PRESBYTERIAN UNIVERSITY COLLEGE, GHANA

FACULTY OF DEVELOPMENT STUDIES

DEPARTMENT OF ENVIRONMENTAL AND NATURAL RESOURCES MANAGEMENT

ASSESSMENT OF LEVEL OF NOISE FROM SOME SELECTED CHURCHES IN SOUTHERN GHANA

A PROJECT WORK DISSERTATION SUBMITTED TO THE DEPARTMENT OF ENVIRONMENTAL AND NATURAL RESOURCES MANAGEMENT OF THE FACULTY OF DEVELOPMENT STUDIES, PRESBYTERIAN UNIVERSITY COLLEGE, GHANA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OFMASTER'S DEGREE IN ENVIRONMENTAL SANITATION.

BY

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DECLARATION

Candidate's Declaration

I hereby declare that this dissertation is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

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Supervisor's Declaration

I hereby declare that the preparation and presentation of the dissertation were supervised in accordance with the guidelines on supervision of the dissertation laid down by the Presbyterian University College, Ghana.

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ABSTRACT

A hand-held Sound level Meter (SLM) calibrated at 114 decibels (dBA) and frequency of 1000Hz was used for the real-time measurement of noise levels from 10 churches at La Nkwantanang Madina Municipal District and Adenta Municipal District. Day time and night time noise level measurements were conducted during the dry and wet seasons for the two Municipal Districts. At Madina the average mean values for day time and night time noise levels measurement recorded from the 5 churches during the dry season were 74.5 decibels whiles, at the wet season were 67.7 decibels respectively. At Adenta the average mean values for day time and night noise levels measured from 5 churches during the dry season were 70.6 decibels and in the wet season were 71.0 decibels respectively. All noise levels measured and recorded at the 10 churches at Madina and Adenta municipal districts were higher than the recommended noise standards of 55 day and 48 night set by EPA Ghana. This specified that the risk factors for inhabitants living in these areas were high due to extended continuous exposure of noise. A questionnaire was administered to 100 respondents in the environs of Madina and Adenta Municipalities. Assessment conducted on gender showed that females were 60% while males were 40%. Majority was citizens, educated and was being disturbed by the exposure of noise emanating from the churches. Forty-nine percent (49%), of the respondents were of the opinion that, diseases associated with noise exposure were high blood pressure while 37% of the respondents were unable to sleep. Other respondents (28%) were of the view that anxiety and annoyance were ailments related to noise exposure to achieve any success with noise pollution control, it is incumbent for authorities responsible to enforce the existing regulations.

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DEDICATION

This dissertation is dedicated to my wife Benedicta Debrah Yeboah and my two daughters: Augusta Debrah Yeboah and Carolyn Debrah Yeboah.

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ACRONYMS

HOD : Head of Department

EPA Ghana : Environmental Protection Agency - Ghana

LAeq : A-weighted scale, equivalent continuous sound pressure level (Reference Point of measurement)

LA_{10} : The noise nuisance level in decibels

LA_{90} : A weighted scale, background sound level. Sound level equaled or exceeded 90% of the time which is adopted as a good measure of the ambient baseline noise level of the measurement site

dB (A) : equivalent A-weighted scale sound pressure level measured in decibel

SPL : Sound Pressure Level

Hz : Hertz (Cycle per second)

WHO : World Health Organization

MMDAs : Metropolitan, Municipal and District Assemblies

m : meters

M/s : Meters per second

A.M.V : Average Mean Values

Std. Dev.or SD : Standard Deviation

A-weighted scale : An expression of the related loudness of sound in air as perceived by the human ear

Day time : Is define as the time between 6: 00am and 10:00pm

Night time : Is define as the time between 10: 00pm and 6:00am

Ambient noise : The sound pressure levels associated with a given environment, and usually a composite of sounds from near and far sources and none of which are particularly dominant

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

In modern times, the issue of excessive noise making (pollution) has become a thing of concern, especially in built-up residential areas. Pollution is very significant and should not be underestimated because of its adverse effect on man and its environment. Pollution is one of the major environmental problems and is defined as the presence of impure, unwanted, and harmful substance present in an environment (Azizi, 2010). Simlarly, noise is audible sound that causes disturbance, impairment or health damage. According to Gupta and Ghatak (2009), the key to man's health lies largely in his environment and much of man's ill health can be traced to the adverse environmental effects on pollutions such as water pollution, air pollution, soil pollution and noise pollution.

Urbanisation, development, economic growth and transport system are some of the driving forces for environmental noise exposure and public health. According to World Health Organisation report, (2001), environmental noise is one of the physical occupational diseases that adversely affect health conditions in the human being or animal life and the accumulation of all noise present in a specific environment must be recognised as a major threat to human well-being.

The American Medical Heritage Dictionary defined noise as an annoying or physiologically damaging environmental sound level. Similarly, the term noise is commonly used to describe sounds that are disagreeable or unpleasant produced by acoustic waves of random intensities and frequencies (Akhtar, 1996). According to Raney and Cawthron (1979) defined noise as any audible acoustic energy that adversely affects

the physiological well-being of people. Normal conversation is about 60 dB (A). According to Gupta et al., (2010), rapid urbanization has led to various public health challenges, including environmental pollution because activities that caused pollution are essential to meet the needs of the growing population and development.

Consequently, the commonest noise pollution these days are emanating from religious institutions especially churches. According to Boateng (2019), churches are part of noise pollution problem. Resulting in residents reporting the matter to court as noise from the growing number of churches becomes intolerable. Moreover, in the last five years, 5,000 new churches have sprung up in the capital of Ghana, Accra and that's contributed to the growing misery of residents forced to endure frequent all-night services which have provoked some residents to carry the matter to court Ama Boateng report on Aljazeera (2019).

However, noise pollution is being reported to come from various sources. Most noise globally is a result of economic activities. EPA Ghana (2010) reported that, most of our productive human activities are associated with noise generation. Excessive noise beyond a certain level of intensity and duration adversely affect human health. In general, some of the anthropological factors that propagate these noise nuisances are the industrial and commercial facilities, the spinners and the music and cassette shop, and the honking of horns from various automobiles. Others are excessive noise generated from the markets and the schools attached to such communities, block and corn mills and the churches. All these systems are the significant contributing factors of noise making in the cities and this trend continues up to date.

However, noise has a serious health implication on humans and animals in the environment. Apparently, noise affects man's state of mental, physical and social well-being (Hert & Papakonstantinon, 2016). Noise can, therefore, cause physiological and psychological damage to humans. The World Health Organisation [WHO] (2000), indicated that noise pollution could cause annoyance, sleep disturbances, hearing impairment, hypertension, aggression, low retentive memory, high stress levels, tinnitus, hearing loss, increased heartbeats and heart burns, psychological trauma, irritation and harmful effect to humans.

Similarly, it is against these effects and nuisances of noise-making that Environmental Protection Agency - Ghana, acting on behalf of the government, has enacted bye-laws to regulate it [Environmental Protection Agency (EPA) Ghana, 2010]. The numerous complaints officially received by the regulatory authorities, Environmental Protection Agency and Metropolitan, Municipal and District Assemblies (EPA and MMDAs) from the general public form these churches of noise making in the urban centers and it effect calls for the need for an intensive and integrated noise pollution evaluation. Noise from previous era up to date has been one of the major problems, particularly in urban areas affecting a large number of people within the societies.

Depending on frequency, measure of sound duration, distribution and level of exposure, noise may lead to conflict, emotional upset and reduced academic performance in of children.

Consequently, preventive measures to minimize noise pollution are more practical than their elimination. In India, noise is regarded as a pollutant under the air (Prevention and Control of Pollution) Act, 1981. Secondly, noise has been defined as unwanted sound and

lastly, noise consists of unpleasant obtrusive, annoying, distracting, or persistent sounds that interfere with sleep or the ability to concentrate or enjoy life.

Hert and Papakonstantinon (2016) stated that: "noise which is a destructive entity is governed by laws, regulations and standards". These standards usually specify measurement using a Weighting filter (A) indicated on the sound meter and is normally used as a measure on the sound level meters. Noise is measured in decibels (dB) using a sound level meter.

1.2 Statement of the Problem

Noise generation in Ghana has become a nuisance and public health concern, especially in Greater Accra due to improper monitoring and inability to apply the laws and regulations on noise. This has resulted in poor records on the trends of noise making in the country. There seems to be an increase in human population in Ghana especially in the city of Greater Accra. This has made human more vulnerable to public health diseases such as high blood pressure, deaf, heart attack, the inability to sleep, anxiety, annoyance, inefficiency of work, etc. The recognition of noise as a serious hazard as opposed to nuisance is a recent development and the health effects of the hazardous noise exposure are now considered to be an increasingly important public health problem (WHO, 2001).

It has been observed that noise is one of the most common activities in the Ghanaian environment with the cities being the worst affected. However, it has been confirmed by the World Health Organisation (2016), that noise pollution ranked second among a series of environmental stressors. The highest of the noise complaints received was that of the noise pollution emanating from the churches. According to Environmental Protection

Agency, Ghana, it has also been confirmed that, about 70% of such noise complaints are about churches in Southern Ghana (EPA Ghana, 2007). One of the places where high levels of noise can have a significant effect on public health is churches and mosques. Madina and Adenta Municipalities in Southern Ghana cannot be exempted as far noise making is concern.

In Madina and Adenta Municipalities shows that, there is an increase in population due to the area being a trading centre, a noise prone environment and church based zone. However, there have not been any research on noise making in these areas though there have been about 75% of noise complaints from residents to EPA Ghana on noise nuisance emanating from churches in these areas. In an explanation, Philomina and Escroghene (2019) recounted that noise pollution in churches in Port Harcourt is one of the health encounters facing the country. Churches represent an excellent environment in the propagation of sound which poses a high risk in the occurrence of noise induced loss (da Lilly- Tariah et al, 2017). A great percentage of population in these Municipalities is ignorant of the effects of being exposed to high noise level. The WHO (2014) confirmed with estimates that about 1.1 billion children and youth around the world may face the risk of hearing loss and other harmful effects due to unsafe listening practices.

The developments have made the Municipalities to become noise prone with a lot of noise "hot spots" (EPA Ghana, 2010). It has been observed that noise pollution in Madina and Adenta municipal districts is ever increasing with population increasing. Most residents would be affected by the noise generated by the churches in these Municipalities in the near future. Based on these adverse effects on human health and others on the exposure on noise making in Madina and Adenta Municipalities in the Southern Ghana, it is therefore

imperative to conduct a study on noise making to assess the intensity of level of noise generated by these churches and its adverse effect on public health and,to ascertain whether they conform to the standards set by EPA Ghana during the day time and night time and to give recommendations to reduce the levels of noise .

1.3 Purpose of the Study

The purpose of the study was to evaluate the excessive noise levels generated by 10 selected churches in Adenta and Madina municipalities in the Greater Accra Region, its adverse effect on public health and recommendation to remedy the situation.

1.4 Research Questions

The following research questions guided the study:

- What has been the intensity of excessive level of noise generated by the churches in the day time and night time and during the dry and wet seasons of the year?
- How is the excessive level of noise from the churches compared with the EPA Ghana noise standards?
- What is the impact of the excessive level of noise from the churches in Madina and Adenta municipalities of Greater Accra Region on human health?

1.5 Main Objective

The main aim of this study is to assess the excessive level of noise with their corresponding frequency levels at varying distances from the source and quantify the noise pollution

levels in 10 selected churches in Madina and Adenta Municipalities and its impact on human health.

1.6 Specifics Objective

The specific objectives of the study were to:

- determine the intensity of excessive noise generated by the churches in the day time and night time of worship during the dry and wet seasons of the year.
- determine whether the excessive level of noise from the churches is beyond the acceptable limits by EPA Ghana standards.
- examine the impact of excessive level of noise from the churches in Madina and Adenta municipalities on human health.

1.7 Significance of the Study

The study is to investigate whether the level of noise conform to the standard set by EPA Ghana and to evaluate the adverse effect of noise on public health. This study is designed to provide information on the intensity of levels of noise generated from the churches in Madina and Adenta municipalities in day and night hours of worship and also during the dry and wet seasons. It serves to contribute to the development of education on noise awareness and its adverse effect on human health.

It will also encourage the churches the need to reduce noise making in their environment to meet the standards set by EPA Ghana and to understand the differences between noise levels. The findings of the study would be loyal to assist researchers, decision-making groups and the government in general as a data-base and a reference point for future. The

outcome to be considered would be for developing measures to mitigate higher levels of noise pollution emanating from these churches and as a reference base for other communities.

1.8 Delimitation of the study

Noise is a variety of sound, usually meaning any unwanted sound. Noise is unwanted sound judged to be unpleasant, loud or disruptive to hearing. From a physics standpoint, noise is indistinguishable from sound, as both are vibrations through a medium, such as air or water. The difference arises when the brain receives and perceives a sound. A sound is produced when something vibrates. The vibrating body causes the medium (water, air, etc.) around it to vibrate.

The scope of topic of study is limited to the use of sound level meter for evaluation and a structured questionnaire for the data analysis. This would determine the level of noise generated by the churches in the day and night hours of worship, during the dry and wet seasons of the year and its intensity. The geographic location is solely Madina and Adenta municipalities in the Greater Accra Region.

1.9 Limitations of the study

The following are some limitations of the study:

It was difficult in getting the residents, as most of them were traders and ready to leave for their businesses.

Most of the residents are government workers, so they leave very early to work in the morning.

Some of the residents also thought otherwise not ready to listen to us because the team and I had some folders in my hands.

The batteries for the instrument (Sound Level Meter) had to be changed on time as they get weaker and at the same time the meter re-calibrated to get accurate measurement which brought in some delay into the field of work.

In addition, outdoor (ambient) investigation conducted was worked out such that noise in the environment would not hamper the study and picking information from the residents was not easy as one has to wait for more time before taking

1.10 Organization of the Chapters

Chapter One of the research work consist of the following: Introduction, Background of the study, Statement of the problem, Purpose of the study, Research questions, Objectives (Main and Specific), Assumptions, Significant of the study, Delimitation of the study, Limitation of the study, and Organization of the Chapters. This is the subject matter for relevant discussion. Chapter Two of the research work is the Review of related literature of the topic selected. This includes the primary and secondary data and other views from other journals. It looks at the literature of others and serves as the bases for the rest of the research work. Chapter Three of the research work represents the methodology, Study areas, Method, Data collection procedure and Data analysis. It deals with sample procedure and the analysis procedure used. Chapter Four of the research work talks about the Results and Discussions. This indicates the results and discussion of the research work. Chapter Five deals with the Summary, Conclusion and Recommendation,

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter reviews the literature of related document under study. This study also assesses the intensity of noise generation from the churches and determines whether the noise levels measured meet the EPA Ghana noise standard. It also talks about the impact of the excessive noise levels on human health.

2.2 Physics of Noise and Sound

Sound is produced when something vibrates. The vibrating body causes the particles of the medium (water, air, etc.) around it to vibrate. Vibrations in air are termed traveling longitudinal waves, which we can hear and Sound is a longitudinal mechanical wave. The frequency of a sound wave is perceived as its pitch and the amplitude is perceived as its loudness. Sound waves consist of areas of high and low pressures called compressions and rarefactions, respectively (Talia, 2017). Acoustic noise is any sound in the acoustic domain, either deliberate (e.g., music or speech) or unintended. In contrast, noise in electronics may not be audible to the human ear and may require instruments for detection. Performance car exhausts and car alarms are types of noise pollution that can affect people with Autism Spectrum Disorder (ASD) (Goines & Hagler 2007).

Sound is measured based on **the** amplitude and frequency of a sound wave. Amplitude measures how forceful the wave is. This measurement describes the amplitude of a sound wave**.** Decibels dB (A) are expressed in a logarithmic scale. On the other hand, pitch describes the frequency of a sound and is measured in hertz (Hz). The main instrument

used to measure sounds in the air is the sound level meter**.** Recently smartphone-based sound level meter applications (apps) are being used to measure environmental noise.

A sound level meter**,** is one of the main tools for measuring sounds in the environment and the workplace. A-weightin**g** is applied to a sound spectrum to represent the sound that humans are capable of hearing at each frequency. Sound pressure is thus expressed in terms of dBA. Zero (0) dBA is the softest level that a person can hear. Normal speaking voices are around 65 dBA. Background noise or ambient noise is any sound other than the sound being monitored (primary sound). Background noise is an important concept in setting noise levels.

Noise as a sound sensation has its origin in the mechanical vibration of matter, either in the solid or fluid state. The ring of a bell or the escape of the gas in a pressurized system, are two simple examples of the mechanical vibration of matter.

Sound waves are transverse waves because the wave particles oscillate in the same direction as the wave. Unlike electromagnetic waves it requires a medium for propagation. It is propagated through air at a speed of approximately 340 m/s. As the disturbance spreads geometrically, its effect decreases with distance from the sound source, but the diminution in sound intensity is also affected by the dumping of the sound waves by the transmitting medium. This effect may arise in the atmosphere and is influence by the degree of humidity and the frequency of the sound. It is of a particular importance in a closed space, such as a concert hall or a conference room, where the geometrical spreading is almost disregarded (Gupta & Ghatak, 2010).

2.3 Concept of Noise Pollution

Noise is defined as "unwanted sound", which implies sound pressure levels that are annoying or disrupt activities people are engaged in. It is also defined as sound that is disordered and irregular producing an unpleasant sensation that is often unwanted or that interferes with the ability to hear and communicate (EPA Ghana, 2007). The human sense of hearing is subjective and highly variable between individuals. Noise regulations and guidelines set quantitative limits to the sound pressure level (measured with sound analyzers and predicted with computer models) in order to protect people from sound exposures that most would judge to be annoying and disruptive. The loudness of a sound depends on the radiated energy of the sound source and the propagation and attenuation characteristics of the air.

Pollution is the introduction of any substance or any form of energy that lowers the ambient quality of the environment (i.e. pollutant) (Gupta & Ghatak, 2010). Noise pollution is basically any form of noise which has the potential to disrupt the normal functioning of any natural ecosystem or some human community, or an excessive displeasing human, animal, or machine created environmental noise that disrupt the activities or balance of human or animal life (Boman et al., 2005). Noise as a physical pollutant is not easily recognized. This is because the sensitivity of the human ear gets automatically adjusted to the ambient level of sound and so increases in the ambient level go unnoticed.

Therefore, noise continues to do the damage silently. Stansfeld et al., (2000) found that, as pollution in general is a by-product of some essential function or activity, it is therefore almost impossible to completely eliminate the pollutant but it can be controlled or reduced. Most of the pollutant can be tolerated only up to a certain level, the level being dependent

on the type of the pollutant. When the level of pollution continues to increase, it becomes necessary to know the amount by which the permissible limit has been exceeded so that its increase can be checked by the introduction of suitable regulations. To know the level of pollution, the pollutant has to be measured. In the case of noise pollution, it is more essential because of the inability of our auditory system to recognize slow changes (Stansfeld et al, 2000).

2.4 Noise impact on sleep

Noise can and could disturb sleep in a continuous manner. According to Mckennell (1963) as cited in E.O Abankwa (2014) has observed that 40% of the London residents who were interviewed had been awakened by aircraft noise at least: occasionally" and since the volume of aircraft has certainly increased substantially since then, it is likely that even more people are affected now. However, disturbance thresholds vary widely among individuals, with some people being disturbed by levels as low as 35 dBA and others being able to sleep through 90 dBA levels.

2.5 Noise pollution on Health

Noise pollution affects both health and behavior. Unwanted sound (noise) can damage physiological health. Noise pollution can cause hypertension, high stress levels, tinnitus, hearing loss, sleep disturbances, and other harmful and disturbing effects (Choiniere, 2010). Sound becomes unwanted when it either interferes with normal activities such as sleep or

conversation, or disrupts or diminishes one's quality of life. Noise-induced hearing loss can be caused by prolonged exposure to noise levels above 85 A-weighted decibels.

Noise pollution can have negative effects on adults and children on the autistic spectrum. Those with Autism Spectrum Disorder (ASD) can have hyperacusis, which is an abnormal sensitivity to sound. People with ASD who experience hyperacusis may have unpleasant emotions such as fear and anxiety, and uncomfortable physical sensations in noisy environments. This can cause individuals with ASD to avoid environments with noise pollution, which in turn can result in isolation and negatively affect their quality of life. Sudden explosive noises typical of high- performance car exhausts and car alarms are types of noise pollution that can affect people with Autism Spectrum Disorder, Goines and Hagler (2007).

2.6 Sources of Noise

The major sources of noise in Ghana are human–induced noise which include transportation, principally motor vehicles; commercial noise such as the operations of drinking bars and restaurants; religious activities (especially, Newly established Churches and street preachers, social gathering (funerals, child naming ceremonies etc.); use of loud speakers, music recording shops and currently the mobile cassette vendors Abankwa et al., Noise is also generated from the entertainment activities like sports and concerts; street hawkers and commercial activities (at the lorry parks and markets) and industrial activities (from stationery and mobile equipment/machines) including aircrafts, trains, generator sets, fitting shops, printing houses; textiles, sawmills, flour and corn mills, and blasting at mines Standfeld et al., 2000.

2.7 Noise and its Impacts

Several works have been done on noise pollution. The WHO (2001) standards for community noise recommend noise levels less than 30 A-weighted decibels (dB (A)) in bedrooms during the night for a sleep of good quality and noise levels less than 35 dB (A) in classrooms to allow good teaching and learning conditions. According to European Union (EU) publication (WHO, 2014), about 40% of the population in EU countries is exposed to road traffic noise at levels exceeding 55 dB (A), 20% are exposed to levels exceeding 65 dB (A) during the day time, and more than 30% is exposed to levels exceeding 55 dB (A) at night. In humans, hearing is normally limited to frequencies between 50 and 60 dB (A).

In year 2000, EPA Ghana carried out noise assessment which was used to establish the ambient noise guideline for Ghana (EPA-Ghana, 2000). The noise was re-assessed in 2008 in Accra and Tema Metropolis which showed that 15 out of 25 locations had a change (rise) of the ambient noise levels of commercial values in residential areas (EPA, 2010). The noise assessment carried out in 2011 in 10 selected schools in Accra Metropolis indicated that the values recorded are higher than the values of residential areas. There are various effects associated with noise. These could be Social, Ecological, Physiological and Psychological, Nervous, Circulatory and Vision, and Ailments.

2.7.1 Social and Ecological Effect

Noise pollution produces negative after-effects on performance, particularly in productivity of both adults and children and the longer the exposure, the greater the damaging effects (Standsfeld et al., 2000). The effect may depend on the volume of the noise, duration, distribution frequency, exposure and the background noise that may mask

its effect. Socially, normal conversation is within the range of 50-60 dB (A), nonetheless, noise level above it can be nuisance hampering communication between two people. It is well establish now that noise is a potential hazard to health, communication enjoyment of social life. It is becoming an unjustifiable interference imposition upon human comfort, health and quality of life (WHO, 2014). Workers in the noise prone premises have the potential of suffering from noise induced hearing loss, stress, abnormal secretion of hormones and tensing of muscles which affect productivity. Road traffic causes almost 80% of the noise annoyances in Ghana (EPA Ghana, 2001). Gupta and Ghatak (2010) indicated that background noise interferes with the ability of children to hear and has direct correlation with academic performance. In Gupta and Ghatak (2011) it indicated that, environmental noise assessment and its effect normally occurs in urban areas. Children with learning disabilities may also be more susceptible to the negative effect of chronic noise exposure (Gupta and Ghatak, 2010).

2.7.2 Physical and Psychological Effect

Any noise above 90 dB (A) may cause damage to the hearing apparatus either temporary or permanently. Ambient noise levels about 45 dB (A) is noted to disturb sleep and most people cannot sleep above the noise level of 70 (dBA) (Choiniere, 2010). In Rwanda, 38% have been disturbed by the inhabitants of neighbouring properties in two years. For almost one in ten, this is a regular occurrence. Noise pollution is known to cause effects like fatigue, depression, aggression, sleep disturbances tinnitus (ringing in the ear) and hearing loss (Stansfeld, 2000). Noise has been concerned of having effects on hearing and other physiological effects (Malnick, 1979). Noise can result in an increased risk of depression and physiological disorders, migraines, and even emotional stress (Gupta and Ghatak,

2010). Hearing may be damage by exposure to very loud noise for a short period e.g. an explosion at close range or prolong exposure to lower levels of noise. More so, a short period of exposure to noise above 130 dB (A) can cause instant irreversible hearing damage. Noise pollution brings about decrease in work performance, sleep and speech interferences and mental health as well as indigestion, palpitation and heart related diseases.

2.7.3 Nervous, Circulatory and Vision Effects

The circulatory, digestive and nervous systems as well as vision are affected by noise. High noise levels are contributors to cardiovascular effects whereas exposure to moderately high levels during a single eight (8) hour period can cause a statistical rise in blood pressure levels between five (5) and ten (10) points. This is confirmed by (Babisch, et al., 2005), that long-time exposure could result in an increase in hypertension, cardiovascular risk as well as permanent cardiovascular changes, such as atherosclerosis.

Recent studies have suggested that noise levels of 50 dB (A) at night may also increase the risk of myocardial infarction by chronically elevating cortisol production. Combinations of noise and vibration have a significant detrimental effect on health, even at low sound pressure levels. The effects of noise on human health and comfort, depends on the duration, volume of noise and distance from noise source are; physical effects, such as hearing and ear burning; physiological effects, such as increased blood pressure, irregularity of heart rhythms and ulcers; psychological effects, such as disorders, irritability, annoyance, and stress; and finally performance effect; such as reduction of productivity and lack of understanding (WHO, 2015).

This leads in turn to smooth muscle hypertrophy, narrower lumen in small vessels, and increased resistance to blood flow. Babich (2005) also indicated that the people who moved to the noisier area more likely to develop high blood pressure than these who moved to a quieter area due to lack of coping style.

2.7.4 Ailments

Exposure of workers to high levels of noise could lead to blood pressure and heart abnormalities, and causes loss of productivity at work places. Stress and hypertension are major health problems experience in Ghana. Although some presbyacusis (hearing deterioration associated with aging itself) may occur naturally with age. Noise exposure has also been known to induce tinnitus, hypertension, vascoconstriction, coronary artery disease and other cardiovascular impacts Levak et al., (2008). Tinnitus which is noise effect can bring about forgetfulness, severe depression and at times panic attacks. Excessive noise pollution has been blamed for community annoyance, fatigue, heart trouble, disturbed serum lipid, triglycerides, platelet count, plasma viscosity, glucose and reduced motor efficiency (WHO, 2001). It is also known that sleep related noise effects could also result in increased blood pressure, increased heart rate, increased pulse amplitude, vascocontriction, cardiac arrthymias, and increased body movement which do not decrease over time. Various scientists have indicated that noise may be a contributory factor to various ailments such as ingestion, ulcers, heartburn and gastrointestinal malfunctions in the body and psychological problems (EPA Ghana, 2010).

2.8 Noise Complaints from Churches

The Environmental Protection Agency-Ghana received various complaints on noise nuisance. The noise nuisance recorded were from diverse activities and sources such as churches and mosques, block moulding factories, generators, drinking bars and spots, fitting shops/mechanic shops, night clubs, music and cassette shops, milling machines etc. The highest of the noise complaints received was that of the noise pollution emanating from the churches.

One of the places where high levels of noise can have a significant effect on public health is churches and mosques. Philomina and Eseroghene (2019) recounted that noise pollution in churches in Port Harcourt is one of the health encounters facing the country. Both Pastors and Reverends are exposed to different sound levels during church services, many of which can last for hours. The first important phase to control noise pollution that is very important nowadays is to measure noise pressure level and the considered parameters and to compare it with standard parameters Kheirbek, et al., (2010). Churches represent an excellent environment in the propagation of sound which poses a high risk in the occurrence of noise induced hearing loss (da Lilly-Tariah et al, 2017). Many of them have increased their musical experience with loud music instruments, and some of them are always filled with thousands of people during their weekend service with loud blaring music from musical instruments. A great percentage of the population in this region is ignorant of the effects of being exposed to high noise level. The WHO (2014) estimates that about 1.1 billion children and youth around the world may face the risk of hearing loss and other harmful effects due to unsafe listening practices. Chronic exposure to moderate sound levels of less than 90 dB as found in many church environment causes the hair cells especially the outer

hair cells of the inner ear to degenerate within the organ of corti during each period of exposure. The environmental effects of proliferation of churches continued to be a major concern to all and particularly those in the mainstream of environmental protection. So disturbing has it become that, analysts begin to think of the need for a legal framework to tackle the menace (Adesanya 2011). Safe permissible sound levels to hearing depend on the intensity (loudness) and duration of exposure (Atolagbe, Tanimowo, 2006). The longer the exposure to noise the more intense the sound and the more the degeneration the loss the hair cells (Berglund, Lindval, 1995).

2.9 Proliferation of Churches

The global society today is undergoing significant constant proliferation of religious houses which are thought to provide solutions to the numerous problems confronting people, especially, the black race and Nigeria in particular (Adesanya, 2011). In Africa, Nigeria is a country with the highest number of churches per capital in the world and a fertile soil for the growth of independent churches (WHO, 2015). Ghana is no exception to the level of increased proliferation of Churches. This proliferation of religious houses is borne out of the understanding that in Ghana, there is freedom of religious worship but central to this is the question of its environmental effects on the people in the society (Adesanya, 2011).

Religious houses are springing up at an alarming rate in all available spaces, shops, uncompleted buildings, warehouses, hotels, abandoned cinema buildings, studios and other public places. It is a common sight to see a minimum of fifty different religious centers on a street of four kilometers long in Accra and other urban centres (WHO, 2015). Churches and places of worship represent an excellent sound propagation in a closed space which

poses a high risk in the occurrence of noise induced hearing loss (Quarteri, et al., 2009). They have several sources of sound which includes piano, organs, bands, choir and the loud speakers (Asamoah-Baidoo, 2011).

2.10 Control of Noise

In Ghana, the Environmental Protection Agency develop ambient noise guideline covering all the zones (residential, commercial, educational, civic and culture, industrial, etc. (EPA, 2010) which includes areas religious institutions are located. Churches and mosques like any other projects are expected to obtain the necessary permits or licenses pertaining to that sector. The goal for any permitted operation should be a minimize increases in SPL above ambient levels at the chosen point of sound reception.

The hierarchy of controls concept is often used to reduce noise in the environment or the workplace. Engineering noise controls can be used to reduce noise propagation and protect individuals from overexposure. When noise controls are not feasible or adequate, individuals can also take steps to protect themselves from the harmful effects of noise pollution (WHO, 2015). If people must be around loud sounds, they can protect their ears with hearing protection (e.g., ear plugs or ear muffs). These programs promote the purchase of quieter tools and equipment and encourage manufacturers to design quieter equipment (Berglund and Lindvall, 1995).

There are three general methods of minimizing noise problems: to control the sound source; to modify the acoustic path from the source to the listener and to protect the ear of the listener. When practicable, the first named alternative is most desirable and the reduction of the radiated acoustic power may be achieved by the introduction of mufflers, by

mounting the vibrating system on isolating mounts, by introducing vibration damping operation (WHO, 2015).

Noise from Churches and other urban factors can be mitigated by urban planning and better design of roads (EPA, 2010). Noise generated by the churches can be reduced by the use of noise barriers, limitation of speakers used (Adesanya, 2015). An important factor in applying these strategies is the designs of the churches and frequent monitoring of the churches activities to ensure that their sound is with the permitted decibels and also a policy that is capable of addressing noise exposures and hypothetical mitigation (da Lilly-Tariah, et al, 2017).

Other possible procedures are: increasing the length of the sound path; re-orienting the sound source with respect to the receiving area; introducing sound barriers between source and reception; completely enclosing the source, etc. and finally the listener may be aurally protected the use of ear- muffs or ear plugs (Adesanya, 2015). The control of sound within enclosure may be achieved by the use of sound absorption materials such as porous tiles for ceiling and hard surfaces where stronger reflection is desired. This form of sound attenuation is known as passive absorption and is not efficient in its application to low frequencies (Atolagbe and Tanimowo, 2006). At these frequencies the alternative technique of active attenuation in its modern development has the advantage.

2.11 Noise Control Enforcement in Ghana

In Ghana, noise control and enforcement of appropriate noise levels at various places of our national life is a principal environment of concern to the EPA and MMDAs particularly in urban settlements with high population growth (EPA, 2010). Environment Protection

Agency Act, 1994 (Act 490) mandates EPA to prescribe standards and guidelines relating to the pollution of the three media of environment: water, land and air where noise is part. EPA does this by acting in liaison and cooperation with government Agencies, Assemblies and other bodies and institutions to control pollution and generally protect the environment. It is in this vein that Motor Court was established in 2011 to prosecute culprits on noise related offences and other environmental related offences within the Accra Metropolis (Bench & Trevor, 2011) The Environmental Protection Agency of Ghana developed noise level guidelines in the year 2000 for the country and was reviewed recently in 2018. Dealing with noise making in Ghana, the jurisdictions have laws defining loud music as a criminal offense, typically a misdemeanor (EPA, 2010). The exact definition of what constitutes a loud music violation varies by location, either at a certain volume (measured in decibels) or the distance from the source at which the music can be heard. The time of day is also often a factor in the law, with the restrictions in some places applying only to specified nighttime hours e.g. 10 pm-6 am (EPA, 2001). The amount of effort put forth by law enforcement members in dealing with loud music also varies by location. The most common punishment for a conviction is a fine or some other small sanction. But on rare occasions, loud music may be grounds for imprisonment.

Local Government Act, 1993 (Act 462), empowers the District Assemblies by section 10 (3) (e) to be responsible for the development, improvement and management of human settlements and the environment in the districts. Each District Assembly is also established by Act 462 as the Planning Authority, for its area of authority (Section 46) (1). One important function of the Planning Authority, very relevant to having implications for noise pollution control is its powers of enforcement against nuisance (Section 54). There is

therefore a legal and legitimate basis for the intervention of the assemblies to control and deal with noise pollution by Act 462 as the Planning Authority for for its area of authority (Section 46) (1)..

To strengthen the heads of AMA to deal with noise, the AMA has enacted the Accra Metropolitan Assembly (Abatement of Noise) Bye Laws, 2017. AMA bye-laws (2017) on noise abatement contained in the AMA buye-Laws section 181 of the Local Governance Act, 2016 (ACT 936) States that person conducting a religious service shall not play or cause music to be played so loudly so as to cause a nuisance to the public and residents in the area. Any person who contravenes this provision of the Bye-Law commits an offence liable to a fine of imprisonment. The other essential elements of these byelaws are as follows:

- The prohibition of sale of records and other recorded music without approval and license.
- The prohibition of the play of any recorded music in public for advertising purpose so as to cause a public nuisance.
- The prohibition of play of music in night clubs, restaurants or drinking bars or other places of refreshment or entertainment so as to cause a nuisance to the public o residents in the areas.

2.12 Regulatory Institutions Responsible for Permitting Religious Institutions

Legally, the establishment of any religious institution has to undergo various permitting processes from the relevant regulatory bodies. Religious institutions are required to be sited at the areas zoned as civic and culture (worship) (Town and Planning Act 1945, CAP 84).

When the site is not zoned as worship, nonetheless, with adequate land size, the zoning status of the site is changed to worship by TCPD based on the merit of the application. Environmental Protection Agency Act, 1994 (Act 490) and Environmental Assessment Regulations, 1999 (LI I652) mandates EPA to assess any impact from the religious institutions. EPA also gives permit by requesting for the zoning of the site, affidavit and neighbourhood consultation, Environmental Protection Agency.

The structural development of any religious institution is supposed to be supervised by the Works Department of EPA. Works Department offers building engineering advice as to the sort of structure to build to contain any noise nuisance. For instance, a worship structure should have a block with cork and concrete, a plaster board which is used to cover the inner part of the structure and a basement auditorium. Others are improvement of the external walls of the structure to a minimum thickness of 250 mm to ensure its integrity. There should be ceiling and acoustic materials to be used for the windows and doors. According to the building regulation (National Building Regulation 1996 LI 1630), any structure which is not covered by the building permit is to be demolished unless the structure meets all the requirements, hence it is regularized, Environmental Protection Agency.

2.13 Reason for Vibration of Matter

Two physical properties which control the vibrations of matter are its density and elasticity (or springiness). Any external force imparted to a system which produces a displacement of the material body invokes an elastic restoring force and the work done against this force is stored as potential energy. On release of the external force, this energy expands in imparting kinetic energy to the mass of the body and this accelerates until reaching its

original displaced boundary in the absence of damping. The presence of damping involves an energy loss thus reducing the outward displacement.

This ensure a continuous and reversible interchange between the motion of the body and the elastic deformation thus given rise to an oscillatory motion of the system about its equilibrium position, i.e. a mechanical vibration. In most case, the mechanical systems are a continuum matter in either solid or fluid states. Owning to the elastic bonds in matter, any local vibration is transmitted to the neighbouring elements.

2.14 Zoning, Description and Permissible Noise Standards

Ghana Environmental Protection Agency Act, 1994 (act 490) mandates the Environmental Protection Agency (EPA Ghana) to prescribe standards and guidelines relating to the pollution of air, water, land and noise, The EPA Ghana is also to work in effective partnership with all stakeholders and catalyzing change to make environmental protection and sustainable development commonly held values. It does that by acting in liaison and cooperation with government agencies, District Assemblies and other bodies and institutions to control pollution and generally protect the environment. This is presented in Table 1.

Table 1: Ambient Noise Control Level based on categorized zones

Zone	Description of area of noise reception	Permissible noise level in dB (A)	
		Day time 6:00a.m -10: 00p.m	Night time 10:00p.m -6:00a.m
A	Residential areas	55	48
B	Educational and Health facilities, Office and Courts	55	50
C	Mixed used	60	55
D	Areas with some light industry	65	60
E	Commercial areas	75	65
F	Light Industrial areas	70	60
G	Heavy Industrial areas	70	70

Source: Field data, 2019

2.15 Education

Noise travels through air and is measured in ambient air quality level. Noise is measured in decibels. Experts believe that continuous noise levels in excess of 90 decibels can cause loss of hearing and irreversible changes in nervous systems. The World Health Organisation (WHO) has fixed 45 decibels as the safe noise level for a city.

In Ghana, permissible ambient noise as set by the Environmental Protection Agency (EPA) for residential areas requires that, during the day noise levels should not be above 55 decibels and 48 at night (EPA, 2008). A study conducted in Cape Coast showed the range of noise pollution levels at high-density residential areas is 58-68 dB (A), whiles that of low-density residential areas is 53-72 dB (A) (Essandoh & Armah, 2011).

Noise does not only cause irritation or annoyance but also increases the flow of adrenaline and forces the heart to work faster. Continuous noise causes an increase in the cholesterol level resulting in permanent constriction of blood vessels, making one prone to heart

attacks and strokes. Health experts are of the opinion that excessive noise can also lead to neurosis and nervous breakdown. Stansfeld and Crombie, (2001) and Kempen et al., (2006) reported there is a possible association between environmental noise, exposure and hypertension. Also exposure to acute noise influences the body's compensatory mechanics to stress (Maschke et al., 2000), and may contributes to heart attacks. Noise is also known to cause learning disabilities (Moszynski, 2011) as well cause deafness.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

An overview of this chapter takes a look at the study areas and the research methodology and this have been described into detailed. The study areas included the Madina and Adenta Municipalities. The areas to be considered are their locations and maps, geology, vegetation, relief and drainage and finally the climate conditions. The methodology also describes the method applied during the research period.

3.2 Study Areas

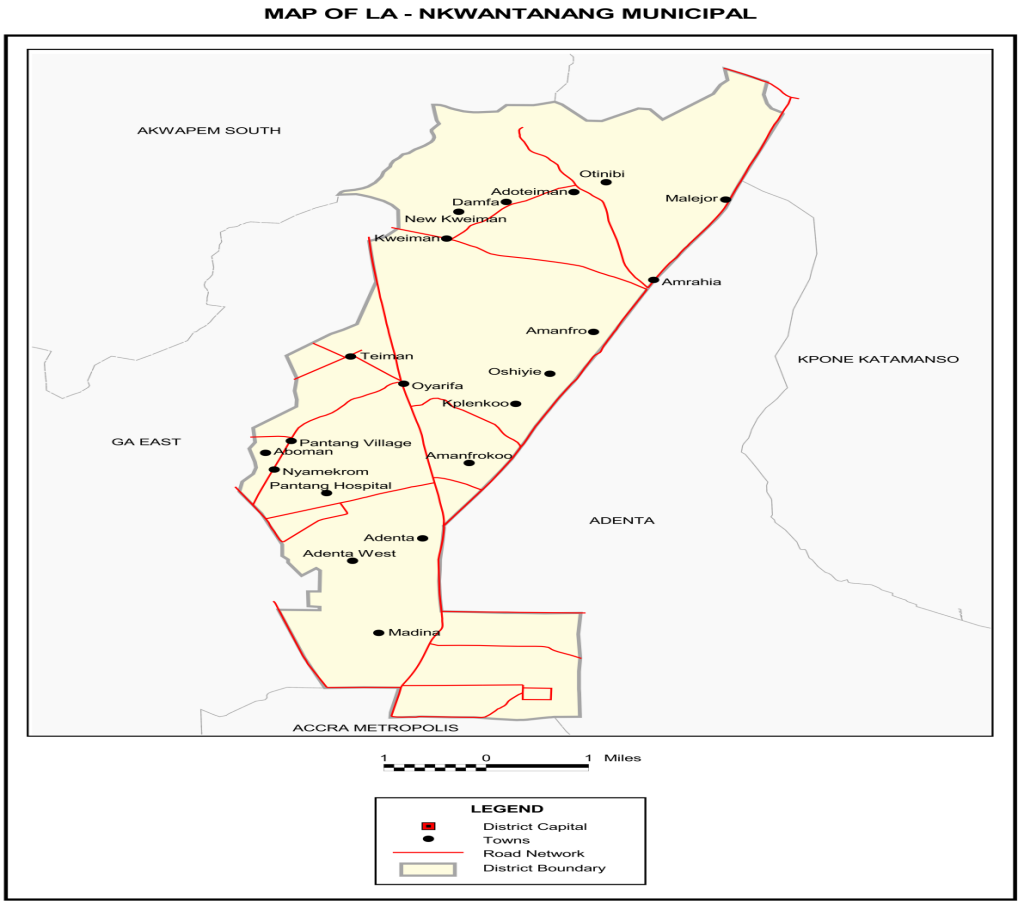
The study was carried out in two Municipal Districts namely, La Nkwantanang Madina Municipal District and Adenta Municipal District in the Greater Accra Region. Adenta Municipal District is among the newly created districts in the year 2008 while La Nkwantanang Madina Municipal District was created in the year 2012.The two districts shared boundary together. Maps of the study areas were from the Ghana, Statistical Service (2010) and its report dated 2010 population and housing census.

The La Nkwantanang-Madina Municipality is located in the Greater Accra Region. It is one of the 16 Metropolitan, Municipal and District Assemblies in the region and was created in 2012 as part of the newly created assemblies aimed at deepening decentralization and bringing development to the people. It was established by Legislative Instrument (L.I) 2131. It was carved out of the Ga East municipality and located in the northern part of Greater Accra Region. It covers a total land surface area of 70.887 square Kilometers and bordered on the west by Ga East Municipal, on the East by the Adentan Municipal, the

south by Accra Metropolitan area and the North by the Akwapim South District. According to the 2010 Population and Housing Census, the population of La Nkwatanang Madina municipality is 111,926 representing 2.8 percent of the region's total population. Also about 84.0 percent of the population in the municipality resides in urban localities. Females constitute 51.5 percent and males represent 48.5 percent.

3.3 Map of La Nkwatanang Madina Municipal District

Figure 1: Map of La Nkwantanang Municipal District



Source, Ghana Statistical Service, GIS 2010.

3.4 Geology

Geologically, the zone is made up of rocks of the Dahomeyan formation. In the municipality, a strain of metamorphic rocks mainly consisting of granite, gneiss and schist possibly derived from the sedimentary layers. This rocky information's are weathered at the surface and carried by run-off towards the plains. The geological formation of the area has resulted in the occurrence of sandy loam soils in the area. There are five soil type in the municipality namely; Fete consociation, Nyibgenya Hatso, Complex Association, Oyarifa –Manfe Complex Association, Danfa-Dome Association and Fete Bediesi Complex Association.

3.5 Vegetation

The municipality is dominated by two closely related vegetation types, namely; shrub lands and grassland. The grassland covers the low lying parts of the municipality graduating into shrubs and wood thickets towards the northern part close to the Akuapim-Togo range.

3.6 Relief and Drainage

The land area of the municipality consists of plains interspersed with undulating topography in the south and west. The Akuapim range rises steeply above the northern part and lies generally at 375-420m south of Aburi and falls to 300 m southwards. Major rivers and streams traversing the municipality included the Sisami and the Dakubi.

3.7 Climate condition

According to Ghana Statistical Service, the municipality lies within the dry equatorial climate zone. It experiences double maxima rainfall of 700 mm in the first rainy season

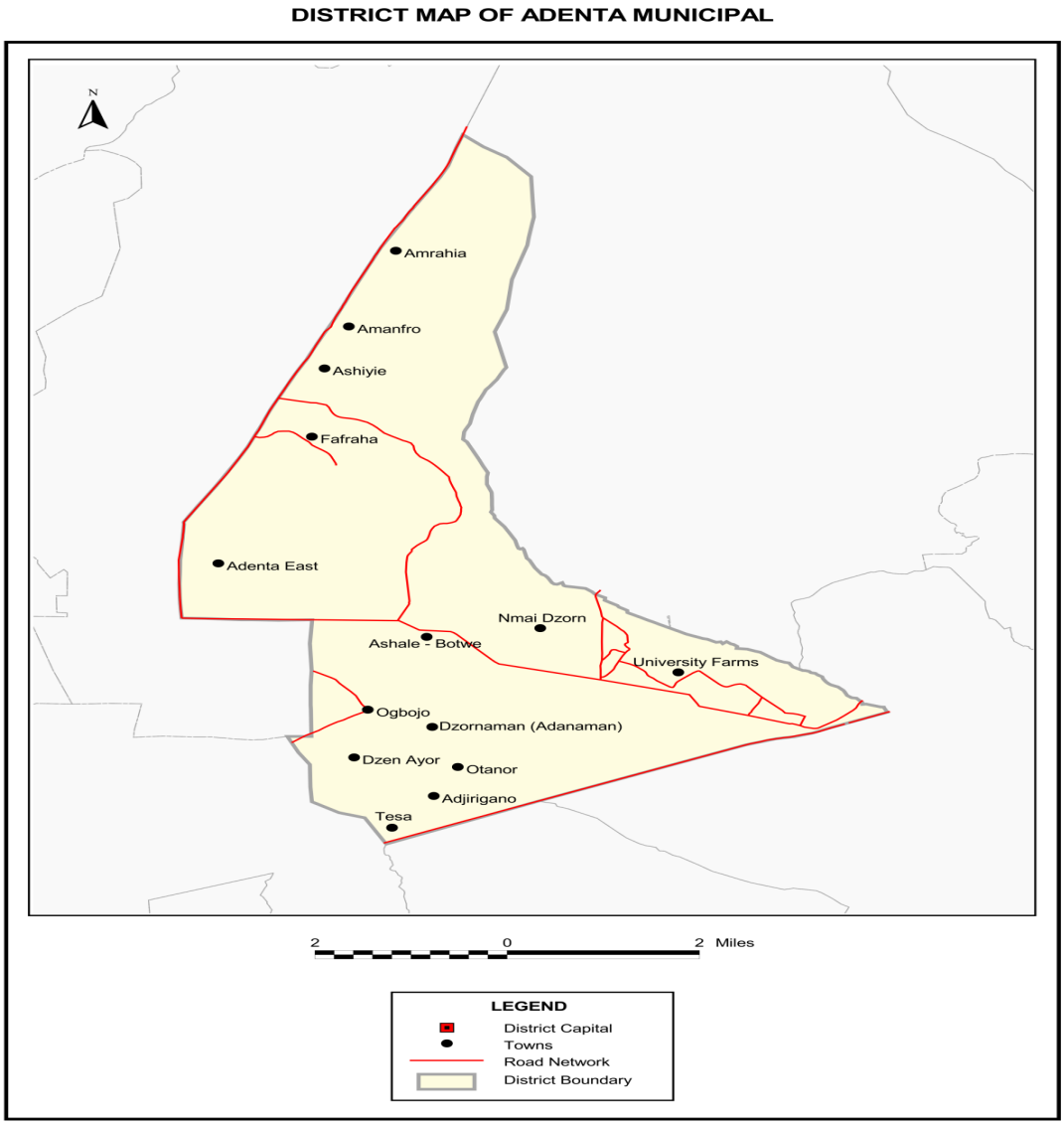
and 770 mm in the second rainy season. The Akwapim-Togo range heavily influence the rainfall pattern of the municipality. The northern side of the range, which is on the leeward side, receives a lot of rainfall and moisture in the form of dew then the other parts of the municipality thus creating a somewhat distinct ecological zone. The annual temperature ranges between 25.1 C in August and 28.4 C in February and March. February and March are normally the hottest months (Dickson & Benneh, (2001).

3.8 Adenta Municipal District

The Adenta Municipality was carved out of Tema Metropolitan Assembly in February 2008 by LI 1888. Adenta serves as a dormitory town for most people who have migrated to seek employment in the service sector, industries and government institutions within the Tema-Accra metropolitan areas. The 2010 Population and Housing Census is the first census conducted by the Ghana Statistical Service with Adenta as a district. The Adenta Municipal Assembly (with Adenta as its Central Business District) lies 10 kilometres to the Northeast of Accra, which is specifically located on latitude 5′ 43″ north and longitude 0′ 09″ west. The Municipal has a land area of about 928.4 sq km. It shares boundaries with Ashaiman Municipal Assembly and Kpong Akatamanso District Assembly in the east and north, La Nkwantanang Municipal Assembly in the west and south, in the north.

3.9 Map of Adenta Municipal District

Fig2. Map of Adenta Municipal District



Source, Ghana Statistical Service, GIS 2010

3.10 Vegetation

The rainfall pattern and the terrain of Adenta have influenced the vegetation cover of the environment. The southern part of Adenta is covered by Savannah grass with scattered Nim trees. The northern part has Savannah semi-rain forest with deciduous trees but due to human activities, the general vegetation cover of some parts of the community have changed to grassland and in some places, bare land. The climatic condition and vegetation cover have contributed immensely to animal rearing and vegetable production in the area**.** Deposits are found on the northern part that consists of granite and gneiss making this part rocky and stony appearance. The rock formation in the area has promoted stone quarry and sand winning, providing a kind of informal employment.

3.11 Geology

The soils are highly elastic when wet but become hard and compact when dry and then crack vertically from the surface. This renders the soil unsuitable for land cultivation. The soil type is confined mainly to small amounts of subsistence crop farming. The short type of grassland provides extensive grazing fields. There is brownish grey, medium or coarse sand, underlain by a hard porous gristly loam along the Frafraha area. The soils have low nutritional status and are quick in becoming parched at the end of the rainy season. The area is underlain with Precambrian rocks of the Dahomeyan formation. Sedimentary rocks are deposited at the southern, western and eastern parts of the Municipality. Metamorphic rocks metamorphic rocks deposits are found at the northern parts that consist of granite and gneiss making this part rocky and stony in appearance. The rock formation in the area has promoted stone quarry and sand winning, providing a kind of informal employment.

3.12 Climate condition

Temperatures are generally high throughout the year. The high temperatures warm up the air, which rises to condense contributing to the second type of precipitation called Conventional rainfall for the area. March to April is usually the hottest period with temperatures reaching 32°C during the day and 27°C at night. Cooler temperatures occur from May to September, with a high of 27-29°C during the day and 22-24°C in the night. Adenta experiences two types of rainy seasons: the first and the major season is from April to July while the second but minor season is from September to November. The bi-modal rainfall pattern provides a suitable environment for farming activities in most months (8 months) of the year as residents are able to cultivate and harvest different type of crops in each season.

3.13 Method

3.13.1

To ascertain information for the study, hundred (100) respondents were picked.

3.14 Sampling Procedure

In the study, purposive sampling was used in selecting respondents. The snowball sampling method was used to identify them. This was done by identifying a respondent, after which a subsequent respondent was identify by the previous respondent.

3.15 Data collection instrument

Both qualitative and quantitative instrument were used for the study. The Sound Level Meter was used to collect quantitative data by measuring and recording the level of noise emanating from the churches in both Municipalities. Also a structured questionnaire was used to collect qualitative data from respondents. The questionnaire was divided into sections to curtail the questionnaire for appropriate use.

3.16 Data collection

Data collection was done with the use of a Sound Level Meter (a hand-held 3M SoundPro Integrated Data Logging Sound Level Meter type 1). The sound level meter was calibrated at 114 dB (A) and at 1000Hz. Measurement of noise levels were recorded in the nearby homes of residents at a distance closed to the church at the Adenta and Madina Municipalities. Measurements were taken in the day time and night time of worship. This was conducted in January during the dry season and April during the wet season, 2019. The real time measurement and recordings were done on Sundays during the day time of worship and the night time assessment was also conducted on Wednesdays and Fridays during the night time of worship. During the pre-investigation period the background noise levels (LA_{90}) were measured. This background noise measurement was to access the level of noise pollution when the churches in questioned were not in session.

A formulae programmed by the manufacturer to generate, the equivalent noise levels (LAeq) which is the reference point for assessment is used to judge whether the values obtained were higher or lower than the standard set by EPA Ghana of 48 dB (A) day time and 55 dB (A) night time.

Also a structured questionnaire was used to collect information on bio data and demographic data of respondents, noise during the day and night time, the relationship between day and night in relation to noise, the adverse effect of the noise on human health and the period disturbed most.

3.17 Data Analysis

After the real time measurements of the levels of noise, recordings were analysed manually using Statistical Package for Social Science (SPSS 16.0 version)) software. After which Excel was used to generate statistical information into frequencies and percentages. Results of the analysis are available in the next chapter. The results are presented as Tables.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

The chapter is organised into three sections. The background information of the respondents is presented in section while the results based on the research questions are presented in the second section. The discussion of the results is presented in the third section.

4.2 Background Information of the Respondents

The background information of the respondents is presented in Table 4. Gender distribution of respondents showed that the frequency of male to female was 40 to 60%. The ages of the respondents ranged between 20 and 50 years. The age range of 20 to29 had the highest number of respondents (25 %) while the age range of 10 to19 years had the least number of respondents. The rest of the respondents were almost equally distributed among the rest of the age ranges.

A good number of the respondents (35%) were married. The respondents who were single constituted (26%). The respondents had different levels of education, only five percent of the respondents had no formal education while (42%) of them had tertiary education. The rest of the respondents either had junior high school certificate (BECE) or senior high school certificate (SSCE or WASSCE).

Almost all of the participants were Ghanaians (92%) and (8%) were non-Ghanaians. A little above half of the respondents (57 %) were employed and only 15 % were unemployed and 28 % were students.

Table 4.1 Background data of the respondents

Variable	Frequency	% frequency
Gender		
Male	40	40
Female	60	60
Total	100	100.0
Age (years)		
10-19	11	11.0
20-29	25	25.0
30-39	20	20.0
40-49	23	23.0
50+	21	21.0
Total	100	100.0
Nationality		
Ghanaian	92	92.0
Non-Ghanaian	8	8.0
Total	100	100.0
Resident		
Native	92	92.0
guest	8	8.0
Total	100	100.0
Marital status		
Single	26	26.0
Married	35	35.0
Widowed	21	21.0
Divorced	18	18.0
Total	**100**	**100.0**

Educational status		
None	5	5.0
Primary	9	9.0
JHS	16	16.0
SHS	28	28.0
Tertiary	42	42.0
Total	**100**	**100.0**
Occupational status		
Public servant	24	24.0
Civil servant	33	33.0
Self-employed	15	15.0
Student	28	28.0
unemployed	0	0.0
Total	**100**	**100.0**

Source: Field data, 2019

4.3 determine the intensity of excessive noise generated by the churches in the day time and night time of worship and during the dry and wet seasons of the year.

From the data gathered presented in Table 4.2 to 4.5 determine the intensity of excessive noise generated by the churches during day and night time. It also determines the intensity also during the dry and wet seasons of the year. The data indicates that the noise level were high which exceeded the permissible noise standards at day and night. During the day and night time in the dry season as compared to the day and night time in the wet season in Madina Municipality, observation showed that mean values in the day time of 74.52 dB (A) and night time of 71.12 dB (A) during the day dry season was higher than the mean values

in the day time of 67.7 dB(A) and night time of 66.8 dB(A) in the wet season. In Adenta the trend was not different from that of Madina.

4.3.1 Data for Madina Municipality

The data for day time and night time measurement for Madina municipality during the dry and wet seasons are presented in Tables 4.2 and 4.3 respectively. Further details are provided in tables presented in Appendix A (Tables 10 and 11) and Appendix B (Tables 14 and 15).

Table 4.2: Mean values of noise levels recorded in day time and night time during the dry season in the Madina Municipality

Churches	LAeq Day	LA_{10} Day	LA_{90} Day	LAeq Night	LA_{10} night	LA_{90} night
Church A	74.6	77.9	41.1	70.5	72.1	40.1
Church B	75.5	78.4	40.8	62.5	64.1	37.1
Church C	70.7	70.5	41.2	74.1	74.9	38.5
Church D	76.3	80.0	39.6	74.0	75.7	39.1
Church E	75.5	79.1	35.8	74.5	78.4	37.1
AMV*	74.52	77.18	39.70	71.12	73.04	38.38

*AMV = average Mean Values

Source: Field data, 2019

The noise levels recorded at the day time during the dry season in the Madina Municipality ranged between 70.7 dB (A) and 76.3 dB (A) with average mean value of 74.52 dB (A). The (reference point of measurement), A-weighted equivalent continuous sound pressure level (LAeq) values for Churches A, B, D and E were higher than the day time permissible noise standard of 48 dB (A). The background sound level (LA_{90}) indicates the sound level when the environment was without any church activity. These are values less than the reference point of measurement (LAeq).

The noise levels recorded at the night time ranged between 62.5 dB (A) and 74.5 dB(A) with average mean value of 71.12 dB(A). This shows that the values obtained were higher than the noise standard. The noise levels for Churches A, B, C, D and E were all above the LAeq day time and night time values of 48 dB(A) and 55 dB(A) respectively. The corresponding noise nuisance levels (LA_{10}) in decibels as recorded by the sound level meter were also high. This demonstrates the fact that noise was actually being generated in these residential areas by the churches.

Table 4.3: Mean values of noise levels recorded in day time and night time during the wet season in the Madina Municipality

C Churches	LAeq day	LA_{10} day	LA_{90} day	LAeq night	LA_{10} Night	LA_{90} night
Church A	68.4	70.7	40.7	67.4	69.4	40.3
Church B	68.2	69.3	42.5	65.2	67.0	38.5
Church C	66.5	68.4	39.1	67.0	69.5	41.9
Church D	67.7	70.8	42.1	66.0	68.0	42.3
Church E	67.5	70.8	40.0	68.3	69.8	40.6
A. M. V	67.7	70.0	40.9	66.8	68.74	40.7

Field work, 2019

The noise levels recorded in the day time during the wet season in Madina Municipality ranged between 66.5 dB(A) and 68.4 dB(A) with average mean value of 67.7 dB(A). The equivalent continuous sound pressure level (LAeq) measured and recorded from the various churches during the wet seasons exceeded the permissible standard of 48 dB (A). They all appear same in values with little disparities. During the wet season it was observed that the LAeq values obtained in the day time and night time were a little less than the dry season. The LAeq recorded during the night time measurement of the wet season ranged

between 65.2 dB (A) and 68.3 dB (A) with average mean value of 66.8 dB (A). These values exceeded the permissible standard of 55 dB (A). The background noise level (LA_{90}) an indication which shows that there was no operation of the various churches at the time of measurement was less than the LAeq in the table 4.3. The noise nuisance level (LA_{10}) as an unlawful interference with a person's use or enjoyment of land or of some right over, or in connection with it shows that noise nuisance level exceeded the LAeq. This indicates that noise level was actually generated by the churches.

4.3.2 Data for Adenta Municipality

The data for day time and night time measurement for Adenta Municipality during the dry and wet seasons are presented in Tables 4.4.and 4.5 respectively. Further details are provided in Appendix A (Tables 12 and 13) and Appendix B (Tables 16 and 17).

Table 4.4: Mean values of noise levels recorded in day time and night time during the dry season in the Adenta Municipality

Religious Institutions	LAeq day	LA_{10} day	LA_{90} day	LAeq night	LA_{10} night	LA_{90} night
Church F	71.0	73.0	42.7	67.6	68.7	41.8
Church G	70.3	72.0	42.1	69.6	72.2	41.2
Church H	69.7	71.7	42.3	72.6	74.9	40.0
Church I	73.7	75.1	41.0	71.0	72.6	40.7
Church J	76.3	75.9	43.0	73.3	74.5	42.0
A. M. V	72.2	73.54	42.22	70.82	72.58	41.14

Source: Field data, 2019

The noise level measurements recorded in the day time during the dry season in the Adenta Municipality ranged between 69.7 dB (A) and 76.3 dB (A) with average mean value of 72.2 dB (A). The noise values for Churches F, G, H, I and J as recorded in Table 4.4 were higher than the day time permissible noise standard of 48 dB (A). The (LAeq) is the

reference point of measurement, A-weighted equivalent continuous sound pressure level values. The background sound level (LA_{90}) shows the sound level when the environment was without any church activity. These are values less than the reference point of measurement (LAeq).

The noise levels measured at night time during the hours of worship in the dry season in the Adenta Municipality ranged between 67.6 dB (A) and 73.3 dB (A) with average mean value of 70.82dB (A). The corresponding noise nuisance levels (LA_{10}) in decibels as recorded by the sound level meter were also high. This demonstrates the fact that noise was actually being generated in these residential areas by the churches.

The data for the day time and night time for churches in Adenta during the wet seasons are presented in Tables 4.5. The noise levels during the wet season ranged between 69.6 dB (A) and 73.2 dB (A) with average mean value of 70.92 dB (A). The noise nuisance levels (LA_{10}) in decibels were high. This validates the fact that noise was actually being generated in these residential areas by the churches.

Table 4.5: Mean values of noise levels recorded in day time and night time during the wet season in the Adenta Municipality

ligious nstitutions	LAeq day	LA_{10} day	LA_{90} day	LAeq night	LA_{10} night	LA_{90} night
Church F	73.2	74.8	44.7	71.4	72.9	39.7
Church G	70.2	71.8	41.5	70.4	72.6	42.1
Church H	71.5	73.2	36.7	72.0	73.5	37.9
Church I	70.1	71.3	38.9	67.4	69.6	37.7
Church J	69.6	71.6	33.5	69.3	71.1	36.7
A. M. V	70.92	72.54	39.06	69.02	71.94	38.82

Source: Field data, 2019

The noise levels recorded at night time during the wet season in the Adenta Municipality ranged between 69.3 dB (A) and 72.0 dB (A) with average mean value of 69.02 dB (A). The equivalent continuous sound pressure level (LAeq) was higher than the permissible level of 55 dB (A) set by EPA. Accordingly, the nuisance noise levels (LA10) were high than the LAeq which also indicate that noise is generated by these churches in these residential environments.

The data obtained from the churches in the Madina and Adenta Municipalities during day time and night time in both wet and dry seasons exceeded the noise standards of day 48 dB (A) and night 55 dB (A) established by EPA-Ghana. A similar trend was observed with the data on noise levels for the night time of the churches. This implied that the noise levels of these churches exceeded the acceptable levels and therefore constituted a nuisance to the communities.

Consequently, 4.3 explain the noise levels of research question two of the study of excessive noise emanating from the churches in the Adenta and Medina Municipalities of the Greater Accra Region.

4.4 Differences between the excessive noise levels generated during the dry and wet seasons in the Madina Municipality

The differences observed during measurement between the excessive noise levels during the dry and wet seasons are presented in Table 4.6.

Table 4.6: Differences between the excessive noise levels generated during the dry and wet seasons in the Madina Municipality

	Dry season				Wet season			
Churches	LAeq Day	Difference (LAeq-55)	LAeq Night	Difference (LAeq-48)	LAeq Day	Difference (LAeq-55)	LAeq Night	Differenc (LAeq-48
Church A	74.6	19.6	70.5	22.5	68.4	13.4	67.4	19.4
Church B	75.5	20.5	62.5	14.5	68.2	13.2	65.2	17.2
Church C	70.7	15.7	74.1	26.1	66.5	11.5	67.0	19.0
Church D	76.3	21.3	74.0	26.0	67.7	12.7	66.0	18.0
Church E	75.5	20.5	74.5	26.5	67.5	12.5	68.3	20.3

Source: Field data, 2019

The mean values of noise recorded in the Madina Municipality during day and night services in both dry and wet seasons exceeded the permissible noise standards recommended by EPA-Ghana. The differences between the permissible levels and the mean values of noise generated by the churches during day sessions ranged between 15.7 and 21.3 and between 14.5 and 26.5 during night time in the dry season. Similarly, the differences between the permissible levels and the mean values of noise generated by the churches during the day sessions ranged between 11.7 and 13.4 and between 17.7 and 20.3 during night sessions in the wet season. However, excessive noise levels recorded in the dry seasons were higher than those recorded in the wet seasons. It was also noticed that the

values recorded during the night for both seasons were higher than those recorded in the day sessions (Table 4.6).

The differences between permissible noise levels and recorded noise levels from the churches in the Adenta Municipality during dry and wet season respectively are presented in Table 4.7. The recorded noise levels generated by the churches in the Adenta Municipality during day and night services in both dry and wet seasons exceeded the permissible noise levels recommended by EPA-Ghana. The other observations made on Table 4.6 may be made of the data in Table 4.7.

Table 4.7: Differences between permissible noise levels and recorded noise levels from the churches in the Adenta Municipality during dry and wet season respectively

	Dry season				Wet season			
Religious institution	LAeq Day	Difference (LAeq-55)	LAeq Night	Difference (LAeq-48)	LAeq Day	Difference (LAeq-55)	LAeq Night	Differenc (LAeq-48
Church F	71.0	16.0	67.6	19.6	73.2	18.2	71.4	23.4
Church G	70.3	15.3	69.6	21.6	70.2	15.2	70.4	22.4
Church H	69.7	14.7	72.6	24.6	71.5	16.5	72.0	24.0
Church I	73.7	18.7	71.0	23.0	70.1	15.1	67.4	19.4
Church J	76.3	21.3	73.3	25.3	69.6	14.6	69.3	21.3

Source: Field work, 2019

4.5 Examine the impact of excessive level of noise from the churches in Madina and Adenta municipalities on human health.

A questionnaire was used to gather information from the sample's assessment of the noise levels from the 10 churches and their perceived effects excessive noise levels have on human health. The sample's responses were organised into frequency counts and converted into percentages. The results of the analysis of the sample's perceived health effects are presented in Table 4.8.

Table 4.8: Health effects of excessive noise levels generated by churches in Madina and Adenta Municipalities

S/N	Health effect	%frequency
1	Hearing difficulty	56
2	Inability to sleep	49
3	High blood pressure	49
4	Anxiety and annoyance	28

Source: Field Source: 2019

Almost half of the respondents (48 %) reported that their environment was very noisy while 40 % of the respondents indicated that the excessive noise was generated during both day and night sessions. They attributed the situation to the noise generated from the religious institution during their worship sessions. The excessive noise they alleged was generated during the praise time during the sessions.

The health effects with high percentage values are reported in the table. Hearing difficulty (56 %) followed by possibility of developing high blood pressure (49%) and inability to sleep

(49 %) and anxiety and annoyance were the major health effects the respondents in the study indicated they experienced from exposure to excessive noise levels generated from religious institutions located in the study areas. It was observed that, 30% of the respondents regarded praise time during religious sessions as the most nuisance of the activities associated with these sessions. During assessment it was detected that 48% realize that the environment was very noisy and 40% also realised that noise generated by the churches was in the day time and night time.

The noise levels generated from the religious institutions were above the permissible noise levels of 55 dB (A) and 48 dB (A) for day and night sessions respectively. The high noise levels recorded could have significant impact on the residents' health. The health effects of noise pollution cannot be over-emphasised. This has prompted the World Health Organization (WHO) and the EPA, Ghana to set standards and limits of allowable noise levels.

Several physiological and psychological effects of excessive noise levels exist. Some of these were reported in this study. The study respondents reported that hearing difficulty (56 %) followed by possibility of developing high blood pressure (49 %), inability to sleep (49 %) and anxiety and annoyance (28 %) were the major health effects of the excessive noise levels generated by the religious institutions located in the study areas. These effects are also reported in the literature. Dickson, Audu and Nwaomah (2015) examined source and effects of religious noise among three major religions in Nigeria and reported that the noise generated caused sleep disturbance, ability to aggravate high blood pressure among patients and potential victims. Akintaro (2014) also reported similar findings in Osun State in

Nigeria. He reported that 58.8% of the noise from religious sessions disrupted respondents' sleep, and sometimes gave them headache.

The direct effects of annoyance and anxiety are disruption of one's peace of mind, the enjoyment of one's property, and the enjoyment of solitude. Continuous high level exposure can lead to aggression in a hostile, angry, and helpless population. The latter seems to lend support to the assertion of Zakpala, Ato, Sackey and Pabi (2014) that excessive night-time noise exposure has the greatest detrimental effect on public health. It could be concluded that the excessive noise levels recorded in the Madina and Adenta Municipalities, which were above the permissible noise levels set by the EPA-Ghana, would be unhealthy to the worshipers and residents close these religious institutions.

4.6 Discussion on noise levels generated from churches in Madina and Adenta Municipalities

The study assessed the noise levels generated by ten religious churches during their day and night sessions in Madina and Adenta Municipalities. The study also assessed the health risks of the noise levels. The results showed that the noise levels recorded at all the churches for both dry and wet seasons and day and night sessions far exceeded the permissible noise levels of 55 dB (A) for day time sessions and 48 dB (A) for night time sessions set by EPA-Ghana (see Tables 4.2 to 4.5). These figures are comparable to figures reported by Zakpala, Ato, Sackey and Pabi (2014) and Onanugbo and Avwiri (2019). Zakpala, Ato, Sackey and Pabi (2014) reported in their study that noise levels recorded in Ashiama (Ghana) exceeded the EPA permissible level of 48 dB (A) for night time expected for residential areas. Onanugbo and Avwiri (2019) reported in their study carried out in Port Harcourt (Nigeria)

that all the noise levels recorded in the churches were higher than the permissible levels or limits of sound of 55dB (A) or 48dB (A). It was observed that irrespective the season the noise levels were higher during the night time than during the day time. The magnitude of the figure for night-time noise exposure is striking particularly given that excessive night-time noise exposure has the greatest detrimental effect on public health (Zakpala, Ato, Sackey & Pabi, 2014). The impact that these levels of exposure are having on individual health and the quality of life as well as the economic impact in terms of reduced productively of residents is likely to be considerable.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The purpose of the study was to assess noise levels generated from 10 selected churches within the Adenta and Madina Municipalities in southern Ghana and its associated health effects on human health. An assessment was used to obtain data for the study. Five (5) churches from each Municipality and 50 respondents from each municipality were purposively sampled for the study. A calibrated Sound Level Meter (a hand-held 3M SoundPro Integrated Data Logging Sound Level Meter type 1) was used to measure noise emanating from each church within these municipalities during day time and night time of worship. A structured questionnaire was administered to 100 respondents to assess the socio-economic and health related characteristics. A Statistical Package and Social Science (SPSS) was used to perform statistical analysis. It was also used to find the mean scores and the standard deviation of the respondents. The results showed that mean noise levels obtained from all the 10 churches exceeded the EPA Ghana permissible noise standards for day time of 48 dB (A) and night time of 55 dB (A).

5.2 Main Findings

The main findings of the study were:

The real time measurement of noise levels taken from the various churches within the Madina and Adenta Municipalities were very high which exceeded the permissible noise standard set by the EPA Ghana. This showed that the noise pollution emanating from the churches has great effect on the residents.

The noise levels obtained from churches at night time during the wet and dry seasons were less than during the day time at the time of measurement.

The dominant health effects indicated by the respondents were: of the following: hearing difficulty, inability to sleep, high blood pressure, anxiety and annoyance.

5.3 Conclusions

It is assumed from the study that noise pollution is one of the major problems facing human and his environment. It is important also to note that the impact of noise pollution with time is a cumulative problem. From the data gathered, it is convincing that the range of noise levels as revealed Tables 4.2, 4.3, 4.43, and 4.5 are more enough to cause sleep disturbance, heart attack, high blood pressure, annoyance reduced efficiency at home, hearing impairment which further affect intelligibility and effective communication, just to mention a few. The data obtained clearly indicated that the citizens of Madina and Adenta Municipalities were exposed to unacceptable noise levels during the day time and night time sessions of the churches. Hence, the higher the percentage of noise levels the greater the impact on health of human and his environment. The inevitable fact remains that noise pollution cannot be completely avoided with respect to increase in population. Besides, the government should enact laws that will inculcate people on the necessity to abide by the permissible noise standard. The noise abatement task force should be strengthened and empowered to regulate noise pollution in the nation. Hence, all of the above put together and constituted will assist to attenuate the gross impacts of noise pollution on human and the environment; making public health anf the environment friendly.

5.4 Recommendations

Based on the findings of the study, the following recommendations were made to mitigate the excessive noise levels from the churches and its corresponding health effects.

The EPA Ghana outfits in Amasaman should be enforced to carry out an environmental and social impact assessment of the churches operating in the municipalities and the southern Ghana in general.

Local Government authorities such Land Use and Spatial Planning Authority-Ghana (LUSPAG) of the municipalities should be allowed to monitor and ensure that churches have the required permit to operate and land placement is well designed.

The EPA-Ghana outfits should be enabled to carry out educative programmes on the effect of noise pollution with the leadership of the churches. The health hazards of the excessive noise and its associated health ailments.

Raising the awareness of the cause and effects of noise pollution in the environment is vital in changing the attitudes and behaviours of people living in these environments.

To achieve any success with noise pollution control, it is incumbent for authorities responsible to enforce the existing regulations.

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APPENDICES

APPENDIX A

Table 10: Noise level measurement recorded at Madina Municipality during the dry season

Churches	Dist. in meters (m)	Period (Hrs.)	LAeq Day	LA_{10} Day	LA_{90} Day	LAeq Night	LA_{10} Night	LA_{90} Night	Day Noise Std. dBA	Night Noise Std. dB
Church -A	30	**1**	72.3	77.5	43.0	69.2	70.4	39.5	55	48
		2	75.0	76.8	40.0	72.2	71.4	40.5	55	48
		3	76.6	79.5	40.4	70.2	74.4	40.2	55	48
Church -B	30	**1**	74.5	78.2	40.4	63.2	64.6	37.1	55	48
		2	73.5	77.0	42.4	62.1	63.6	38.0	55	48
		3	78.5	80.0	39.7	62.2	64.0	36.2	55	48
Church -C	30	**1**	70.0	72.2	42.2	73.4	75.5	38.4	55	48
		2	72.7	71.2	43.0	76.4	76.0	39.2	55	48
		3	69.4	68.2	38.5	72.4	73.2	38.0	55	48
Church -D	35	**1**	74.6	79.2	39.5	75.0	75.8	39.0	55	48
		2	77.4	80.6	39.0	74.6	76.4	39.3	55	48
		3	76.9	78.8	40.3	71.0	75.0	39.0	55	48
Church -E	25	**1**	76.6	79.0	37.2	75.0	77.9	36.5	55	48
		2	75.5	81.0	33.0	71.2	77.4	38.0	55	48
		3	74.3	77.4	37.2	77.2	79.9	36.8	55	48

Source: Field data, 2019

Table 11: Noise level measurement recorded at Madina Municipality during the wet season

Churches	Dist. in meters (m)	Period (Hrs.)	LAeq Day	LA_{10} Day	LA_{90} Day	LAeq Night	LA_{10} Night	LA_{90} Night	Day Noise Std. dBA	Night Noise Std. dB
Church -A	30	**1**	67.2	70.2	38.0	67.5	68.7	39.2	55	48
		2	68.3	72.5	40.6	67.9	71. 0	40.6	55	48
		3	69.6	69.4	43.4	66.7	68. 4	41.0	55	48
Church -B	30	**1**	68.7	69.5	42.3	64.2	65.1	39.1	55	48
		2	69.0	70.2	43.7	66.6	68.5	38.0	55	48
		3	66.8	68.1	41.5	64.7	66.2	38.3	55	48
Church -C	30	**1**	66.9	68.6.	36.4	67.8	69.0	42.2	55	48
		2	67.5	69.1	41.2	68.9	70.0	43.0	55	48
		3	65.2	67.6	39.7	64.2	69.5	40.5	55	48
Church -D	35	**1**	66.7	69.6	42.5	64.7	67.0	39.4	55	48
		2	68.4	71.6	39.5	66.3	68.5	41.2	55	48
		3	68.1	71.2	44.2	65.5	67.9	40.2	55	48
Church -E	25	**1**	66.3	67.7	41.3	67.7	69.4	38.8	55	48
		2	67.8	70.2	38.0	68.1	70.2	40.4	55	48
		3	68.3	74.4	40.7	69.0	69.9	42.6	55	48

Source: Field data, 2019

Table 12: Noise level measurement recorded at Adenta Municipality during the dry season

Churches	Dist. in meters (m)	Period (Hrs.)	LAeq Day	LA_{10} Day	LA_{90} Day	LAeq Night	LA_{10} Night	LA_{90} Night	Day Noise Std. dBA	Night Noise Std. dB
Church- F	30	**1**	71.5	75.0	45.0	67.2	68.4	39.5	55	48
		2	70.6	72.3	40.3	68.4	70.1	42.3	55	48
		3	71.0	71.7	42.7	67.1	67.7	43.6	55	48
Church -G	35	**1**	67.5	68.0	41.7	70.2	70.6	38.1	55	48
		2	72.3	74.6	45.3	69.9	74.0	42.1	55	48
		3	71.1	73.5	39.2	68.8	72.0	43.3	55	48
Church -H	30	**1**	70.0	72.2	42.2	76.4	77.0	38.4	55	48
		2	70.5	72.8	45.0	71.1	74.6	36.7	55	48
		3	68.7	70.1	39.8	70.5	73.3	45.1	55	48
Church -I	35	**1**	76.4	78.4	39.3	75.0	75.8	39.0	55	48
		2	71.0	72.2	41.4	67.7	70.4	40.0	55	48
		3	73.6	74.7	42.3	70.3	71.7	43.2	55	48
Church -J	25	**1**	75.6	76.0	37.2	77.2	77.9	36.5	55	48
		2	73.7	74.6	46.5	71.2	72.7	45.2	55	48
		3	79.5	77.0	45.5	71.7	73.0	44.4	55	48

Source: Field data, 2019

Table 13: Noise level measurement recorded at Adenta Municipality during the wet season

Churches	Dist. in meters (m)	Period (Hrs.)	LAeq Day	LA_{10} Day	LA_{90} Day	LAeq Night	LA_{10} Night	LA_{90} Night	Day Noise Std. dBA	Night Noise Std. dB
Church -F	30	**1**	75.3	77.5	45.0	73.0	74.4	37.5	55	48
		2	74.7	76.0	43.4	70.4	72.5	42.2	55	48
		3	69.8	71.1	45.8	71.0	72.0	39.5	55	48
Church -G	35	**1**	73.5	75.0	41.7	69.2	72.6	38.1	55	48
		2	68.0	69.2	43.4	72.6	74.6	42.7	55	48
		3	69.2	71.3	39.4	69.4	70.8	45.6	55	48
Church -H	30	**1**	70.0	72.2	42.2	76.4	77.0	38.4	55	48
		2	74.4	76.0	34.2	71.0	72.5	40.6	55	48
		3	70.1	71.4	33.7	68.7	71.1	34.8	55	48
Church -I	35	**1**	68.6	70.2	39.3	66.3	69.8	39.0	55	48
		2	71.7	72.4	45.5	67.5	68.9	41.2	55	48
		3	70.0	71.5	32.1	68.6	70.2	33.0	55	48
Church -J	25	**1**	69.6	72.0	35.2	67.4	70.9	36.5	55	48
		2	70.4	71.2	31.0	71.6	72.5	39.6	55	48
		3	68.8	71.6	34.4	69.1	69.9	34.2	55	48

Source: Field

APPENDIX B

Table 14: Standard deviation of mean values during the dry season at Madina Municipality

Churches	Day Time Mean values (x)	Day Time Mean values $(x)^2$	Night Time Mean values (x)	Night Time Mean values $(x)^2$
NChurch I	74.6	5565.16	70.5	4970.25
Church G	75.5	5700.25	62.5	3906.25
Church H	70.7	4998.49	74.1	5490.81
Church I	76.3	5821.69	74.0	5476
Church J	75.5	5700.25	74.5	5550.25
	Σ (x) = 372.6	$\Sigma (x)^2 = 27785.84$	Σ (x) = 355.6	$\Sigma (x)^2 = 25393.5$

Standard Deviation (Day) = 1.98 Standard Deviation (Night) = 4.55

Source: Field data, 2019

Table 15: Standard deviation of mean values during the wet season at Madina Municipality

Churches	Day Time Mean values (x)	Day Time Mean values$(x^2$	Night Time Mean values (x)	Night Time Mean values $(x)^2$
Church F	68.4	4678.56	67.4	4542.76
Church G	68.2	4651.24	65.2	4251.04
Church H	66.5	4422.25	67.0	4489
Church I	67.7	4583.29	66.0	4356
Church J	67.5	4556.25	68.3	4664.89
	Σ (x) = 338.3	$\Sigma (x)^2 = 22891.59$	Σ (x) = 333.9	$\Sigma (x)^2 = 22303.69$

Standard Deviation (Day) = 0.67 Standard Deviation (Night) = 1.08

Source: Field data, 2019

Table 16: Standard deviation of mean values during the dry season at Adenta Municipality

Churches	Day Time Mean values (x)	Day Time Mean values $(x)^2$	Night Time Mean values (x)	Night Time Mean values $(x)^2$
Church F	71.0	5,041	67.6	4569.76
Church G	70.3	4,942.09	69.6	4844.16
Church H	69.7	4,858.09	72.6	5270.76
Church I	73.7	5,431.69	71.0	5041
Church J	76.3	5,821.69	73.3	5372.89
	Σ (x) = 361	$\Sigma (x)^2 = 26094.56$	Σ (x) = 354.1	$\Sigma (x)^2 = 25098.57$
Standard Deviation (Day) = 2.46			Standard Deviation (Night) = 2.06	

Source: Field data, 2019

Table 17: Standard deviation of mean values during the wet season at Adenta Municipality

Churches	Day Time Mean values (x)	Day Time Mean values $(x)^2$	Night Time Mean values (x)	Night Time Mean values $(x)^2$
Church F	73.2	5358.24	71.4	5097.96
Church G	70.2	4928.04	70.4	4956.16
Church H	71.5	5112.25	72.0	5184
Church I	70.1	4914.01	67.4	4542.76
Church J	69.6	4844.16	69.3	4802.49
	Σ (x) = 354.6	$\Sigma (x)^2 = 25156.7$	Σ (x) = 350.5	$\Sigma (x)^2 = 24579.77$
Standard Deviation (Day) = 1.30			Standard Deviation (Night) = 1.39	

Source: Field data, 2019

APPENDIX C

SPSS - Statistics

		Gender	Age	marital status	Educational Background	Nationality	Occupation	Residential Status
N	Valid	100	100	100	100	100	100	100
	Missing	0	0	0	0	0	0	0
Mean		1.60	3.18	2.45	3.93	1.08	2.47	1.74
Median		2.00	3.00	3.00	4.00	1.00	2.00	2.00
Mode		2	2	3	5	1	2	2
Std. Deviation		.492	1.321	1.067	1.183	.273	1.141	.543

Source: Field data, 2019

Statistics continued

	Type Activities	Type of Hearing Loss	EPA Ambient Noise	Improve noise level	Category of Construction	Period
N Valid	100	100	100	100	100	100
Missing	0	0	0	0	0	0
Mean	2.69	1.56	2.84	2.31	2.55	2.16
Median	2.00	2.00	4.00	2.00	2.00	2.00
Mode	1	2	4	2	4	2
Std. Deviation	.535	.499	1.54	1.107	1.209	.735

Source: Field data. 2019

Statistics continued

		Noise Pollution	Effect Noise Pollution	of Major Health Problems	Sensitive Noise	to Impact Noise	of Health effect from Noise
N	Valid	100	100	100	100	100	100
	Missing	0	0	0	0	0	0
Mean		2.42	2.04	2.06	2.85	2.41	2.72
Median		3.00	2.00	2.00	3.00	2.00	3.00
Mode		3	2	2	3	2	4
Std. Deviation		.867	.737	.763	.999	.944	1.083

Sourcee; Field data, 2019

Statistics continued

		Self-Reported Sleep	Diseases Noise	of Estimated Distance	House Disturbance	Alternative Way
N	Valid	100	100	100	100	100
	Missing	0	0	0	0	0
Mean		2.96	3.22	2.42	2.23	2.59
Median		3.00	4.00	3.00	2.00	2.00
Mode		2	4	3	1	2
Std. Deviation		.840	1.528	.912	1.090	.922

Source: Field data, 2019

Statistics continued

		Assessment of Noise Level	Church make most Noise	Zoning Status	Steps Improve Noise Level	Stayed in this area	Most Disturbance	Acceptable Noise Level
N	Valid	100	100	100	100	100	99	100
	Misin g	0	0	0	0	0	1	0
Mean		1.85	2.19	2.34	2.61	2.89	2.07	2.48
Median		2.00	2.00	2.00	2.00	3.00	2.00	2.00
Mode		2	3	1	2	4	2	4
Std. Deviation		.730	.761	1.380	.994	.952	.799	1.227

Field data, 2019

Table 18: Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	40.0	40.0	40.0	40.0
	Female	60.0	60.0	60.0	100.0
	Total	100	100.0	100	

Field data, 2019

Table 19: Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10-19	11	11.0	11.0	11.0
	20-29	25	25.0	25.0	36.0
	30-39	20	20.0	20.0	56.0
	40-49	23	23.0	23.0	79.0
	50+	21	21.0	21.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 20: marital status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Single	26	26.0	26.0	26.0
	Widow/Widower	21	21.0	21.0	47.0
	Married	35	35.0	35.0	82.0
	Divorced	18	18.0	18.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 21: Educational Background

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	5	5.0	5.0	5.0
	Basic	9	9.0	9.0	14.0
	J.H.S	16	16.0	16.0	30.0
	S.H.S	28	28.0	28.0	58.0
	Tertiary	42	42.0	42.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 22: Nationality

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Ghanaian	92	92.0	92.0	92.0
	Non- Ghanaian	8	8.0	8.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 23: Occupation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Public Servant/ Civil Servant	2	24.0	24.0	24.0
	Self Employed	3	33.0	33.0	57.0
	Student	1	15.0	15.0	72.0
	Unemployed	2	28.0	28.0	100.0
	Total	1	100.0	100.0	

Source: Field data, 2019

Table 24: Residential Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Native	31	31.0	31.0	31.0
	Resident	64	64.0	64.0	95.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 25: Type of Activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Praises time	30	30.0	30.0	30.0
	Worshipping	26	26.0	26.0	56.0
	Preaching	10	10.0	10.0	66.0
	Offertory	13	13.0	13.0	79.0
	All the various activities	21	21.0	21.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 26: Type of Hearing Loss

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Temporary	44	44.0	44.0	44.0
	Permanent	56	56.0	56.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 27: EPA Ambient Noise

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Residential: Day 55-Night 48	33	33.0	33.0	33.0
	School and Hospitals: Day 55-Night 50	1	1.0	1.0	34.0
	Commercial: Day60-Night 55	15	15.0	15.0	49.0
	None	51	51.0	51.0	100.0
	Total	100	100.0	100.0	

Source; Field data, 2019

Table 28: Improve noise level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Preventive measures	29	29.0	29.0	29.0
	Educative method	32	32.0	32.0	61.0
	Legal method	18	18.0	18.0	79.0
	Find (Penalty) measures	21	21.0	21.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 29: Period

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Day	20	20.0	20.0	20.0
	Night	44	44.0	44.0	64.0
	Both day and night	36	36.0	36.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 30: Assessment of Noise Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Noisy	34	34.0	34.0	34.0
	Very Noisy	48	48.0	48.0	82.0
	Somehow Noisy	17	17.0	17.0	99.0
	Not Noisy	1	1.0	1.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 20219

Table 31: Church make most Noise

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Day time activities	21	21.0	21.0	21.0
	All-night activities	39	39.0	39.0	60.0
	Both day and night time activities	40	40.0	40.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 32: Zoning Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Residential	45	45.0	45.0	45.0
	Commercial	14	14.0	14.0	59.0
	Industrial	3	3.0	3.0	62.0
	Mixed, Residential and Commercial	38	38.0	38.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 33: Steps Improve Noise Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Noise preventive programme especially adults	12	12.0	12.0	12.0
	Noise preventive programme for the church guidance	40	40.0	40.0	52.0
	Noise preventive programme for the community	23	23.0	23.0	75.0
	Minimize noise level at source	25	25.0	25.0	100.0
	Total	100	100.0	100.0	

Source; Field data, 2019

Table 34; Stayed in this area

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	7	7.0	7.0	7.0
	1 year to 2 years	30	30.0	30.0	37.0
	3 years to 5 years	30	30.0	30.0	67.0
	6 years and above	33	33.0	33.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table35: Most Disturbance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Day		28.3		28.3
	Night		36.4		64.6
	Both		35.4		100.0
	Total		100.0		
Missing	System				
Total					

Source: Field data, 2019

Table 36: Acceptable Noise Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Educate the church members	30	30.0	30.0	30.0
	Passing law regulation measures	24	24.0	24.0	54.0
	Churches should obtain permit	14	14.0	14.0	68.0
	Churches without permit should be punished	32	32.0	32.0	100.0
	Total	100	100.0	100.0	

Source; Field data, 2019

Table 37: Noise Pollution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	When the level of noise is equal to the standard est by EPA	25	25.0	25.0	25.0
	When the level of noise is below the standard set by EPA	8	8.0	8.0	33.0
	When the level of noise is higher than the standard set by EPA	67	67.0	67.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 38: Effect of Noise Pollution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Deaf	24	24.0	24.0	24.0
	High blood Pressure	49	49.0	49.0	73.0
	Heart Attack (sudden)	26	26.0	26.0	99.0
	No effect	1	1.0	1.0	100.0
	Total	100	100.0	100.0	

Source: Field data

Table 39: Major Health Problems

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Youth future is denied	26	26.0	26.0	26.0
	Lossing of youth potential	42	42.0	42.0	68.0
	Misbehaving always	32	32.0	32.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 40: Sensitive to Noise

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	12	12.0	12.0	12.0
	Moderate	22	22.0	22.0	34.0
	High	35	35.0	35.0	69.0
	Very High	31	31.0	31.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 41: Impact of Noise

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very slow	18	18.0	18.0	18.0
	Slow	37	37.0	37.0	55.0
	Fast	31	31.0	31.0	86.0
	Very fast	14	14.0	14.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 42 Health effect from Noise

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	It can damage your hearing	17	17.0	17.0	17.0
	It can give you headaches	25	25.0	25.0	42.0
	It can make it hard for you to sleep	27	27.0	27.0	69.0
	All the three	31	31.0	31.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 43: Self-Reported Sleep

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unable to sleep	37	37.0	37.0	37.0
	Forced to sleep	30	30.0	30.0	67.0
	Intermittent sleep	33	33.0	33.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 44: Diseases of Noise

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Inefficiency of work	20	20.0	20.0	20.0
	Blockage of the mind	20	20.0	20.0	40.0
	Lack of obedience	5	5.0	5.0	45.0
	Anxiety	28	28.0	28.0	73.0
	Annoyance	27	27.0	27.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 20219

Table 45: Estimated Distance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	10 meters	19	19.0	19.0	19.0
	20 meters	30	30.0	30.0	49.0
	30 meters	41	41.0	41.0	90.0
	40meters and above	10	10.0	10.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 46: House Disturbance

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	When the church is in full session	34	34.0	34.0	34.0
	When the church groups are practicing	25	25.0	25.0	59.0
	When the church is in prayer and clapping session	25	25.0	25.0	84.0
	When the groups are singing	16	16.0	16.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

Table 47: Alternative Way

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	To move from the area	5	5.0	5.0	5.0
	To report to the appropriate authority	52	52.0	52.0	57.0
	To close the church	26	26.0	26.0	83.0
	Organize a demonstration	13	13.0	13.0	96.0
	None of the above	4	4.0	4.0	100.0
	Total	100	100.0	100.0	

Source: Field data, 2019

APPENDIX D

Questionnaires administered

Questionnaire to solicit response from residents living in the neighbourhood on noise pollution emanating from the religious institutions at Madina and Adenta Municipalities.

Please tick the appropriate box to each of the following question.

SECTION 1: Demographic Information

1. Gender (a) Male [ ] (b) Female [ ]
2. Age (a) 10 - 19 [ ] (b) 20 – 29 [ ] (c) 30 – 39 [ ] (d) 40 – 49 [ ] (e) 50 + [ ]
3. What is your marital status? (a) Single [ ] (b) Widow/Widower[ ] (c) Married [ ] (d) Divorced [ ]
4. What is your Educational background? (a) None [ ] (b) Basic [ ] (c) JHS [ ] (d) SHS [ ]
   (e) Tertiary [ ]
5. What is your Nationality? (a) Ghanaian [ ] (b) Non – Ghanaian (State it) [ ]
6. Which of the following occupational categories do you belong? (a) Public Servant/ Civil servant [ ] (b) Self Employed [ ] (c) Student [ ] (d) Unemployed [ ]
7. Residential Status? (a) Native [ ] (b) Resident [ ]

SECTION 2: To determine the perceptions of the people during the day and night hours of worship

8. What type of activities of the church usually emits noise levels greater than the normal permissible levels? (a) Praises time [ ] (b) Worshiping time [ ] (c) Preaching time [ ] (d) Offertory time [ ] (e) All the various activities [ ]
9. There are two types of hearing loss from noise exposure. What do you think the level of noise exposure emitted by the church at your area could be? (a) Temporary [ ] (b) Permanent [ ]
10. Environmental Protection Agency (EPA) has permissible ambient noise levels guidelines for various zonings. Which one are you familiar with? (a) Residential: Day 55 –Night 48 [ ] (b) School & Hospitals: Day 55- Night 50 [ ] (c) Commercial: Day 60-Night 55 [(d) None [ ]
11. What steps should be taken to improve the level of noise emitted by the church during the day and night hours? (a) Preventive measures [ ] (b) Educative method [ ] (c) Legal method [ ] (d) Find (penalty) measures[ ]
12. During which period does the level of noise emitted by the church disturb most? (a) Day [ ] (b) Night [ ] (c) Both day and night[ ]

SECTION 3: To determine the relationship between day and night levels

13. How will you describe the level of noise in your area during the day and at night? (a) Noisy [ ] (b) Very Noisy [ ] (c) Somehow Noisy [ ] (d) Not Noisy [ ]
14. What type of activities of the church makes the most noise during the day and night? (a) Day time activities [ ] (b) All-night activities [ ] (c) Both day and night time activities [ ]
15. What is the zoning status of your area as far as noise level is concern? (a) Residential [ ] (b) Commercial [ ] (c) Industrial [ ](d) Mixed, Residential & Commercial [ ]
16. What steps should be taken to improve noise level of this area? (a) Noise preventive programme especially for adults [ ] (b) Noise preventive programme for the church guidance [ ] (c) Noise preventive programme at night timing [ ] (d) Minimize noise level at source [ ]
17. How long have you stay in this area? (a) less than 1 year [ ] (b) 1 year to 2 years [ ] (c) 3 years to 5 years [ ] (d) 6 years and above [ ]
18. During which periods are you disturb most? (a) Day [ ] (b) Night [ ] (c) Both [ ]
19. What could be the best option to contain noise to an acceptable noise level in the day and night times? (a) Educate the church members [ ] (b) Passing Noise regulation measures [ ] (c) Churches should obtain permit [ ] (d) Churches without permit should be punished [ ]

20. When do we say sound is polluted? (a) When the level of noise is equal to the standard set [ ] (b) When the level of noise is below the standard set [ ] (c) When the level of noise is higher than the standard set [ ]

SECTION 4: What is the adverse effect of noise on human health and the environment?

21. What are the predominantly the negative effect of Noise pollution among the aged of the Madina and Adenta community? (a) Deaf [ ] (b) High blood pleasure [ ] (c) Heart Attack [ ] (d) No effect [ ]

22. What are the major health problems associated with noise among the youth and the aged? (a) Youth future is denied [ ] (b) Losing of youth potential [ ] (c) Misbehaving always [ ]

23. How sensitive are you to the noise of disturbance? (a) Low [ ] (b) Moderate [ ] (c) High [ ] (d) Very High [ ]

24. What are the impacts of Noise on the development of Madina and Adenta community? (a) Very slow [ ] (b) Slow [ ] (c) Fast [ ] (d) Very fast [ ]

25. How can noise pollution hurt your health? (a) It can damage your hearing [ ] (b) It can give you headaches [ ] (c) It can make it hard for you to sleep [ ] (d) All the three [ ]

26. At night how is your self-reported sleep disturbance? (a) Sound sleep [ ] (b) Unable to sleep [ ] (c) Force to sleep [ ] (d) Intermittent sleep [ ]

27. Which of the following diseases of noise affected your motion? (a) Inefficiency of work [ ] (b) Blockage of the mind [ ] (c) Lack of obedience [ ] (d) Anxiety [ ] (e) Annoyance [ ]

SECTION 5: What period are you disturbed most and what action is to be taken

28. How is your place of abode disturbed by the noise generated by the church activities? (a) When the church is in full session [ ] (b) When the church groups are practicing [ ] (c) When the church is in prayer and clapping session [ ] (d) When the groups are singing [ ]

29. What is the alternative way to deal with the noise as far as your residence is closer to the church? (a) To move from the area [ ] (b) To report to the appropriate authority [ ] (c) To close the church [ ] (d) Organize a demonstration [ ] (e) None of the above [ ]