noise levels decreased as the distance from the church increased.

4.1.2: Night time noise levels at the various noise sources, 50m and 100m distances

The noise levels recorded at the churches, mosques and the various distances away from the noise sources all exceeded the EPA permissible level of 48dB(A) for night time (2200 – 0600h) expected for residential areas. These are presented in Tables 5 and 6.

Table 5: Night time noise levels at the Churches, 50 m and 100 m distances

NIGHT TIME(2200 – 0600h) NOISE LEVEL(dB(A))			
CHURCH	**SOURCE**	**50 m**	**100 m**
TABOO LINE			
Church of Jesus	80.1	85.3	72.5
Voice of the Lord Evangelical Church	89.0	81.5	64.8
Tribe of Judah Ministries International	101.7	78.5	74.3
MARKET SQUARE			
Apostolic Church, Ghana	86.3	80.5	76.5
Musama Disco Christo Church	100.5	81.3	74.7
St. Peter Methodist Church	83.7	69.7	61.7

Grace Assembly (Assemblies of God)	71.9	78.0	74.1
TAIFA			
Central Assemblies of God	94.8	74.3	73.9
Unique Chapel International	94.7	84.2	67.6
NEW TOWN			
Church of Pentecost	99.5	83.3	70.5
Global Evangelical Church	98.5	86.9	70.7
Liberty Centre Annex(Assemblies of God)	85.1	74.8	65.3
CHRISTIAN VILLAGE			
Presbyterian Church	82.5	70.8	63.7
Church of Pentecost	97.1	83.0	72.5
Christ Apostolic Church	94.5	91.4	83.5
Evangelistic Fire Ministries International	93.2	82.5	72.7
ZONGO LAKA			
Grace Chapel International	87.3	72.5	62.5
ROMAN DOWN			
Church of Pentecost	82.4	64.9	61.6

St. Augustine Catholic Church	80.9	73.9	64.0
Christ Apostolic Church	100.0	85.1	73.1
JERICHO			
Church of Pentecost	85.7	71.2	63.7
Church of Christ	82.3	75.2	64.8
Christ Apostolic Church	94.3	83.9	74.4

Table 6: Night time noise levels at the Mosques, 50 m and 100 m distances

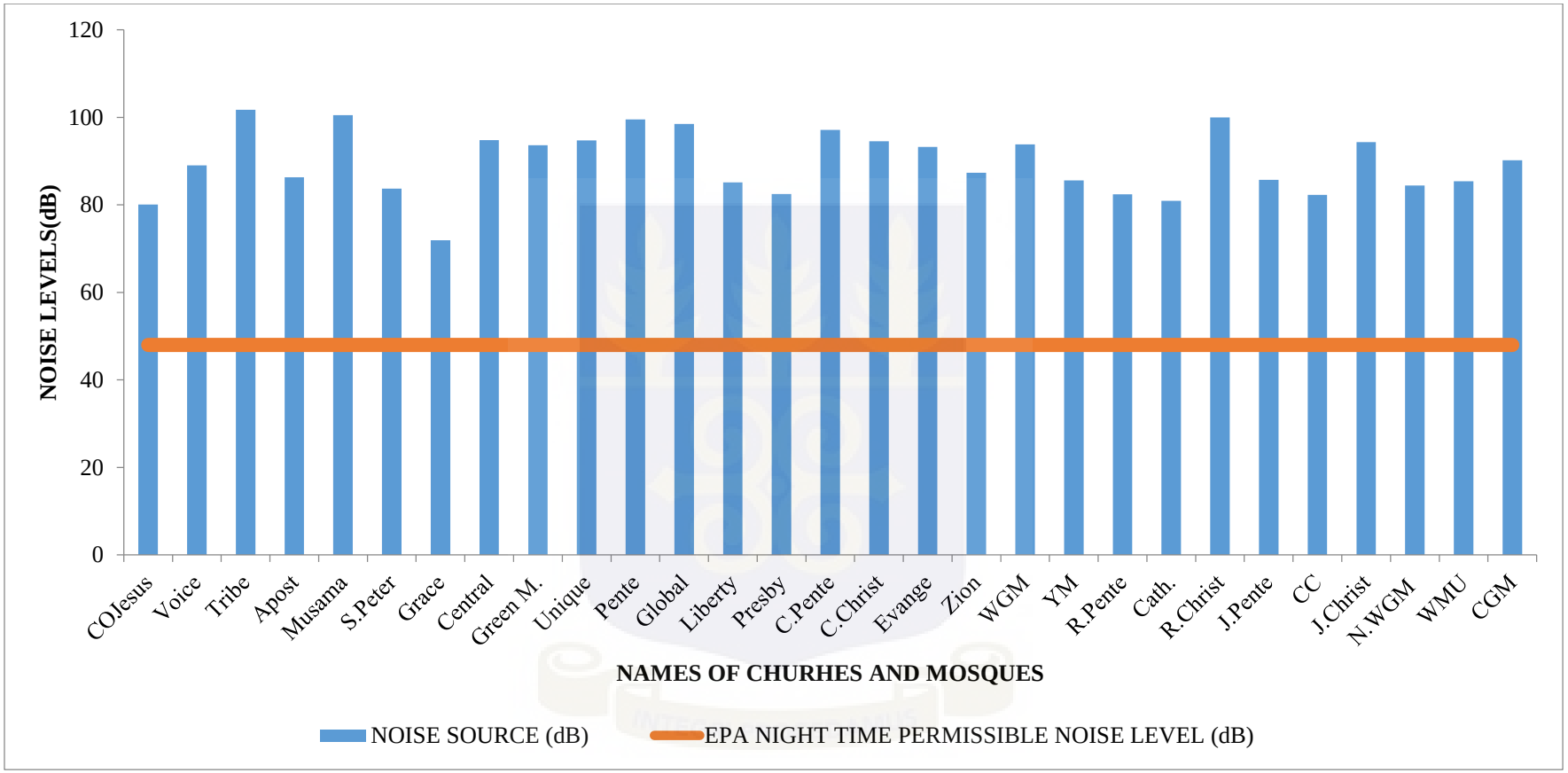
NIGHT TIME(2200 – 0600h) NOISE LEVEL(dB(A))			
MOSQUES	**SOURCE**	**50 m**	**100 m**
TAIFA			
Green and Cream Mosque	93.6	76.8	68.6
ZONGO LAKA			
White and Green Mosque	93.8	85.6	75.2
Yellow Mosque	85.6	81.2	72.6
NIGHT MARKET			
White and Green Mosque	84.4	76.2	64.2
White Mosque (Uncompleted)	85.4	75.6	64.6
Cream and Green Mosque	90.2	77.4	64.0

For night time (2200 – 0600h) noise levels, Grace Assemblies of God church recorded the lowest value of 71.9dB and Tribe of Judah Ministries International recorded the highest value of 101.7dB at the noise source. Pentecost church at Roman Down and Christ Apostolic church at Christian Village recorded noise levels of 64.9dB and 91.4dB respectively at the 50 m distance and 61.6dB and 83.5dB for the 100 m distance.

Tribe of Judah Ministries International at Taboo Line recorded the highest value of 101.7dB (A) and Grace Assemblies of God at Market Square recorded the lowest value of 71.9dB (A). However, at a distance of 50 m from the source, Tribe of Judah Ministries which recorded the highest value at the source recorded 78.5dB (A) and Grace Assemblies of God which recorded the lowest value at the source also recorded 78dB (A). The decrease could be attributed to the glass windows used which acted as a form of sound- proof whilst the increment could be due to other activities aside the church service such as traffic noise.

None of the churches nor mosques produced noise within the permissible level of 48dB(A) for night at a distance of 100 m from the church/mosque.

Figure 4.4: Night time noise levels at the churches and mosques



Source: Generated by the researcher through fieldwork (2013).

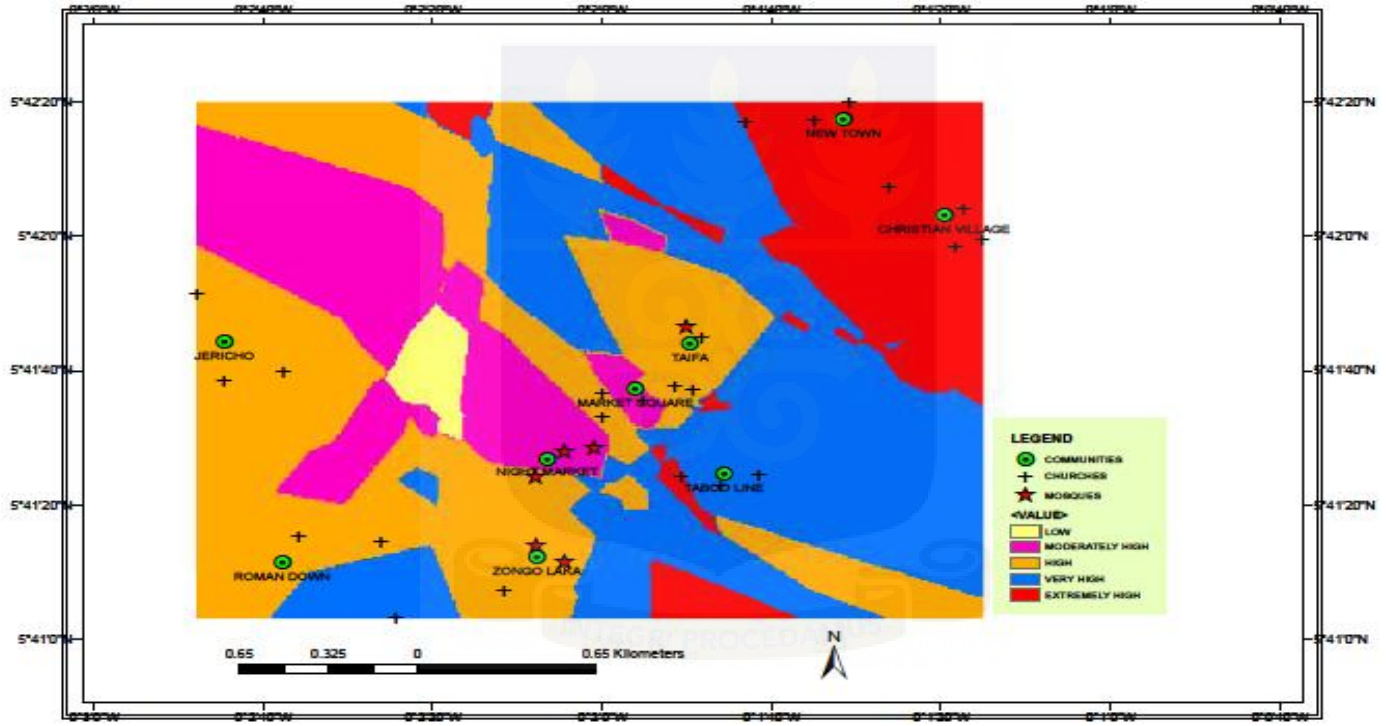
For the night time readings, Figure 4.4 shows that all the churches and mosques produced noise above the permissible level of 48dB(A) for the period 2200 – 0600h. Tribe of Judah Ministries International at Taboo Line recorded the highest value of 101.7dB (A) and Grace Assemblies of God at Market Square recorded the lowest value of 71.9dB(A). However, at a distance of 50 m away from the source, Tribe of Judah Ministries which recorded the highest value at the source recorded 78.5dB(A) and Grace Assemblies of God which recorded the lowest value at the source also recorded 78dB (A). The decrease could be attributed to the glass windows used which act as a form of sound proof whilst the increment could be due to other activities aside the church service such as traffic noise. None of the churches/mosques produced noise within the permissible level of 48dB for night at a distance of 100 m from the church or mosque.

Figure 4.5: Some mosques with loud speakers

Figure 4.5 shows pictures of the White Mosque (Uncompleted) on the left side and the White and Green Mosque on the right side both at Night Market with loud speakers installed on them. These mosques are in proximity to some houses. The discussion to this figure is on page 74.

4.2: Noise maps and exposure zones in residential neighbourhoods of the Ashaiman Municipality

Figure 4.6: Noise exposure level map for day time (0600 – 2200h)



Source: Generated by researcher and assisted by Pabi (2013).

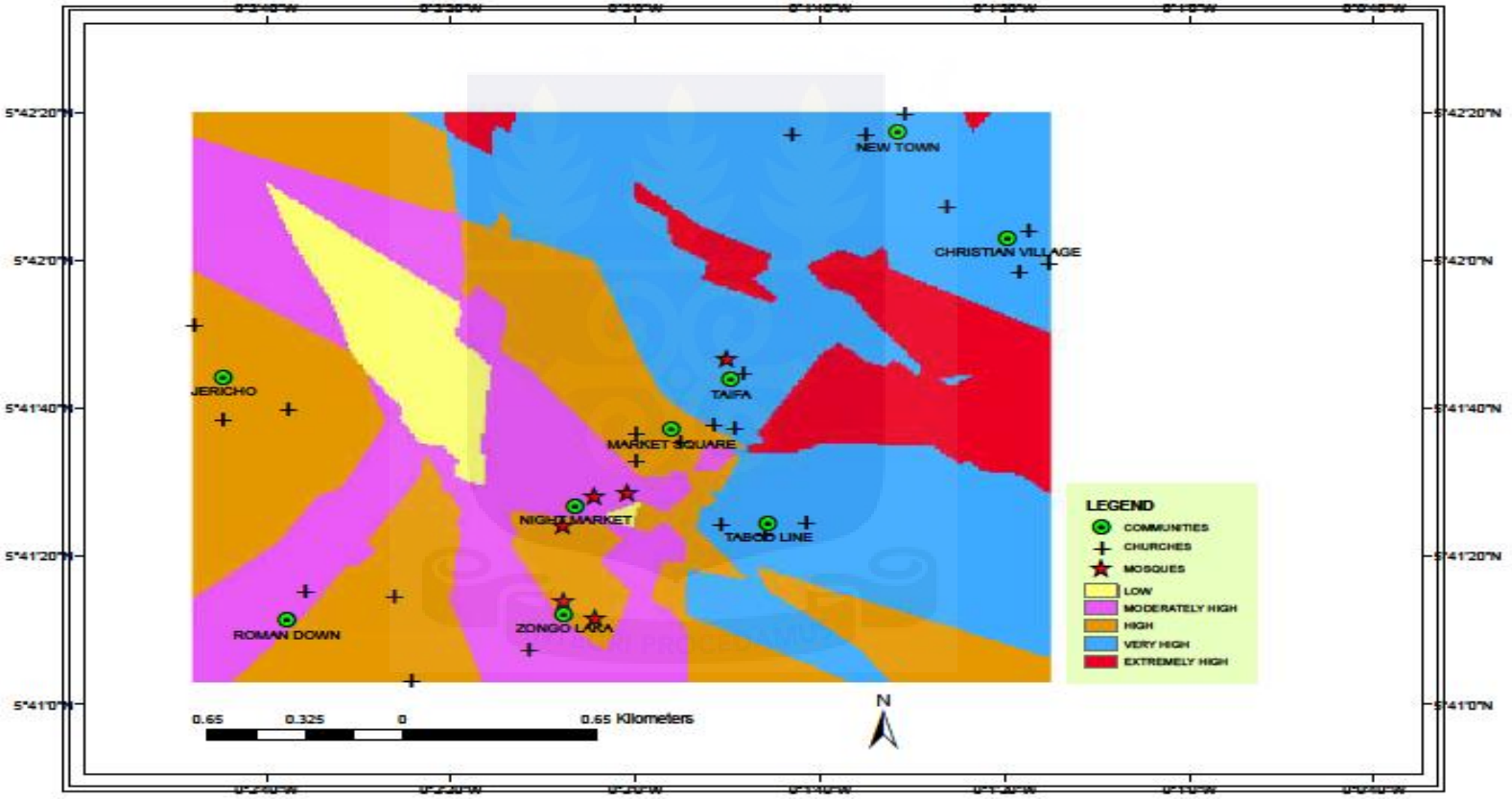
Based on the noise levels produced from the churches and mosques, noise maps indicating the various exposure classes were generated and are shown in Figure 4.6. The noise levels were arbitrarily classified into various exposure classes based on their levels. Thus, they are just indicative of noise level exposure. These classes and noise levels are shown in Table 7.

Table 7: Day time exposure classes

NOISE RANGE (dB(A))	EXPOSURE CLASS
79.9 – 82.8	LOW
82.8 – 85.6	MODERATELY HIGH
85.6 – 88.5	HIGH
88.5 – 91.4	VERY HIGH
91.4 – 94.3	EXTREMELY HIGH

None of the communities was within the Low noise exposure class. A major part of Night Market and a small portion of Market Square were within the Moderately High noise exposure class. Every part of Taifa, Zongo Laka and Jericho, a major part of Roman Down and Market Square were in the High noise exposure class. A major part of Taboo Line and a small portion of Roman Down were within the Very High noise exposure class. New Town, Christian Village and a small portion of Taboo Line were in the Extremely High noise exposure class.

Figure 4.7: Noise exposure level map for night time (2200-0600h)



Source: Generated by researcher and assisted by Pabi (2013).

Figure 4.7 shows the noise map for night time noise levels.

The classes and noise levels for night time (2200-0600h) are also shown in the Table 8.

Table 8: Night time exposure classes

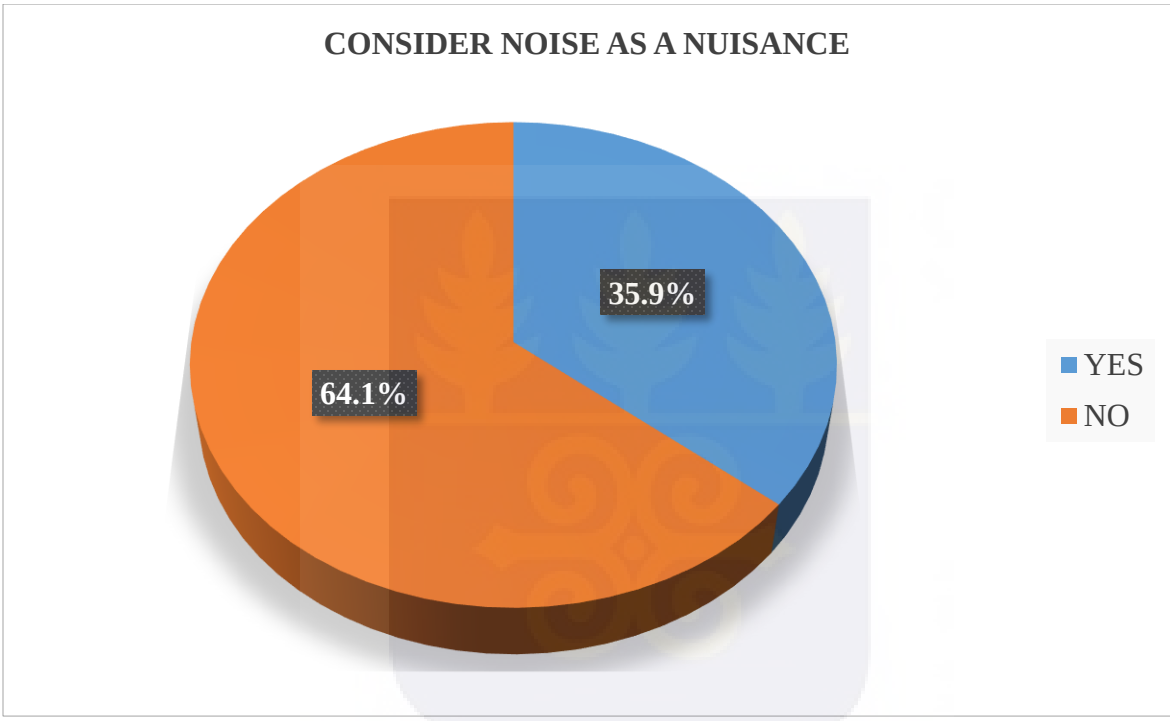
NOISE RANGE (dB(A))	EXPOSURE CLASS
81.8 – 84.8	LOW
84.8 – 87.2	MODERATELY HIGH
87.2 – 89.9	HIGH
89.9 – 92.6	VERY HIGH
92.6 – 95.3	EXTREMELY HIGH

None of the communities was within the Low noise exposure class. A major part of Night Market and small portions of Roman Down and Zongo Laka were in the Moderately High noise exposure class. Every part of Jericho, major parts of Market Square, Zongo Laka and Roman Down and a small portion of Night Market were in the High noise exposure zone. Every part of New Town, Christian Village, Taifa and Taboo Line and a small portion of Market Square were in the Very High noise exposure class. None of the communities was within the Extremely High noise exposure class.

4.3: General Perception of participants about noise

4.3.1: Noise as a nuisance

Figure 4.8: Noise as a nuisance



Source: Generated by the researcher through fieldwork (2013).

As regards the perception of noise as a nuisance, 64.1% of participants responded that they did not consider the noise as nuisance. The reasons being that it did not cause any disturbance and that it was a form of worship to God. However, 35.9% responded in the affirmative with majority of them stating that the noise disturbs sleep. The other reasons stated as to why they considered the noise as a nuisance were that: it causes irritations, interferes with concentration, increases heart beat and interferes with conversations (Figure 4.8).

Most males (55.7%) considered the noise as a nuisance as compared to the females (44.3%).

Table 9: Perception of noise in relation to distance from noise source

DISTANCE FROM NOISE SOURCE	NOISE AS A NUISANCE		TOTAL
	YES	NO	
50 m	11	12	23
100 m	20	26	46
150 m	25	43	68
200 m	23	60	83
TOTAL	**79**	**141**	**220**

Table 9 shows that most of the participants (47.8%) within the 50 m as compared to the other radii stated that the noise was a nuisance. This can be attributed to their proximity to the noise sources. The rest are: 100 m (43.5%), 150 m (36.8%) and 200 m (27.7%). It is worth noting that the 50 m radius had the least number of the respondents (23) as compared to 46, 68 and 83 participants for 100 m, 150 m and 200 m respectively.

Table 10: Perception of noise in relation to educational level of participants

EDUCATION OF PARTICIPANTS	NOISE AS A NUISANCE		TOTAL
	YES	NO	
PRIMARY	13	22	35
JUNIOR HIGH	28	48	76
SENIOR HIGH/TECHNICAL	16	28	44
TERTIARY	12	14	26
NONE	10	29	39
TOTAL	**79**	**141**	**220**

In Table 10, most participants regardless of their level of formal education did not perceive the noise as a nuisance. For participants with Non-formal education, majority of them did not perceive the noise as a nuisance (74.4%) but 25.6% considered the noise as a nuisance. This was followed by those with Senior High/Technical education, 63.6% did not consider it as a nuisance but 36.4% stated that it was a nuisance. For Junior High level of formal education, 63.2% stated that it was not a nuisance and 36.8% considered it as a nuisance. These were followed by: Primary education (62.9%) not a nuisance and 37.1% a nuisance and then Tertiary education 53.8% stated that it was not a nuisance and 46.2% (the highest percent so far) stated that it was a nuisance.

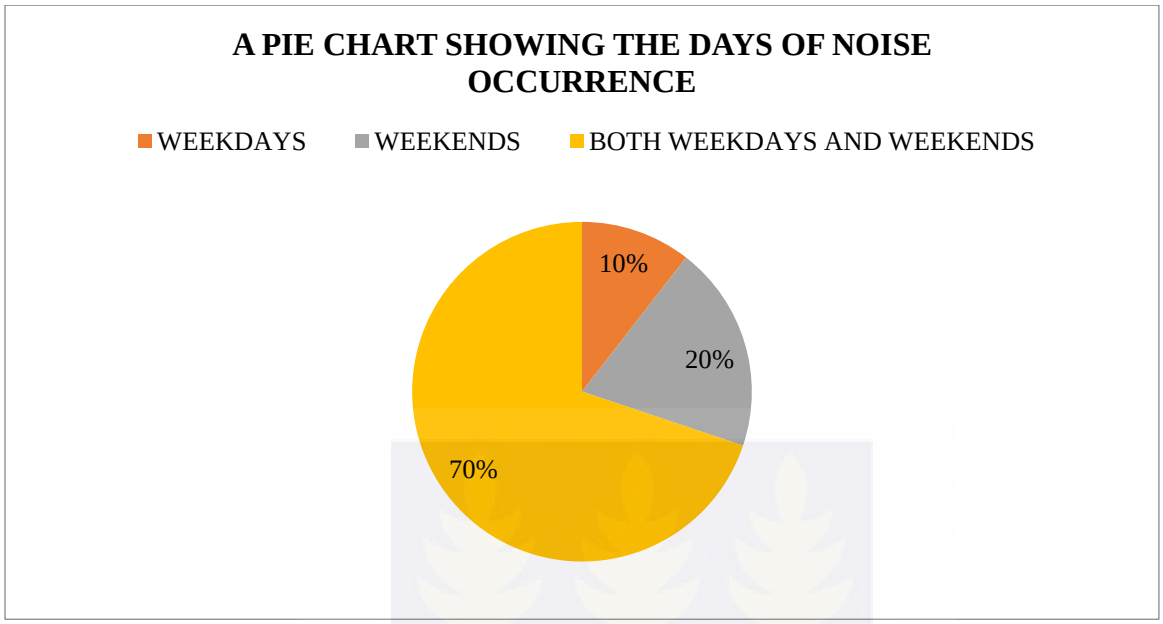
A Chi-square test at the confidence level of 95% indicated no significant relationship between participants' level of education and their perception of noise as a nuisance.

Table 11: Effects of noise on participants at different distances from the noise sources

DISTANCE FROM NOISE SOURCE	REASONS FOR NOISE BEING A NUISANCE					TOTAL
	NOT A NUISANCE	IRRITATION	DISTURBS SLEEP	INTERFERES WITH CONCENTRATION	OTHER	
50 m	12	1	7	0	3	23
100 m	26	2	13	4	1	46
150 m	43	4	12	9	0	68
200 m	60	0	16	6	1	83
Total	**141**	**7**	**48**	**19**	**5**	**220**

Most of the participants (141 out the 220) representing 64.1% of the people interviewed did not consider the noise as a nuisance regardless of their distance from the source of noise. Forty-eight participants representing (21.8%) of the sample stated that the noise disturbs sleep whilst nineteen participants (8.6%) stated that the noise interferes with concentration. Also 3.2% of the participants stated that the noise causes irritation whilst 2.3% gave other reasons such as increases heart beat and causes headache as presented in Table 11.

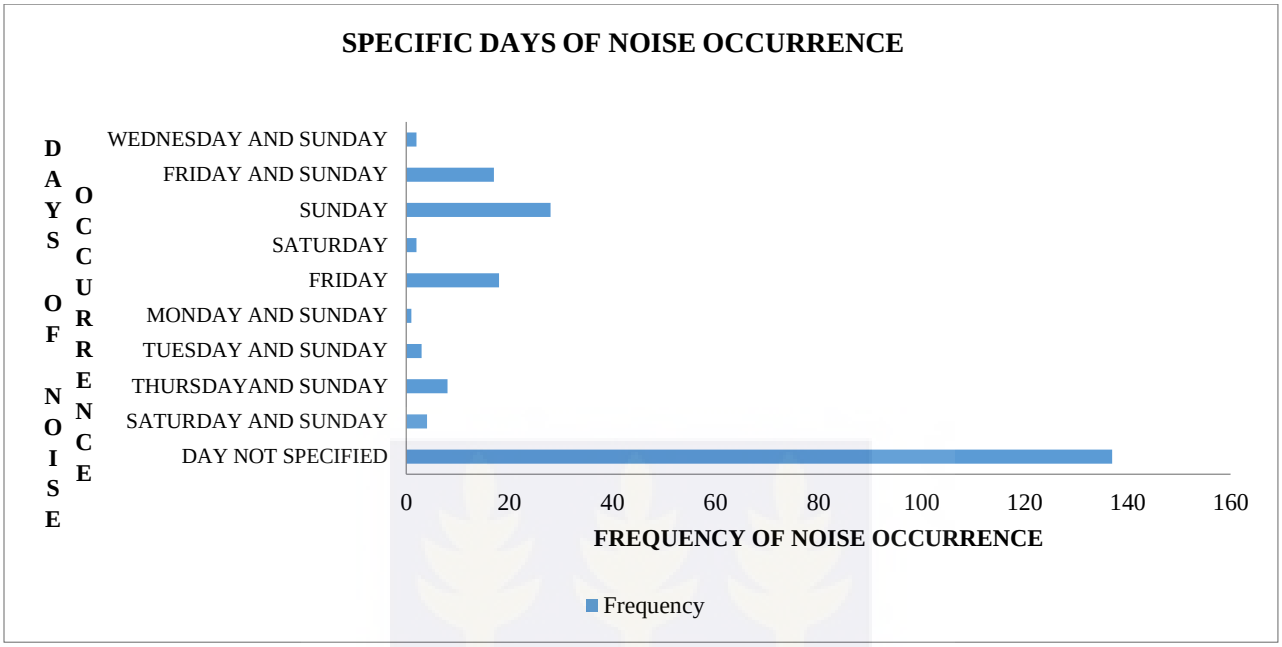
Figure 4.9: Knowledge of days of noise occurrence



Source: Generated by the researcher through fieldwork (2013).

Figure 4.9 shows that ten percent (10%) of the participants stated that the noise occurred during the weekdays whilst twenty percent (20%) stated the noise occurred during the weekend with Sunday recording the highest value. Seventy percent (70%) stated the noise occurred at both weekdays and weekends. This could be due to the fact that most of the religions, especially, the Christian religion has activities throughout the week.

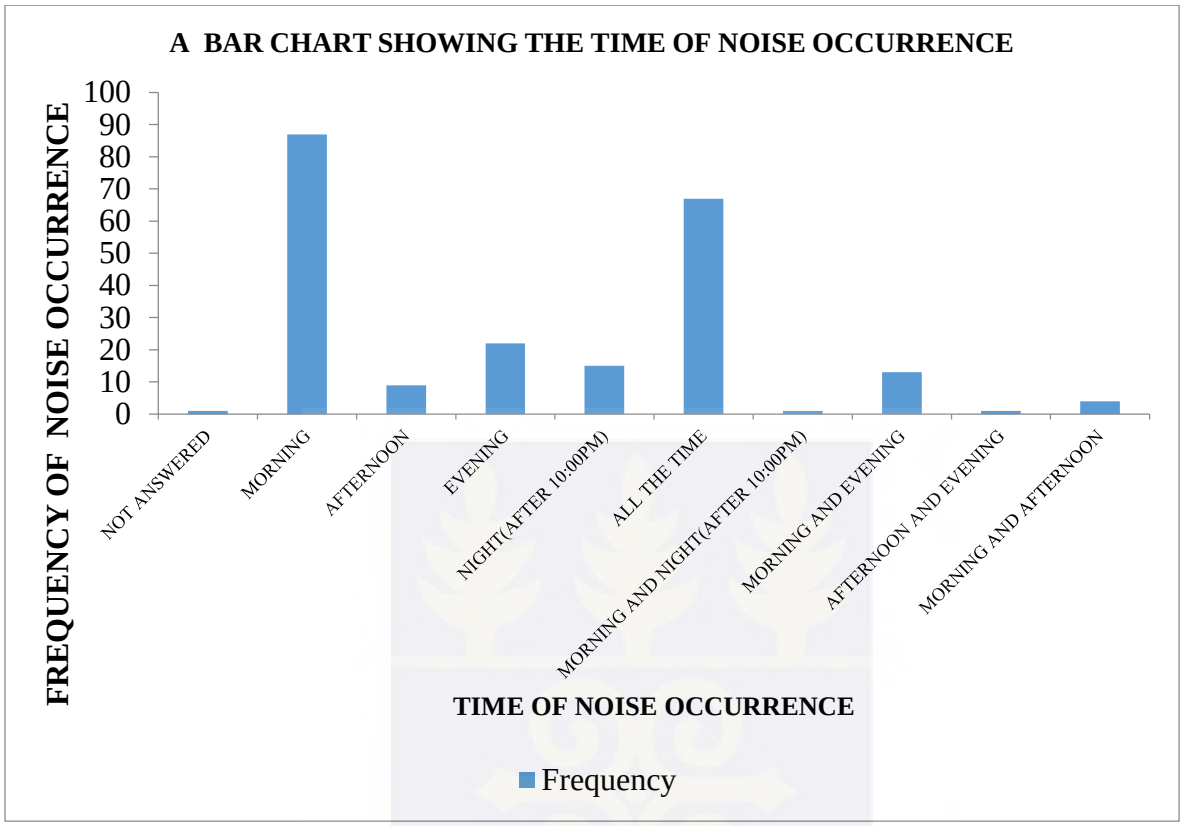
Figure 4.10: Specific days of noise occurrence



Source: Generated by the researcher through fieldwork (2013).

The specific days of noise occurrence as presented in Figure 4.10 indicates that Sunday recorded the highest value of 12.7% followed by Friday with a value of 8.2%. Less than one percent (0.5%) of the participants selected both Monday and Sunday as the day noise occurs and was the lowest value recorded. This is due to the fact that, most of the religious activities occur on Sundays and on Fridays (all nights) especially for the Christians and Friday prayers for the Muslims. However, 62.3% of the respondents did not specify exactly the day the noise occurred.

Figure 4.11: Time of noise occurrence



Source: Generated by the researcher through fieldwork (2013).

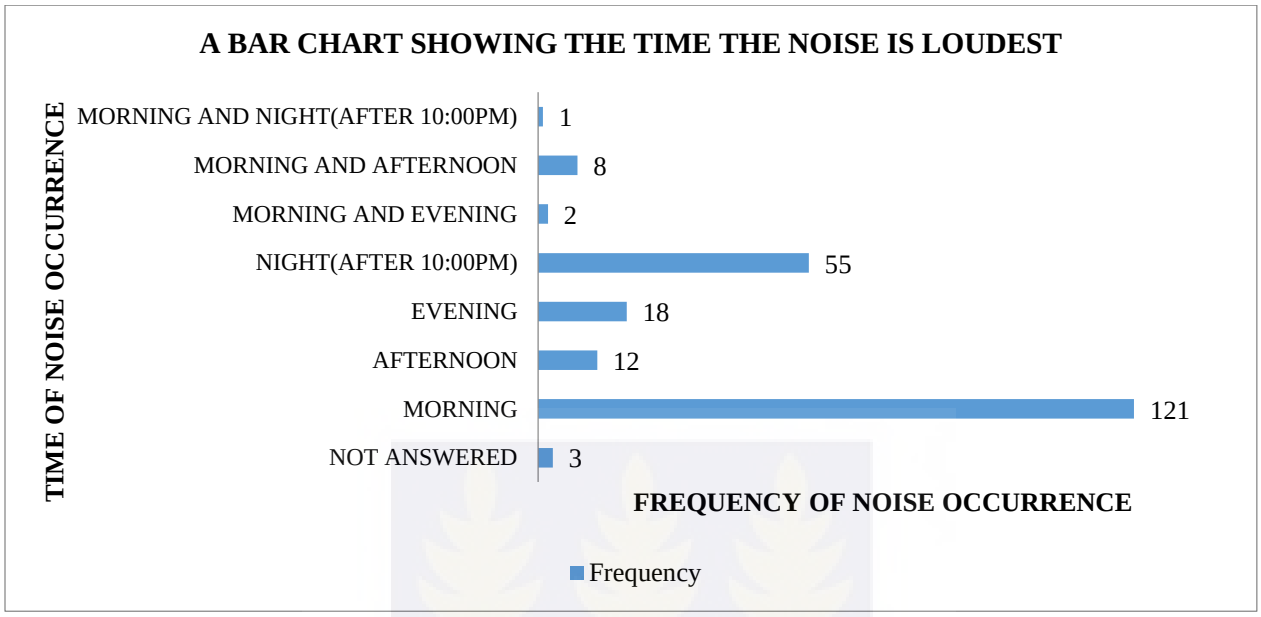
In Figure 4.11, thirty-nine percent (39%) of the participants stated that morning was the time of the day that the noise occurred and 30.5% stated that the noise occurred all the time. Ten percent (10%) of the participants stated evening whilst 6.8% mentioned night (that is, after 10:00 PM) as the time the noise occurred which also indicates the time most all night services took place. Almost six percent (5.9%) of the participants stated that the noise occurred both in the morning and evening whilst 4.1% thought it occurred only in the afternoon. Less than one percent (0.5%) stated that the noise occurred at both morning and night (after 10:00PM) and 0.5% also stated that it occurred during both the afternoon and evening. However, 0.5% of participants did not answer the question.

Table 12: Days noise is loudest

DAYS	FREQUENCY	PERCENT
WEEKDAYS ONLY	56	25.5
WEEKENDS ONLY	62	28.2
BOTH WEEKDAYS AND WEEKENDS	97	44.0
DID NOT ANSWER	5	2.3
TOTAL	**220**	**100**

Both weekdays and weekends recorded the highest noise of 44.1% as indicated in Table 12. This could be due to the fact that most churches and mosques have religious activities throughout the week. For instance the five daily mosque calls for the Muslims and the different rehearsals, Prayer meetings, Bible studies, Youth, Men, and Women meetings for the Christians. Weekends only recorded a value of 28.2% and Weekdays only with the least value of 25.5%. Less than three percent (2.3%) did not answer the question.

Figure 4.12: Time noise is loudest



Source: Generated by the researcher through fieldwork (2013).

Figure 4.12 shows the time religious noise is loudest. Morning recorded the highest value of 55%. This was so because church services which attract large congregations took place in the mornings of Sundays hence the loudest noise. It was followed by Night (after 10:00PM) which recorded a value of 25%. This could be as a result of the periodic all night services which occur mostly at night coupled with the dawn mosque calls. Both Morning and Night (after 10:00PM) however recorded the lowest value of 0.5% each.

Table 13: Community perception of noise

NAME OF COMMUNITY	NOISE AS A NUISANCE		TOTAL
	YES	NO	
TABOO LINE	5	10	15
MARKET SQUARE	13	16	29
TAIFA	11	15	26
NEW TOWN	8	12	20
CHRISTIAN VILLAGE	12	18	30
ZONGO LAKA	8	22	30
ROMAN DOWN	7	14	21
NIGHT MARKET	7	23	30
JERICHO	8	11	19
TOTAL	**79**	**141**	**220**

Table 13 shows that there was no significant difference between the perceptions of participants in the planned areas and those in the unplanned areas about the noise. In all the nine (9) communities, most of the participants (64.1%) stated that they did not consider the noise as a nuisance. This could be attributed to the fact that most participants are very sensitive to religious issues and may not want to incur the wrath of God.

Table 14: Levels of noise annoyance

LEVEL OF ANNOYANCE	FREQUENCY	PERCENT
NOT ANSWERED	1	0.5
NOT AT ALL ANNOYED	116	52.7
SLIGHTLY ANNOYED	40	18.2
MODERATELY ANNOYED	30	13.6
VERY ANNOYED	20	9.1
EXTREMELY ANNOYED	13	5.9
TOTAL	**220**	**100**

Majority of participants (52.7%) were 'not at all annoyed' this was followed by those 'slightly annoyed' (18.2%),'moderately annoyed'(13.6%), 'very annoyed'(9.1%) and 'extremely annoyed'(5.9%). Less than one percent (0.5%) did not answer the question as presented in Table 14.

Table 15: Community level of annoyance

NAME OF COMMUNITY	LEVEL OF ANNOYANCE					TOTAL
	NOT AT ALL ANNOYED	SLIGHTLY ANNOYED	MODERATELY ANNOYED	VERY ANNOYED	EXTREMELY ANNOYED	
TABOO LINE	7	2	4	4	0	17
MARKET SQUARE	14	5	4	3	3	29
TAIFA	12	3	6	3	2	26
NEW TOWN	13	3	3	0	1	20
CHRISTIAN VILLAGE	14	5	7	1	2	30
ZONGO LAKA	19	4	2	4	1	30
ROMAN DOWN	14	2	1	0	2	19
NIGHT MARKET	17	8	1	4	0	30
JERICHO	6	8	2	1	2	19
TOTAL	**116**	**40**	**30**	**20**	**13**	**220**

Most participants were 'not at all annoyed' by the noise in all the communities as presented in Table 15. This could be due to the fact that the participants were used to the noise and so did not find anything wrong with the noise.

Table 16: Levels of noise annoyance in relation to the distances away from the noise sources

LEVEL OF ANNOYANCE	DISTANCE FROM NOISE SOURCE				TOTAL
	50 m	100 m	150 m	200 m	
NOT ANSWERED	0	0	1	0	1
NOT AT ALL ANNOYED	15	17	34	50	116
SLIGHTLY ANNOYED	0	9	13	18	40
MODERATELY ANNOYED	0	5	14	11	30
VERY ANNOYED	3	8	6	3	20
EXTREMELY ANNOYED	5	7	0	1	13
TOTAL	**23**	**46**	**68**	**83**	**220**

Table 16 indicates that most of the participants (52.7%) were 'not at all annoyed' with the noise at all the distances away from the noise sources whilst 18.2% of them were 'slightly annoyed'. Thirteen point six percent (13.6%) were 'moderately annoyed' and 9.1% were 'very annoyed'. Only 13 (5.9%) of them were 'extremely annoyed'. Out of this number, seven participants were within the 100 m radius away from the noise source, five participants were within the 50 m radius and surprisingly, one person was within the 200 m radius. Most of the participants who were 'not at all annoyed' were in the 200 m distance away from the noise source. This could be

attributed to the fact that, the noise at that distance would not be as loud as the noise recorded within the distances of 50 m and 100 m.

Table 17: Levels of noise annoyance in relation to educational background

LEVEL OF ANNOYANCE	EDUCATION OF RESPONDENT					TOTAL
	PRIMARY	JUNIOR HIGH	SENIOR HIGH/TECHNICAL	TERTIARY	NONE	
NOT ANSWERED	0	0	0	1	0	1
NOT AT ALL ANNOYED	15	44	22	11	24	116
SLIGHTLY ANNOYED	8	12	7	7	6	40
MODERATELY ANNOYED	5	8	7	3	7	30
VERY ANNOYED	6	9	2	2	1	20
EXTREMELY ANNOYED	1	3	6	2	1	13
TOTAL	**35**	**76**	**44**	**26**	**39**	**220**

Most participants with Junior High education formed the majority of those 'not all annoyed', 'slightly annoyed', 'moderately annoyed' and 'very annoyed' except for those 'extremely annoyed' who had Senior High/Technical as presented Table 17.

Table 18: Participants knowledge of impacts of noise on human beings

LEVEL OF EDUCATION	KNOWLEDGE OF IMPACT OF NOISE		TOTAL
	YES	NO	
PRIMARY	13	35	35
JUNIOR HIGH	33	76	76
SENIOR HIGH/TECHNICAL	27	44	44
TERTIARY	20	26	26
NONE	19	39	39
TOTAL	**112**	**220**	**220**

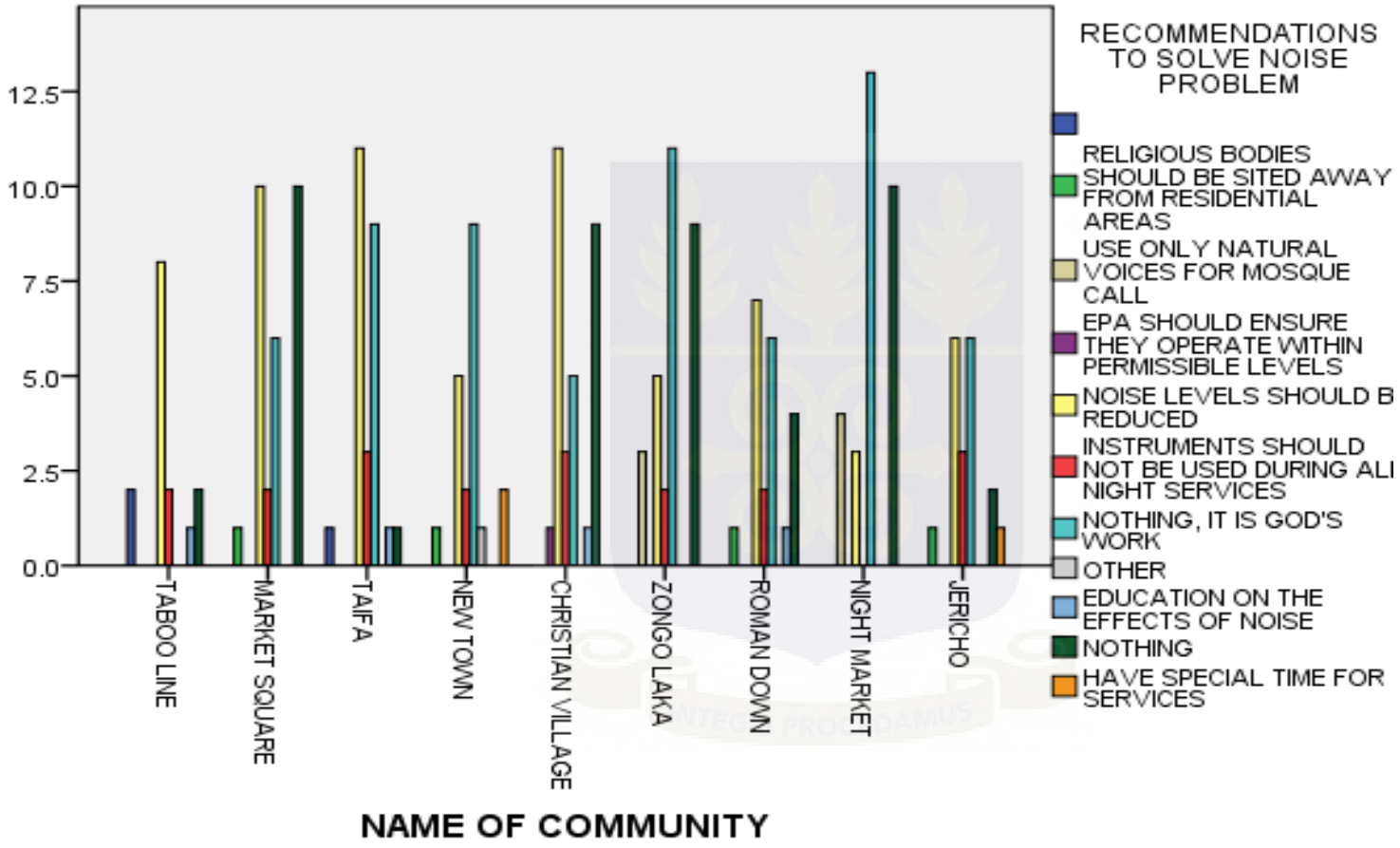
In Table 18, twenty (20) out of 26 participants with tertiary education representing 77% were aware of the impacts of noise on human beings whilst 27 out of 44 participants with S.H.S/Technical education representing 61.4% were aware of the impacts of noise. Forty-four percent (44%) of the J.H.S participants were aware of the impacts of noise on human beings and only 38% of the participants with primary education had knowledge of the impacts of noise on human beings. This shows that as the level of education increased the knowledge of the impacts of noise also increased. However, 51% of the participants with no level of education were also aware of the impacts of noise on the human beings. This could be attributed to the fact that most of the people with no level of formal education were the aged and were mostly found at home and so felt the effects of the noise most.

Table 19: Participants' recommendations on resolving noise problem based on distance from noise source

RECOMMENDATIONS TO SOLVE NOISE PROBLEM	DISTANCE FROM NOISE SOURCE				
	50 m	100 m	150 m	200 m	TOTAL
DID NOT ANSWER THE QUESTION	1	0	1	1	3
RELIGIOUS BODIES SHOULD BE SITED AWAY FROM RESIDENTIAL AREAS	0	0	2	2	4
USE ONLY NATURAL VOICES FOR MOSQUE CALL	1	4	2	0	7
EPA SHOULD ENSURE THEY OPERATE WITHIN PERMISSIBLE LEVELS	0	1	0	0	1
NOISE LEVELS SHOULD BE REDUCED	5	20	22	19	66
INSTRUMENTS SHOULD NOT BE USED DURING ALL NIGHT SERVICES	5	5	7	2	19
NOTHING, IT IS GOD'S WORK	7	10	23	25	65
EDUCATION ON THE EFFECTS OF NOISE	0	2	1	1	4
NOTHING	3	2	10	32	47
HAVE SPECIAL TIME FOR SERVICES	1	1	0	1	3
OTHER	0	1	0	0	1
TOTAL	**23**	**46**	**68**	**83**	**220**

Regardless of the distance away from the noise source, 30% of participants stated that the noise levels should be reduced. Almost thirty percent (29.5%) stated that nothing should be done about it since the noise occurs due to worship rendered to God. Twenty-one point four percent (21.4%) stated that nothing should be done with no particular reason. Nearly nine percent (8.6%) advocated for none use of instruments during all night services and 3.2% also advocated for muezzins to use only natural voices for mosque calls. Almost two percent (1.8%) stated that people should be educated on the effects of noise and another 1.8% stated that religious bodies should be sited far away from residential areas. A few (1.4%) did not answer the question but another 1.4% stated that there should be special times for services and not all the time. Less than one percent (0.5%) stated that EPA should ensure they operate within permissible levels and another 0.5% shared other opinions other than the ones stated in Table 19.

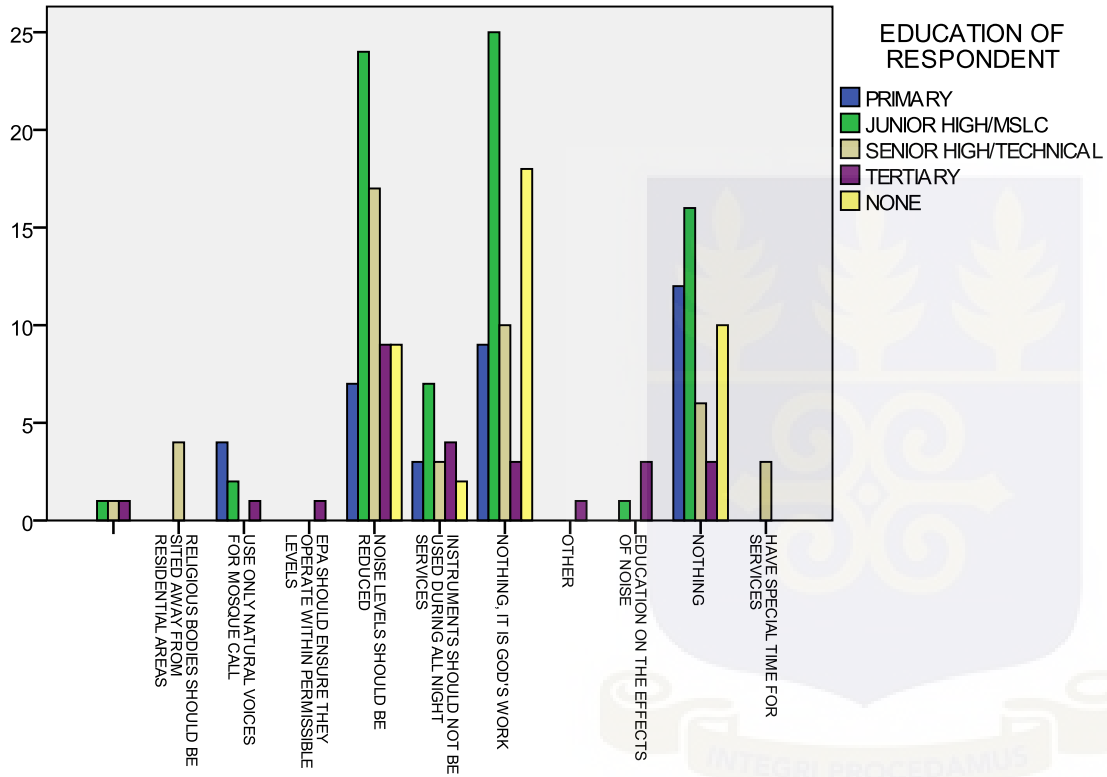
Figure 4.13: Community-based recommendations on resolving noise problem



Source: Generated by the researcher through fieldwork (2013).

Figure 4.13 shows that most communities, except Night Market, stated that the noise levels should be reduced. Most of the participants at Night Market stated that nothing should be done about the noise since it is a form of worship to God.

Figure 4.14: Participants' recommendations based on distance from noise source



Source: Generated by the researcher through fieldwork (2013).

Figure 4.14 presents participants recommendations on how to solve the religious noise problem based on their levels of education.

4.4: Relevant actions taken to solve the noise problem

Table 20: Intended action on noise problem

INTENDED ACTION ON NOISE	FREQUENCY	PERCENT
NOTHING	208	94.5
REPORTED TO RELEVANT BODIES	7	3.2
COMPLAINED AMONG THEMSELVES	5	2.3
TOTAL	**220**	**100**

Majority of the participants (94.5%) had done nothing nor intended to do anything about the noise as shown in Table 20. Less than four percent (3.2%) had reported to a relevant body like the Environmental Protection Agency (EPA) and some had reported to the Municipal Assembly. However, 2.3% had complained among themselves.

Table 21: Neighbourhood intended action on noise problem

INTENTION OF NEIGHBOURHOOD	FREQUENCY	PERCENT
NOTHING	208	94.5
REPORTED TO RELEVANT BODIES	4	1.8
ORGANISED MEETINGS	1	0.5
COMPLAINED AMONG THEMSELVES	4	1.8
PLEADED WITH CHURCH LEADERS TO REDUCE NOISE	3	1.4
TOTAL	**220**	**100**

In Table 21, most neighbourhoods (94.5%) did not intend to do anything about the noise. However, some had organised meetings to find ways to solve the noise nuisance. And some had actually gone ahead to plead with church leaders to reduce noise levels. Others had reported to a relevant body and some had complained among themselves.

Table 22: Community-based intended action on noise problem

NAME OF COMMUNITY	INTENTION OF NEIGHBOURHOOD ABOUT NOISE					TOTAL
	NOTHING	REPORTED TO RELEVANT BODIES	ORGANISED MEETINGS	COMPLAINED AMONG THEMSELVES	PLEADED WITH CHURCH LEADERS TO REDUCE NOISE	
TABOO LINE	14	0	0	0	1	15
MARKET SQUARE	27	0	0	2	0	29
TAIFA	26	0	0	0	0	26
NEW TOWN	18	1	0	0	1	20
CHRISTIAN VILLAGE	27	2	0	1	0	30
ZONGO LAKA	29	0	1	0	0	30
ROMAN DOWN	19	0	0	1	1	21
NIGHT MARKET	30	0	0	0	0	30
JERICHO	18	1	0	0	0	19
TOTAL	**208**	**4**	**1**	**4**	**3**	**220**

Christian Village and New Town were within the Very High exposure class based on the noise maps generated for both day and night noise levels. However, 90% of the participants who answered this question at Christian Village had done nothing nor intended to do anything about the noise. Two people had however, intended to report to a relevant body and one person had complained to her neighbours. At New Town, 90% of participants had not done anything about the noise. Only one person had pleaded with church leaders to reduce the noise and one person had intentions of reporting to a relevant body as shown in Table 22.

Table 23: Outcome of noise complaint

OUTCOME OF COMPLAINT	**FREQUENCY**	**PERCENT**
NOTHING	219	99.5
WARNED THEM	1	0.5
TOTAL	**220**	**100**

Nothing (99.5%) was done about the noise complaints. However, one complaint (0.5%) was attended to and the church was warned to reduce the noise as shown in Table 23.

Table 24: Community-based noise annoyance levels

NAME OF COMMUNITY	LEVEL OF ANNOYANCE					TOTAL
	NOT AT ALL ANNOYED	SLIGHTLY ANNOYED	MODERATELY ANNOYED	VERY ANNOYED	EXTREMELY ANNOYED	
TABOO LINE	7	2	4	4	0	17
MARKET SQUARE	14	5	4	3	3	29
TAIFA	12	3	6	3	2	26
NEW TOWN	13	3	3	0	1	20
CHRISTIAN VILLAGE	15	5	7	1	2	30
ZONGO LAKA	19	4	2	4	1	30
ROMAN DOWN	14	2	1	0	2	19
NIGHT MARKET	17	8	1	4	0	30
JERICHO	6	8	2	1	2	19
TOTAL	**117**	**40**	**30**	**20**	**13**	**220**

Table 24 shows the levels of annoyance of participants in each of the communities. Most participants were 'not at all annoyed' by the religious noise in all the communities.

CHAPTER FIVE

DISCUSSION

5.1: Levels of religious noise produced in the communities

Religious noise levels from the churches and mosques were measured for both the day time (0600 - 2200h) and the night time (2200 - 0600h) with a sound level meter. The levels of religious noise measured in all the communities exceeded the Ghana EPA permissible noise levels of 55dB (A) and 48dB(A) for day and night time respectively. Implying that residents in these selected communities were generally exposed to high religious noise levels during both day and night times. The high noise levels could be attributed to the fact that experimentation and technological advancements have led to the manufacture of sophisticated musical instruments. The subsequent use of these instruments such as the microphones and loudspeakers as shown in Figure 4.5 have contributed in making church services and mosques calls very noisy as compared to centuries ago. Not only that, modern music is far louder than that of the old because of the kind of instruments used nowadays. For example, the hip life of today is a lot louder than the soft and cool Highlife in the Ghanaian society. Even the Gospel music of today is louder than those of old.

The younger generations born in this noisy era find nothing wrong with noisy environments. Most of them consider the relatively quiet services from some churches as dull and the loud and vibrant services from other churches as lively. In order to create the ambiance desired by the younger generations who in fact form a majority of the congregation, some churches spend huge sums of money in acquiring sound systems for church services. The churches with the so called

boring services have also formed new music groups within the churches. This is probably to account for the loud and vibrant element which has become very important as far as evangelising to the younger generation is concerned. All these have contributed to high religious noise which usually far exceeds the EPA permissible noise levels.

The high religious noise levels recorded in this study confirms why religious noise alone constituted 64% out of the total of 71% noise complaints received by the EPA at Tema in 2011. It also supports the study conducted by Armah *et al*., (2010) in which 77% of the churches and mosques sampled produced noise above the permissible levels of the Ghana. These high religious noise levels however, defy the World Health Organisation recommendation of a noise level of less than 35 dB (A) based on the continuous equal energy concept for the restorative process of sleep (Mufuruki 1997; Oyedepo and Saadu 2009).The implications of these high religious noise levels are the auditory effects of noise such as the loss of hearing. And the non-auditory effects such as a lack of adequate sleep which leads to discomfort and irritation, which in the long term will drastically reduce productivity in both the public and private sectors as indicated by Oyedepo and Saadu 2009.

5.2: Noise maps and exposure zones in residential neighbourhoods of the Ashaiman Municipality.

According to Pinto and Mardones (2009), a noise map is a tool that delivers visual information of the acoustic behaviour of a geographic area either in a specified moment or in a statistical base. They are considered as tools to improve or to preserve the quality of the environment

regarding noise pollution. In this work all the data collected at the twenty-nine places of worship were used to develop a noise map for the Ashaiman Municipality. Noise maps based on day time noise levels and night time noise levels were developed. Surface interpolation was carried out using the Kriging technique of interpolation as opposed to the Inverse Distance Weighting (IDW) employed by Armah *et al*., (2010). The Kriging technique specifically shows the local situations of the noise level exposure. This makes it easy for prioritisation of targeted interventions to solve the problem of religious noise pollution. The IDW technique on the other hand only shows a generalised phenomenon without showing the various local differences.

Christian Village, Roman Down and New Town were the planned areas sampled at Ashaiman. It was therefore interesting that Christian Village and New Town were seen in the day time noise map as the areas within the Extremely High noise exposure zone, also indicating that these communities were more prone to religious noise. This however could be attributed to the fact that the churches found in these areas were huge in structure and thus attracted larger congregations. These large congregations clapped their hands while they sang joyfully and loudly during services. Not only that, more sophisticated instruments were used in these churches. Another reason for this was that, some were also not completed and this allowed a lot more sound to escape into the neighbourhood as there were neither windows nor doors to serve as sound-proof. Hence, non-adherent users of these churches were disturbed. It is thus not surprising that 60% of the participants at Christian Village stated that they considered it as a nuisance. In contrast to this however, most participants in these communities were 'not at all annoyed' with the noise. This is probably so because they did not want to incur the wrath of God

nor be regarded as people against God's work. Thus, they would rather consider it as a nuisance but be 'not at all annoyed' with it.

The fact that Christian Village and New Town were in the Extremely High noise exposure zone indicates that residents in these two communities were more exposed to high levels of religious noise than those in the other classes of noise exposure zones stated below.

A major part of Night Market and a small portion of Market Square were within the High noise exposure zone. This zone contained lower noise levels as compared to the noise levels of the Extremely High noise exposure zone. As would be expected, most participants (76.7%) at Night Market did not consider the noise as a nuisance and 56.7% were 'not at all annoyed'. This could be attributed to the fact that most of the participants there were muslims and so considered the noise from muezzins rather useful. It is also possible that since the duration of noise exposure for the mosque calls were very short, residents in this community could accommodate it regardless of how loud it was. The views at Market Square were not different. These views were in line with the fact that these two neighbourhoods were in the Moderately High noise exposure zone.

For the night time noise exposure map, most of these communities still fell within the same exposure zones. This was so because the noise levels were neither reduced nor increased. Christian Village and New Town which were within the Extremely High noise exposure zone for day time were now within the Very High noise exposure zone. This was so because the noise levels produced during the night time were lower than those produced during the day time. And this was so because the volume of instruments used was reduced a little. Taifa and a small

portion of Market Square which were part of the High noise exposure zone for day time were however within the Very High exposure zone and this was due to the fact that volumes of instruments coupled with loud singing and clapping during all night services increased the noise levels produced.

It is worth stating that the selected residential areas have high population densities and as such the religious noise affected a large number of people who may belong to different socio-economic classes. This means that the exposure to religious noise could have differential impacts on the economy of Ashaiman and Ghana as a whole, depending on the proportion of residents within the different social classes.

5.3: General Perception of participants about noise

5.3.1: Noise as a nuisance and level of annoyance of participants

To ascertain the perceptions of participants regarding the noise levels, participants were asked if they considered the noise as a nuisance or not. Their levels of annoyance were also rated using a Five-point Likert scale.

Most of the participants (64.1%) regardless of the community in which they lived were of the view that religious noise was not a nuisance as against 35.9% who stated that it was a nuisance. These opinions were so strong that most participants regardless of their level of formal education did not perceive the noise as a nuisance. These perceptions confirm the research of Sackey (2006) that Africans and particularly Ghanaians are noisy. The reason is that noise marks all the

rites of life. Naming ceremonies, puberty rites, marriages and death are all characterised by noise. It is therefore not amazing that most Ghanaians do not regard religious noise as a nuisance because they are so used to noise. Aside the fact that Ghanaians are noisy, they are also notoriously religious to the extent that religion supersedes everything including the laws of Ghana. Most religious bodies are resistant to by-laws on noise because they perceive them as restrictions to their way of worship and a hindrance to their right to freedom of worship. The story is told of a church and a midwifery which shared the same building, the church on the third floor and the clinic on the second floor. The clinic wanted to ensure peace for its labouring pregnant women and so sought a court injunction to be placed on the church to stop the noise. The police seized the church's musical instruments. The church however bought a new set of musical instruments the next day in non-compliance of this sanction. This shows how some Christians do not respect the laws of the country nor practice what they preach. They are inconsiderate of their neighbours whom the Holy Bible enjoins them to love as themselves. It is interesting to note that whilst they do not obey some laws of the country, they are usually quick to defend themselves by quoting Article Twenty-six (26) Section one (1) of the 1992 Constitution which states that every person is entitled to enjoy, practice, profess, maintain and promote any culture, language, tradition or religion subject to the provisions of this Constitution. It is therefore not surprising that most of the participants stated that the religious noise was not a nuisance.

Also, based on the Five-point Likert scale, most of the participants (52.7%) made up of people of both gender were 'not at all annoyed' at all the distances away from the noise sources whilst only 5.9% were 'extremely annoyed'. The different levels of annoyance of participants to the same

noise confirm the researches of Pinto and Mardones, 2009; Tsai *et al*., 2009 and Berglund *et al*., (2000) which state that the level of annoyance reactions are sensitive to many non-acoustic factors of a social, psychological or economic nature and that there are also considerable differences in individual reactions to the same noise. It also implies that noise is a subjective thing and different people react to it in different ways. Such that, the noise that causes extreme annoyance to one person may hardly be noticed by another as a research by Department of the Environment of Northern Ireland (2010) confirms. Miedema and Vos (1998) in their research found that annoyance is not related to gender and this supports the findings of this study which found no differences between the perceptions of men and women regarding noise annoyance.

5.4: Intention of neighbourhood about noise and recommendations

Christian Village and New Town were the Extremely High noise exposure zones and Very High exposure zones based on the noise maps for both day and night noise levels respectively. However, 90% of the participants who answered this question had done nothing nor intended to do anything about the noise. Two people had intended to report to a relevant body and one person had complained to her neighbours. At New Town, 90% of participants had done nothing about the noise. Only one person had pleaded with church leaders to reduce the noise and one person had intentions of reporting to a relevant body. Most of the participants did nothing or intended to do nothing because first of all, most of them did not think of religious noise as a nuisance. This is probably because they were a part of the noise or were simply used to the noise. Even those who considered the noise as a nuisance did nothing because they were concerned about how they would be judged. Normally such people are tagged as demons or cursed for complaining about religious noise. People's unwillingness to complain about religious noise for

fear of being labeled or cursed support the findings of Sackey (2006), which state that a Catholic priest who shared a wall with a Charismatic church complained to the pastor about the noise being produced from their all night services. He did this with the hope that the noise would be reduced but instead: the congregation cursed him and prayed that the priest be afflicted with epilepsy, madness and even death. This illustrates the kind of religious intolerance that exists between the various Christian denominations. It also shows how Christians choose the portions of the Holy Bible which suit them. That is, they make loud noise and often quote Psalm 100:1 which states: 'Make a joyful noise unto the Lord, all ye lands' but are not considerate of their neighbours even though the same scripture admonishes Christians to 'love your neighbour as you love yourself' (Mark 12:31).

Again Sackey's (2006) research reported that a church which rented one classroom for its services illegally broke the wall of a second classroom to make room for worshippers. When the head teacher confronted them they hurled insults at her, calling her a witch who was scared of God's presence in the school. This also shows the level of indiscipline of some Christians and how the laws of Ghana are broken by some Christians. These two examples explain why most residents had no intentions of reporting to the relevant bodies for redress. They preferred to suffer in silence than be cursed or labeled as witches or demons for complaining about religious noise.

Secondly, most people have lost faith in our State Institutions to protect the interest of the ordinary Ghanaians as indicated by Sackey (2006). The bureaucracy and corruptions have limited the willingness of the ordinary Ghanaian to report such issues especially when the other

party is a religious entity, corporate body or a rich man. Thus, just a few people would lodge formal complaints with the relevant bodies and hope that they obtain some redress.

On the participants' recommendations to solve the noise problem, most of the participants (50.9%) recommended that nothing should be done about the noise levels as they did not regard it as a problem. However, 30% of them recommended that the noise levels should be reduced during worship. This figure was lower than the 66.7% participants in the research of Armah *et al*., (2010) who stated that the noise should be reduced. The other suggestions are the non-use of instruments during all night services, muezzins using their natural voices to do the mosque calls without the help of microphones nor loudspeakers, educating people on the effects of noise, the siting of places of worship away from residential areas, having special times for services and not all the time and the EPA ensuring that religious bodies operate within the permissible levels.

The recommendations by most of the participants (50.9%) imply that they: were either unconcerned about the noise, were simply ignorant of the harmful effects of noise on individuals, were too used to the noise and so no longer perceived it as a problem or were involved in the noise making themselves. And this also means that they would resist the enforcement of any policy or by-law on noise due to one or two of the reasons stated above.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1: Summary

The objectives of this study were to assess the levels of religious noise in the Ashaiman Municipality, generate noise maps indicating exposure zones, and assess the perception of residents about the religious noise and to determine the relevant actions taken to reduce religious noise in the neighbourhoods within the high exposure zones.

The output of the analysis of data collected indicated that all the twenty-three churches and six mosques sampled produced noise levels far exceeding the EPA's guideline standard of 55dB(A) and 48dB(A) for day (0600 – 2200h) and night (2200 – 0600h) respectively. The noise maps generated also showed that most of the communities were exposed to high noise levels due to religious activities as most of them were within the Extremely High, Very High and High noise exposure zones. Just a few communities were within the Moderately High zone, but none of the communities was within the low noise exposure zone. Majority of the respondents (64.1%) did not regard the noise from churches and mosques as a nuisance, but 35.9% considered it as a nuisance, whereas 52.7% of participants were 'not at all annoyed', 5.9% were 'extremely annoyed'. It was also realised from the study that a significant number (94.5%) had done nothing about the noise. However, 1.8% had reported to relevant authorities, less than one percent (0.5%) had organised meetings to deliberate on what to do about the noise. Almost two percent (1.8%) had complained to them and 1.4% had pleaded with church leaders to reduce the noise.

6.2: Conclusion

All the twenty-three churches and six mosques sampled produced noise levels that far exceeded the permissible guideline levels. This could mean that religious leaders are unaware of the EPA permissible guidelines and so do not entreat their followers to observe these guidelines hence the use of loud and sophisticated instruments during religious activities. It also signifies that as far as religious activities are concerned, noise levels will exceed the permissible guidelines regardless of the form of worship.

The noise maps generated indicated that most of the communities were within the Extremely High, Very High and High noise exposure zones and none was within the Low noise exposure zone. This means that most of the participants were exposed to high noise levels due to religious activities which implies that, in the long term residents of these communities may suffer from hearing loss and other physiological effects induced by religious noise. This suggests that there is the need for the enforcement of the Ghana EPA permissible noise guidelines in the Ashaiman Municipality.

Majority of the participants did not regard the noise from the churches and mosques as a nuisance. A sign that most of the people were unaware of the harmful effects of noise on individuals or that they were simply too used to the noise and so did not consider religious noise as a problem that needed redress.

Based on the five-point Likert scale of annoyance, majority of the participants were 'not at all annoyed' by the religious noise and based on this reason most of the participants interviewed had

done nothing nor intended to do anything about the noise. This could mean that most participants were unaware of the harmful effects of high religious noise levels and so were neither bothered nor annoyed about it. Implying that as far as religious noise is concerned, a lot of education on the harmful effect of noise is needed to conscientise the exposed participants to take some action.

6.3: Recommendations

Based on the findings and results of this study the following are recommended:

Environmental Protection Agency (EPA)

Education is the key that unlocks many doors and so the most appropriate way to control religious noise. This agency should educate religious leaders on the negative effects of noise who will in turn also educate their followers. Public education on the harmful effects of religious noise on the individual and on the nation as a whole should be intensified. It can do this by educating more people through all the ten regional radio stations in Ghana. The education should be accompanied by the effective enforcement of regulations on religious noise in residential areas. It should make use of the National Noise Awareness Day celebration by involving the public in their activities and also make use of both the print and electronic media to educate the public. EPA should also collaborate with the National Commission on Civic Education (NCCE) to create awareness on the harmful effects and the health implications associated with noise pollution.

Ashaiman Municipal Assembly (ASHMA)

This assembly should also enforce its Bye-laws on noise without fear or favour and collaborate with EPA to create awareness on religious noise. The provisions and penalties of the by-law on noise from religious activities enumerated earlier are no longer deterrent. ASHMA should make efforts to revise its by-laws, make them relevant today and enforce them.

The Municipal Town and Country Planning Department

This department should enforce the land use plan in Ashaiman. It will be very difficult but it can be done in collaboration with the Ashaiman Municipal Assembly and other relevant stakeholders. In the long term, this department should ensure that places of worship are sited far away from residential neighbourhoods as the findings of the study showed that noise levels reduced with increasing distance from the noise sources.

The Government through the Ministry of Water, Works and Housing and other relevant bodies should ensure that places of worship are built with sound-proof materials such as acoustic tile ceilings and wall coverings and those already built be fitted with window drapes and carpets or linoleum to absorb the sound such that non-adherents are not disturbed by their activities. The government and all benevolent individuals and organistions should support these state institutions mentioned above with logistics so as to enable perform their duties effectively.

Noise maps should be generated for cities in Ghana to serve as a guide to inform citizens to avoid noise nuisances and also to observe the changing trends in environmental noise.

The media could focus more on social issues, which include excessive noise making than on politics and political issues as it pertains currently.

EPA together with the other relevant bodies responsible for controlling noise should make themselves known, as it was evident from the study that, some affected individuals did not know whom to seek redress from. EPA and the other relevant bodies should also ensure that they act swiftly on noise complaints as some of the participants who had lodged formal complaints had not seen any action taken to rectify the problem.

It is recommended that further studies be conducted to find out the perception of religious leaders regarding their knowledge:

- ✓ on the harmful effects of religious noise.
- ✓ on the EPA permissible guidelines on noise and the ASHMA by-laws on noise.

The successful use of GIS in this study implies that the technique can be used to solve other environmental problems of spatial nature.

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APPENDICES

APPENDIX I

SAMPLE QUESTIONNAIRE

Date / / 2013.

TOPIC: SPATIAL MAPPING OF NOISE EXPOSURE ZONES DERIVED FROM RELIGIOUS ACTIVITIES AND PERCEPTIONS IN RESIDENTIAL NEIGHBOURHOODS: THE CASE OF ASHAIMAN MUNICIPALITY, GHANA.

QUESTIONNAIRE FOR RESIDENTS IN ASHAIMAN

Dear respondent, this questionnaire is being administered as part of a preliminary study on religious noise in Ashaiman. I would be grateful if you could spend a few minutes to answer the following questions sincerely by ticking the correct option to the best of your knowledge.

Serial number……...

Name of community……..……..

Name of church/mosque …….

Approximate distance from church/mosque:

a) 50 m b) 100 m c) 150 m d) 200 m

PERSONAL INFORMATION

1. Are you head of the family? a) Yes b) No

2. Gender a) Male b) Female

3. Age: a) Less than 18 b) 18-60 c) Above 60

4. Education: a) Primary b) Junior High c) Senior High /Technical
d) Tertiary e) None

5. Number of people in household? a) Under five b) Five and above

6. Occupation a) Farming b) Trading c) Government worker

Other (specify) ……

7. How long have you lived in your current house?

a) Less than five years b) Five years and above

8. Do you own or rent?

a) Own b) Rent c) Other(specify)……..

9. Why did you choose to live here..?

a) Quiet b) Convenient c) Other (specify)…….

10. When was this church/mosque built?

a) Five years ago b) More than five years ago

11. Was the church/mosque here before you came to live here?

a) Yes b) No

B. NOISE RELATED INFORMATION

12. Which day does the noise occur?

a) Weekday (Specify)……. b) Weekend (Specify)……

c) Both weekdays and weekends (specify)……

13. What time does the noise occur?

a) Morning b) Afternoon c) Evening d) Night (after 10.00 PM) e) All the time

14. Which day is the noise loudest/highest?

a) Weekday (Specify)……. b) Weekend (Specify)…… c) Both

15. What time is the noise loudest/highest?

a) Morning b) Afternoon c) Evening d) Night (after 10.00PM)

16. Do you consider the noise from the church/mosque as a nuisance?

a) Yes b) No

If yes, answer question 17.

If no, answer question 18.

17. Why do you consider it as a nuisance?

a) It irritates me b) Disturbs my sleep c) Interferes with my concentration d) Other (specify)……..

18. Why do you not consider it as a nuisance?

a) It does not disturb me b) It helps me (specify) ……
c) Other (specify) …….

19. Which day is the noise most irritating?

a) Weekday (specify)…… b) Weekends (specify)….....
c) Both Weekdays and Weekends

20. What time is the noise most irritating?

a) Morning b) Afternoon c) Evening d) Night (after 10.00PM)

21. On a Likert scale of 1 – 5 (1= 'Not at all annoyed'; 5= 'Extremely annoyed'), rate your level of annoyance.

a) 5 = 'Extremely annoyed' b) 4 = 'Very annoyed' c) 3 = 'Moderately annoyed' d) 2 = 'Slightly annoyed' e) 1 = 'Not at all annoyed'

22. Do you know the impact of noise on the human being?

a) Yes b) No

23. If yes, name some …….

…….

24. What is the general feeling of your neighbours about the noise?

a) Are bothered b) Are not bothered c) Do not know d) Other (specify)……..

25. What have you done or intend to do about the noise?

a) Nothing b) Report to relevant body c) Other

26. What has the neighbourhood done or intends to do about the noise?

a) Nothing b) Report to relevant body c) Other

27. Do you know the agencies responsible for enforcing regulations on noise levels?

a) Yes b) No

28. If yes, have you or the neighbourhood complained to any of the agencies?

a) Yes b) No

29. If yes, has the agency acted on your complaint?

a) Yes b) No

30. If yes, what did the agency do and what was the outcome?

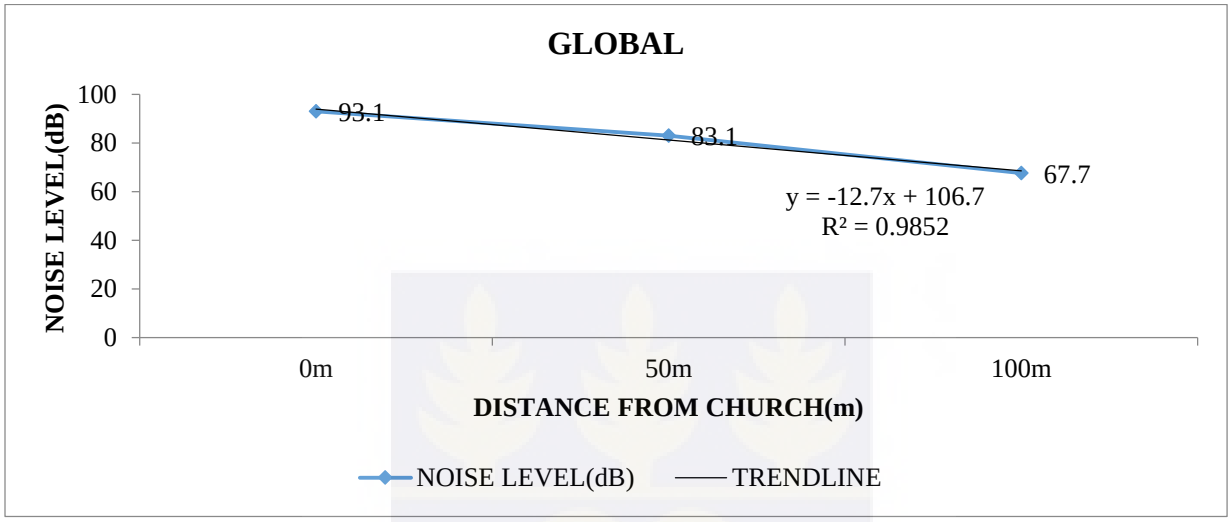
a) Measured the noise b) Warned them c) Other(specify)……..

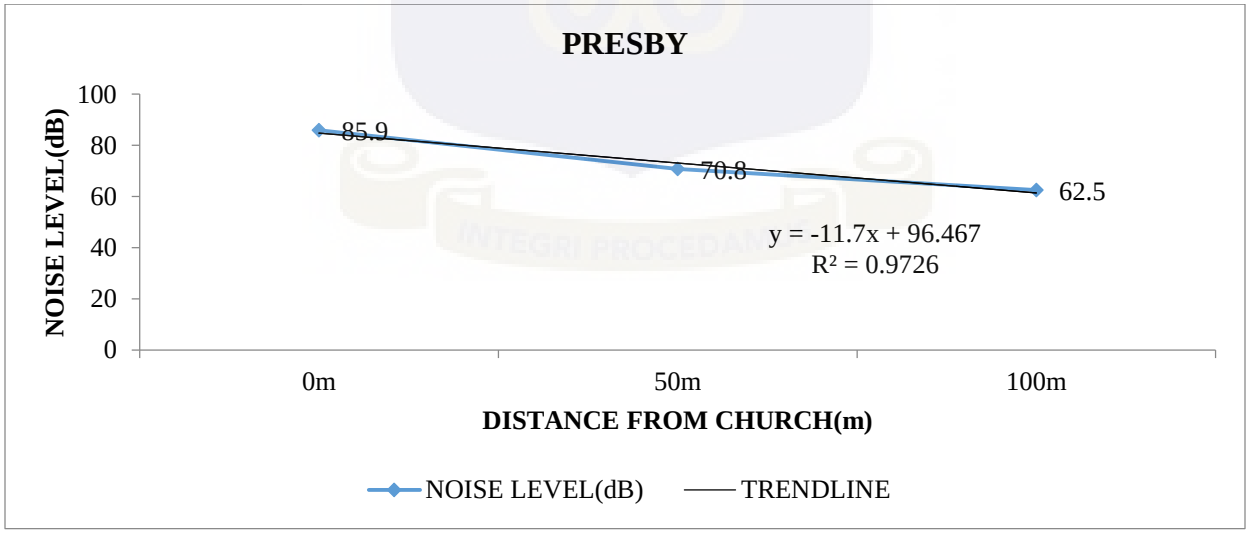
31. What would you recommend be done to solve/control this noise problem?

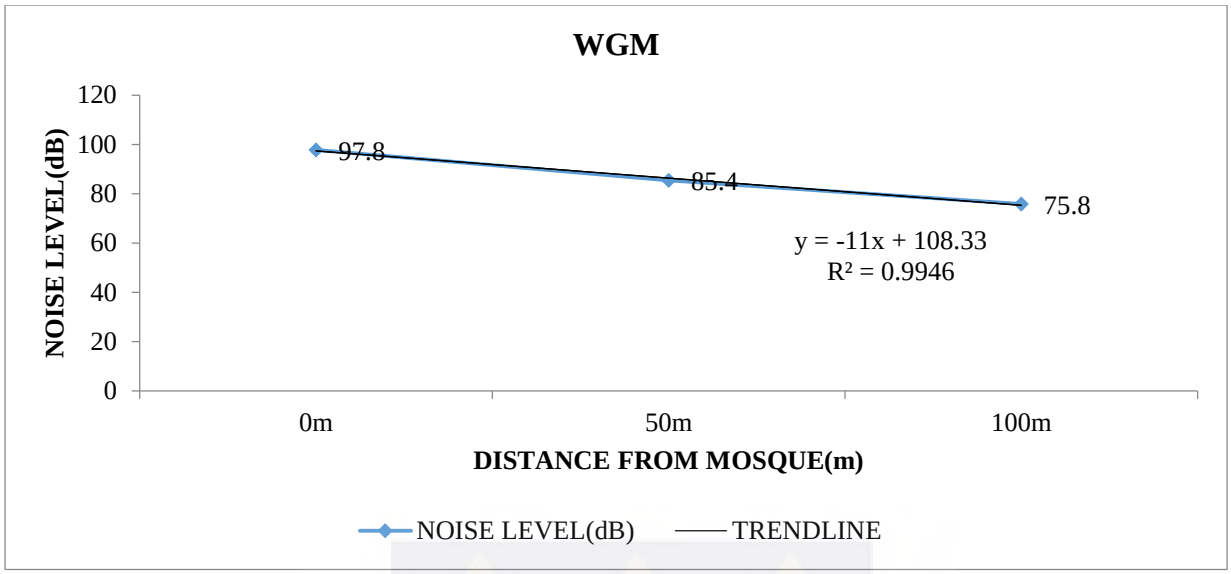
Specify……..

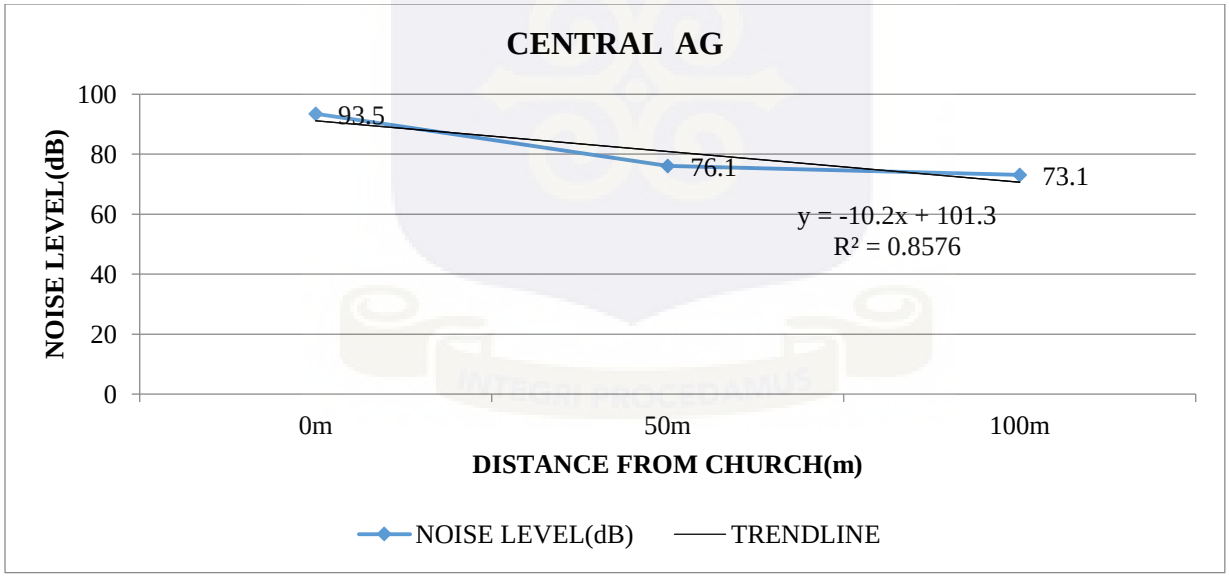
APPENDIX II

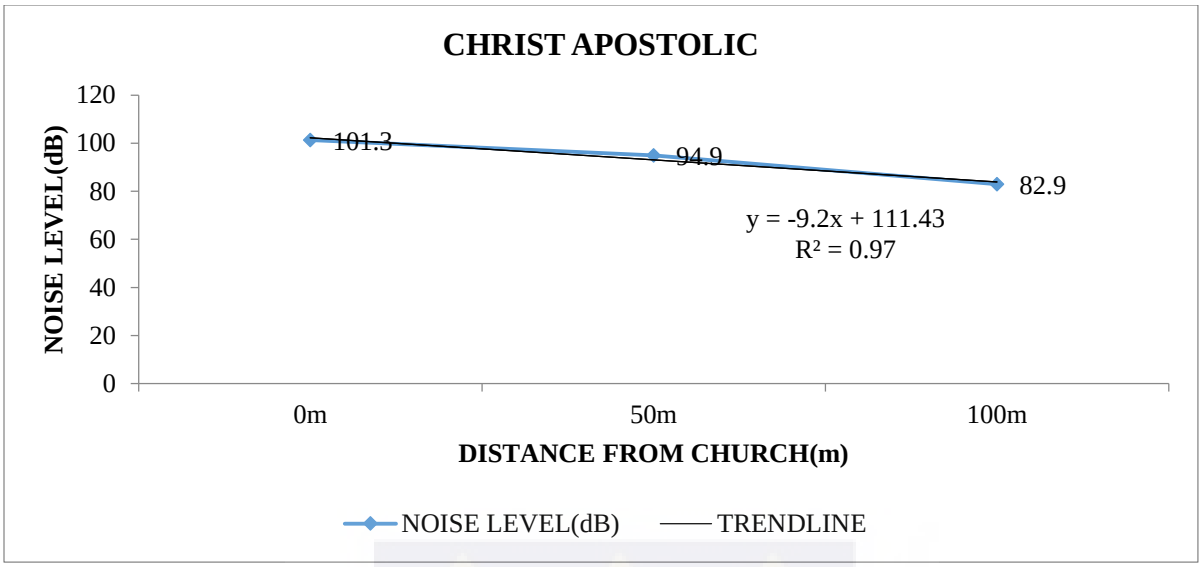
NOISE DISTANCE RELATIONSHIP

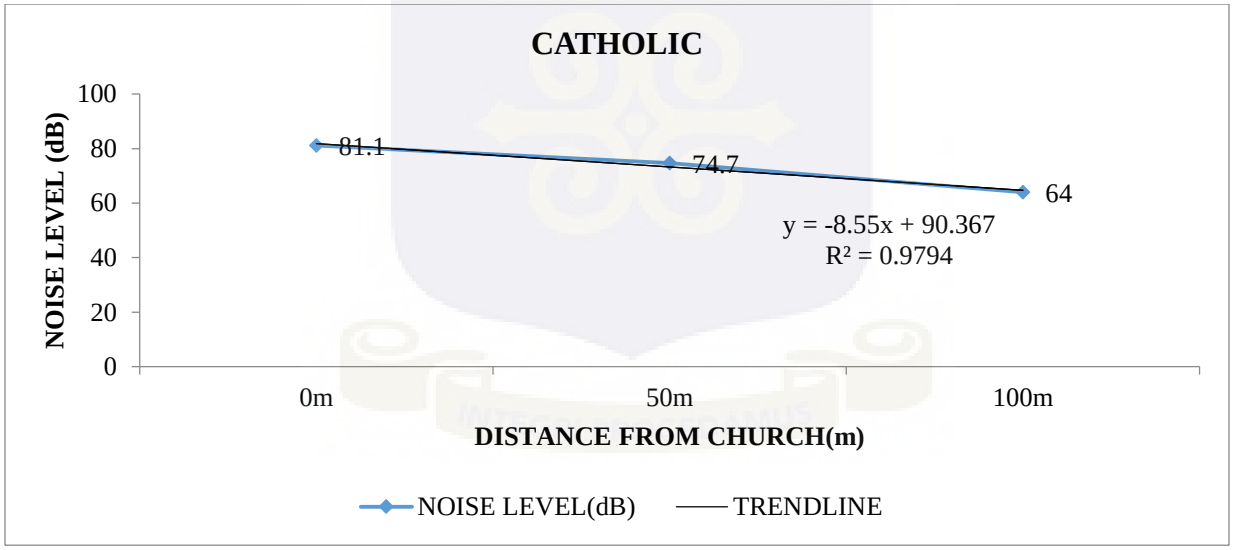


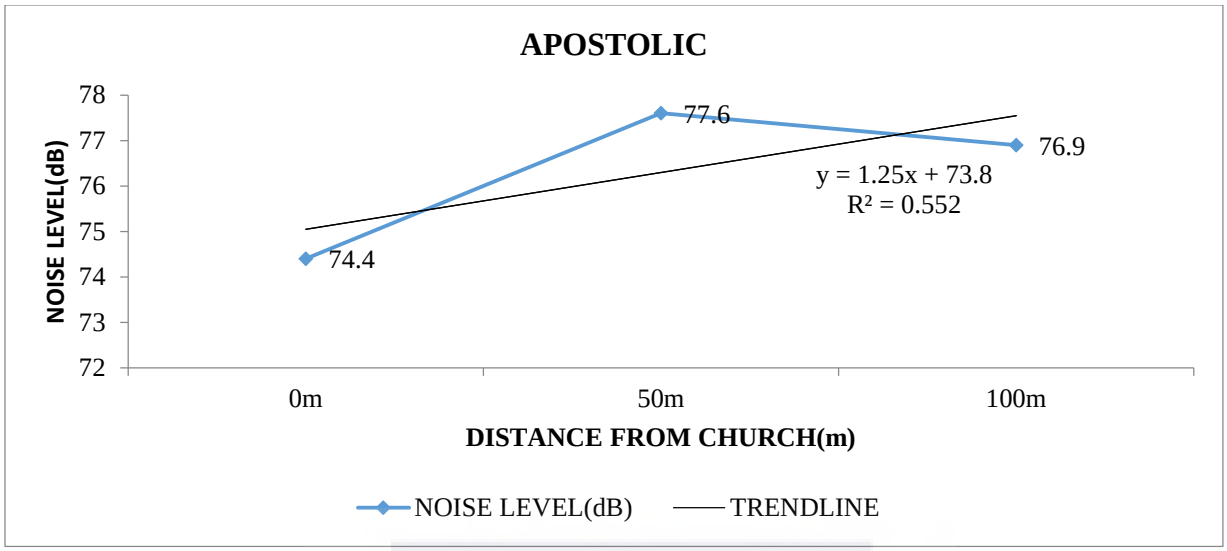












APPENDIX III

STANDARD DEVIATION

A. DAY TIME NOISE LEVELS AT THE NOISE SOURCES

CHURCH/MOSQUE	SOURCE (dB)
TABOOLINE	
Church of Jesus	94.7
Voice of the Lord Evangelical Church	89.8
Tribe of Judah Ministries International	91.6
MARKET SQUARE	
Apostolic church, Ghana	74.4
Musama Disco Christo Church	100.8
St. Peter Methodist Church	86.9
Grace Assembly (Assemblies of God)	66.2
TAIFA	
Central Assemblies of God	93.5
Green and Cream Mosque	90.6
Unique Chapel International	95.8
NEW TOWN	
Church of Pentecost	92.9
Global Evangelical Church	93.1
Liberty Centre Annex(Assemblies of God)	88.3
CHRISTIAN VILLAGE	

Presbyterian Church	85.9
Church of Pentecost	98.5
Christ Apostolic Church	96.2
Evangelistic Fire Ministries International	96.6
ZONGO LAKA	
Grace Chapel International	90.8
White and Green Mosque	97.8
Yellow Mosque	85.2
ROMAN DOWN	
Church of Pentecost	83.7
St. Augustine Catholic Church	81.1
Christ Apostolic Church	94.1
JERICHO	
Church of Pentecost	82.7
Church of Christ	81.9
Christ Apostolic Church	101.3
NIGHT MARKET	
White and Green Mosque	83
White Mosque (Uncompleted)	84.4
Cream and Green Mosque	89.2
STANDARD DEVIATION	**7.9**

B. NIGHT TIME NOISE LEVELS AT THE NOISE SOURCES

CHURCH/MOSQUE	SOURCE (dB)
TABOOLINE	
Church of Jesus	80.1
Voice of the Lord Evangelical Church	89
Tribe of Judah Ministries International	101.7
MARKET SQUARE	
Apostolic church, Ghana	86.3
Musama Disco Christo Church	100.5
St. Peter Methodist Church	83.7
Grace Assembly (Assemblies of God)	71.9
TAIFA	
Central Assemblies of God	94.8
Green and Cream Mosque	93.6
Unique Chapel International	94.7
NEW TOWN	
Church of Pentecost	99.5
Global Evangelical Church	98.5
Liberty Centre Annex(Assemblies of God)	85.1
CHRISTIAN VILLAGE	
Presbyterian Church	82.5
Church of Pentecost	97.1
Christ Apostolic Church	94.5
Evangelistic Fire Ministries International	93.2

ZONGO LAKA	
Grace Chapel International	87.3
White and Green Mosque	93.8
Yellow Mosque	85.6
ROMAN DOWN	
Church of Pentecost	82.4
St. Augustine Catholic Church	80.9
Christ Apostolic Church	100
JERICHO	
Church of Pentecost	85.7
Church of Christ	82.3
Christ Apostolic Church	94.3
NIGHT MARKET	
White and Green Mosque	84.4
White Mosque (Uncompleted)	85.4
Cream and Green Mosque	90.2
STANDARD DEVIATION	**7.4**

APPENDIX IV

PICTURES OF SOME CHURCHES AND A PARTICIPANT

A. SOME CHURCHES

1. ST. PETER METHODIST CHURCH

2. CENTRAL ASSEMBLIES OF GOD CHURCH

3. MUSAMA DISCO CHRISTO CHURCH

4. CHURCH OF JESUS

B. A PARTICIPANT BEING INTERVIEWED