EFFECT OF GREEN HOUSE GAS ON THE BUILT ENVIRONMENT IN KARU LOCAL GOVERNMENT AREA OF NASARAWA STATE, NIGERIA

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DECLARATION

I hereby declare that this project dissertation has been written by me and it is a report of my research work. it has not been presented in any previous application for the award of Master of Science. All quotations are indicated and sources of information specifically acknowledged by means of references.

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CERTIFCATION

The dissertation, effect of built environment greenhouse gas on the environment in karu Local Government of Nasarawa State, Nigeria, has meets the regulations governing the award of Master of Science (M. S. C) Environmental Resource Management of the School of Postgraduate Nasarawa State University, Keffi and is approved for it contribution to knowledge.

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DEDICATION

This work is dedicated to my Mum, Hajiya Aisha Adamu, for the love and support she gave me since I was a child. My wife Sadiya Ibrahim and children for their contribution and patience during this study.

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All glory and honour to the almighty Allah for making this dream come true by sustaining me through the period of this study.

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ABSTRACT

The study is aimed at evaluating the concentration of built environment green house emission on the environment of Mararaba Town, Karu Metropolis and Masaka Town of Karu Local Government Area in Nasarawa State, Nigeria. The built environment was stratified into industry, highway, commercial area, residential, hospital/clinic, school/office and others. Fieldwork was conducted from August to November 2017 both primary and secondary data were used. Which include administering of Questionnaires, mobile gas sensor for detecting and measuring of gaseous pollutants journals and internet source. Systematic and stratified sampling was adopted Air quality sampling for gaseous pollutants were carried out for three days in one week, for one month in each of the three surveyed town. A model for the study was designed to ease the understanding of the research procedure. The results on the questionnaires shows those that uses electricity/generator in the three study areas as source of energy has 73.3%, 83.2% and 81.5% respectively. Those that uses fuel wood as source of cooking/production has 67.7%, 8.2% and 87.5% respectively. Daily waste generation has 96.7%, 93.2% and 88.1% respectively, while those that maintained vegetation after construction has 23.3%, 13.6% and 12.5% respectively. The concentration of the gaseous pollutant were measured by mobile gas sensor (MGS), Haz dust meter HDI10 and Micro Gas Alert Meter. The result shows that carbondioxide (CO) measured in the three areas were 74.2%, 60.8% and 59.6%% respectively, carbonmonoxide (CO) were 14%, 16% and 62% respectively. Particulate matter (PM) were 29.2%, 26% and 22.2% respectively, while Nitrogen dioxide (No) were 150%, 125% and 125% respectively. Only No_2 is above the maximum permissible limit while CO, and CO concentration is very high. There is a significant concentration of the gaseous pollutants in the others built environment apart from highway and industry. It is recommended that green building concept should be adopted, so as

to minimized resources, reduce harmful effects on the environment and provide healthier environment, also national energy policy that places emphasis on the exploitation of Nigeria renewable and alternative energy sources (wind, solar and biomass) prepared by government through the Ministry of Science and Technology should be actualize.

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CHAPTER ONE
INTRODUCTION

1.1. Background to the Study

Built environment is generally accepted is a key factor in the move towards a more sustainable future (Jones et al, 2007). Buildings and transport infrastructures have enabled mankind to thrive in numbers and to a standard not possible in less organized communities. However, growing populations and the extravagant lifestyles of the most successful people threaten the natural sources of the earth (Carpenter, 2001). The building related activities, Constituting approximately 44% of the total material use and 30-40% of the society's total energy demand as well as roughly 1/3 of the total CO_2 emission (Erlandsson and Borg 2003; Li 2006).

Traditionally, built environment has hurt the environment and also contribute to climate change over the years. The hurt could be either in the short and long term. From the environmental perspective, built environment account for 50% green house gas (GHFs) that is attributed to building, Ozone depletion accelerate by 50% due to the pollution caused by buildings (WCED 2009). One of the challenges of the built environment believe it or not, according to the US, Green Building Council (USGBC, 2016), buildings account for an average of 41% of the world's energy use. The two other biggest energy consumers don't even come close. The industrial sector accounts for 30% while transportation accounts for 29% part of this due to the huge amount of Electricity that buildings tend to use. In united States, buildings are responsible for 73% of the country's electricity consumption and building construction is responsible for 38% of all Co_2 emission (USGBC, 2016).

Many of the sustainability challenges are related to the extensive mobilization of materials caused by built environment development. People's will to urbanize and to enlarge the built environment drives the major flux of solid materials in the world (Baccini and Brunner 1991) and lead to one of the greatest transformations of the landscape on the Earth (Douglas and lawson' 2002: Moffatt and Kohler 2008), by depositing in Urban areas the large stocks of materials brought from other places. On one side, raw materials are extracted from Iithosphere to built up the built environment, which leaves huge pits and waste heaps on the mining sites, leads to resource depletion and emission problems due to extensive energy consumption in metals (e.g Iron and Steel) and cement production. For instance, in the year of 2000 about 45% of global Iron entering use is devoted construction (Wang et al, 2007), for the last 25 years of the 20h century, the structural steelwork and build/civil engineering have been consistently the largest application have been consistently the largest application for Iron and steel in an already well developed country like the UK (Davis et. Al, 2007 and Steel has been identified as having globally the highest environmental impact of all mined metals (Staal, 2009).

On the other side, the maintenances, refurbishment of the existing built environment stock and the

replacement of the obsolete part of it generate a big amount of construction and demolition waste (CDW) which leads to waste management pressure. CDW is by far the largest solid waste fraction (Kourmpanis et al. 2008; War et al. 2004), accounting for at least 50% of the total generated solid waste in industrialized countries (Schachermayer et al. 2000). Sustainably managing CDW- the quantitatively vast solid waste fraction is considered a priority in waste management in densely populated countries, because of the shortage of landfill capacities for final disposal (Duran et al, 2006).

Furthermore, sustainability challenges in built environment development are not globally balanced and the emerging or developing countries deserve special attention. According to United Nation Studies, the world population is expected to surpass 9 billion by 2050 (UNPD, 2007) and the urban areas of developing countries are projected to absorb all the additional 2.3 billion population up from now (UNPD, 2007).

Consequently, the demand for expansion of the built environment will be mainly from the rapidly urbanizing developing areas for the next few decades. The built environment make a significant contribution to environmental pollution.

The demolition and renovation of buildings in South Africa result in a large amount of waste. Building waste often includes concrete, metals, glass, plastics, wood, asphalit, bricks and more.
This waste if often disposed of in either landfills or incinerators. The land and air were polluted by this waste. The materials used in building construction also have a serious impact on the environment. First of all, many of the materials used in the construction of buildings are produced in a non-sustainable way. Operation of the building activities accounts for 23% of GHG emissions, while emission from the manufacture of the major materials for the building activities amounts to around 18 mt CO_2 per year, or ground 4% of total CO_2 emissions (CIDB, 2009).

In Nigeria, the challenges of built environment on site activities require energy too1s, machinery and for illumination. The use of petrol a and diesel by heavy equipment directly contribute to atmospheric pollution. in habitable buildings, energy could be used for many various appliances. However, with inadequacy of electricity supply in Nigeria, the use of alternative sources of power mostly generators powered by petrol or diesel make the Situation worst still. Another built environment challenge, is the massive of charcoal in Karu L.G.A for cooking and production. Large amounts of GHGs is generated as well as causing local environment damage. There is an immense increase in the landfill waste containing some none recyclable Building materials such as lead based paint, asbestos, mould fluorescent bulbs, Datteries which pose serious environmental and health problems (Brandi, 2009).

Taking into account the depleting scarce resources on our surrounding the alarming global warming problem, the limited local dumping capacities and the ongoing urbanization, considering the

significant resource extraction, high life cycle energy consumption. It is crucial to orient the development of built environment in the 21st century to a more sustainable direction.

1.2. Statement of the Problem

The proximity of Karu L.G.A to Abuja, the capital territory, give rise to quick urbanization in the area. Many people migrated to this study area for the past two decade. A lot of buildings were constructed, ranging from Residential, Industry, Commercial areas, Hospital/Clinic, Schools, Offices, and others. More roads have been constructed because of traffic congestion.

Urbanization comes as a result of population pressure. The study area is face with the problem of population pressure. Different categories of people migrated to the study area. Ranging from civil Servant, Contractors, traders, labouers, applicants etc who are working either at Abuja or Karu. As the population kept increasing waste generation and energy consumption is increasing too. The source of these energy are electricity, generators and solar panels.

Energy is used for many purpose in the habitable buildings, such as for space heating and cooling, lighting, domestic hot water and to operate various appliances. However, with the level of economy and inadequacy of electricity supply in the study area, the use of alternative sources of power Such as generator and fuel wood were mostly used, generator powered by petrol or diesel make the situation worst than the electricity in terms of G.H.G emission. In the study area, almost all houses used fuel wood or charcoal for cooking and production. Electricity and generators were Used for heating, ventilation and air conditioning (HVAC). It contributes also to GHG emission. A rise of average of just 2c summer temperature would make a large number of naturally ventilated buildings hot as a result of increased demand for air conditioning (Bardett and Prior, 1991). Lighting in buildings is more less exclusively provided by electricity and generator and therefore adds to the green house gas problem in the same way that any electrical appliances or installation does.

Building activities in the study area is just like other places in the country. A large portion is cleared, that is trees, shrubs and ground cover are removed completely in the site. Whereas the structure will not take even 1/3 of the total area. After completing the construction, hardly could the vegetation be replaced. The problem of ecological in balance come in as a result of lost of organism (Plants and animal) species in the area. These activities contribute to global warming. since carbondioxide in the ground is exposed and the Co2 generated from the build environment could reach the ozone layer without any obstruction or absuption.

Activities on site required energy for the use of tools or machinery for illumination. The use of petrol and diesel by heavy equipment directly contribute to atmospheric pollution. The urbanization of the study area, makes it more demanding for built environment. As such, these increase more waste generation in the surrounding as more materials will be needed. There is an immense increase

in some non-recyclable building materials such as lead base paint, asbestos, mould, fluorescent bulbs, batteries, and mercury waste which pose serious environmental and health problems (Brandi, 2009). People will to urbanize and to enlarge the built environment, drive the major flux of solid materials in the world (Baccini and Brunner, 1991).
There are some demolitions, in and around the study area. These also generate waste which contribute to the GHG emission. The highway is double carage way but yet there is heavy traffic congestion. Gas from the exhaust pollute the environment together with the flame of vulcanize along the highway.

There are several international protocols on environmental development, which the Nigeria Government was part of the agreement. The National Council on Environment (NCE), established in 1990, provides a forum for consultation and harmonization of environmental management matters throughout the Federation. Membership includes all the Commissioners responsible for the environmental in all the States of the Federation as well as the Secretaries to the State

Governments. Some of the achievements include the harmonization of environmental protection institution throughout the Federation and the creation of state Environment Protection Agencies in all the States of the Federation. Following the Regional workshop on the implementation of Agenda 21 in Africa held in Abuja, Nigeria, the Federal Government established a National Advisory Committee on the implementation of Agenda 21 in 1993. The Committee is made up of professionals from relevant private sector and government organizations, the academic community, Non Government Organization (NGOs), and Community Based Organization (CBOs). The committee advises the Federal Government of Nigeria on sustainable development issues and strategies for implementing the provision of Agenda 21.

As part of the Government efforts towards integrating environmental concerns into development, the guideline and standards approved prior to the United Nations Conference on Environment and Development (UNCED) were reviewed through Decree 59 in 1992. Apart from expanding the Mandales of Federal Environmental Protection Agency (FEPA), the Decree legalized the Proposed Guideline and Standards for Environmental Pollution Control, the Regulations on Effluent Limitations, Pollution Abatement in industries and the Regulations for the Management of Solid Hazardous waste. The Environmental impact Assessment (ELA) law was enacted by the Federal Government in 1992 as a tool for integrating environmental concerns into all major activities throughout the country. Procedural and sectoral guidelines for Agriculture and Rural Development, Oil and Gas, Infrastructural Manufacturing, and Mining activities in the country have also been put in place. The Nuclear safety and Radiation Protection legislation was enacted in 1995, which sets standards and procedures for the safe use of nuclear radiation.

Nigeria has been actively engaged in international climate policy negotiations since it become a party to the UN framework convention on climate change (FCCC) in 1994. Making its Kyoto

Protocol in 2004. Nigeria submitted its First National Communication (FNC) in 2003 and a second National Communication in February 2014. Nigeria is host to a number of clean developments.

Mechanism projects, as well as project financed by the Adaptation fund in September 2012, the Federal Executive Council approved the Nigeria climate change Policy Responses and strategy. He President Muhammadu Buhari, the President of the Federal Republic of Nigeria on 26th November, 2015, approved the Nigeria intended Nationally Determined Contribution (INDC) the Summary of INDC was reduction of GHGs (CO2, N2O, CH) from Business by the year 2010. 20% unconditional and 45% conditional (FMEA, 2015).

Inspite of the efforts made by the government on the issue of climate change, sill there is an increase of GHG emission confronting the study area. These a are attributed to the urbanization of the area. More built environment demand more energy consumption more haste generation and as Such more GHG emission. If targeted GHG emission reduction in the medium of two decades are to be realized. The problem of how to evaluate al the built environment GHG must be addressed since less attention is given to the other built environment compared to the attention given industries and transport.

1.3. Research Question

This study was framed by the following research questions

i. What are the demographic characteristic of the people in the study area.
ii What are the source of emitting or allowing radiation of GHG in the built environment
iii. What are the rate of GHG emitting from the built environment
iv. What are the effect of the emission on the air quality

1.4. Aim and Objectives of the Study

The aim of this research is to assess the effect of built environment green house gas emission on the environment in Karu L. G. A.

This aim will be achieved through the following objectives set to

i. Identify the demographic characteristic of the people in the study area.
ii. Identify source of emitting or allowing radiation of GHG in the built environment
iii. Determine the Green house emission from the built environment
iv. Assess the effect of the emission on the air quality

1.5. Scope and Limitation of the Study

The study will cover areas in Karu L. G. A. which are Karu Metropolitan, Mararaba Twon, and Masaka Town. The area will be stratified into industry highway, commercial area, residential, hospital/clinic, school/office and others.

As a way of focus, research covered the period of one year between June 2016 to 2017. For it will be enough to assessed the GHG emission generated by the built environment of the study area. Karu L. G. A. may Sound bogus and too large for adequate coverage of this research work. As such three places was selected namely, Karu Metropolitan Town and Masaka Town. On the other hand taking one particular area within the place constitute too narrow a basis for an objective assessment of built environment green house in Karu L. G. A and may render generalization difficult. So stratified and systematic method was adopted.

Majority of the people in the study area are educated so, much attention was given to the researcher, only few that were not educated demand mobilization before their attention is to be receive.

A released letter for two years (2015- 2017) in respect of the programme was issued to the researcher from the Local Government Service Commission Lafia, His employer. This has narrowed the obstacle of the researcher that will confront him in his working place.

1.2.Significance of the Study

The significance of this study is to increase the awareness of the people on the effect of built environment GHG to individuals, neighbourhoods and, community and world at large, by stimulating strategies of minimizing the GHG emission.

The study will also add to the existing knowledge on the issue regarding effect of built environment GHG and it shall also be useful to stakeholders and student who may wish to carry out similar research, hence will serve as a reference for research as well as providing step for further studies in the related areas.

The work will tend to show ways for minimizing the usage of materials and energy in the built environment. Materials for construction are brought from different places to the urban area.

Depleting the natural resources and causing erosion and deforestation in timber manufacturing as while generating large solid waste of the construction materials and demolition in the built environment.

The study is further hope to be useful to government in the area of community health care by utilizing it for grass root mobilization safety.

Finally, 1his study intends to remind the government by giving appropriate consideration to other built environment GHG emission as it was giving to transport and industry.

1.3. Definition of Terms

Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs (1IA, 2013).

Metropolitan area, sometime referred to as a metro area or just metro, is a region consisting of a densely populated urban core and it less populated surrounding territories, sharing industry infrastructure and housing (U.I.P, 2002).

Climate change can be defined as any long-term significant change in the average weather of a region or the earth (Dickson, 2010).

CHAPTER TWO
LITERATURE REVIEW

2.1. Conceptual Framework

The key concept in this study are environment, built environment and green house gas. The definitions by other scholars and disciplines will be discuss.

2.1.1. Environment

In its broadest sense, environment is defined as including water, air, soil, flora and fauna (EEPA, 1990). In the 1972 Stockholm Declaration also "especially representative samples of natural ecosystems" are included in the definitions. The term environment could be said to cover all those elements which in their complex inter-relationships form the framework, setting and living conditions for mankind by their very existence or by virtue of their impact (EEC, 1976). Environment (From the French Environner, to encircle or surround). Can be defined as the circumstances and conditions That surround an organism or group of organism or the social and cultural conditions that affect an individual or community. Since human inhabit the natural world as well as the built or technological, social or technological world, all constitute important parts of our environment (Conningham, 2004).

According to (MININTERE, 2003), environment is a set of physical, chemical, biological element and socio economic, cultural, aesthetic, intellectual factors likely to have a direct or indirect, immediate or long- tem impact on the development of environment, human beings and human activities. The environment in the study refers to the man's activities which modify his own and his wellbeing.

The legal approach to the environment is to separate regulations into broad categories Salter has suggested three groups, under a heading of natural environment, protection of environmental media is included. A second category is the manmade environment including the cultural heritage. A third category concerns human environment, safety issues, leisure and economic health (consumer protection, eco- labeling and so forth) (Scandinvian Law 1957-2009).

2.1.2. Built Environment

In social science, the term built environment refers to the man- made surroundings that provide the setting for human activity, ranging in scale from buildings and parks or green space to neighborhoods and cities that can often include their supporting infrastructure, such as water supply or energy networks. The built environment is a material spatial and cultural product of human labour that combines physical elements and energy in forms for living, working and playing. It has been defined as the humanitarian made space in which people live, work, and recreate on a day to day basis (Roof and Oleru, 2008). The built environment encompasses places and spaces created or

modified by people including buildings, parks and transportation systems.

Public health research has expanded the definition of built environment to include healthy food access, community gardens, walkability and bikeability (Lee, et el, 2012). There are serious concerns about the health impact that a built environment has on people. Studies have shown that people, particularly those in low income area, can be negatively influenced by their built environment. Advocates of healthy living point the lack of adequate exercise space and healthy eating facilities as some of the key reasons why those in low income area have poor health.
Independent civic groups often study particular areas and implement changes to the environment to encourage a more well- rounded community.

2.1.3. Green House Gas (G.H.G)

A green house gas is a gas that absorbs infrared radiation and radiates heat in all direction (Mathew,1930). Green house gases in the earth atmosphere absorb infrared radiation from the sun and release it. Some of the heat released reaches the earth along with heat from the sum that has penetrated the atmosphere. Both the solar heat and radiated heat are absorbed, some is reabsorbed by green house gases to perpetuate the cycle. The more of these gases that exist, the more heat is prevented from escaping into space and consequently, the more the earth heat.

Common example of G. H. Gs listed in order of abundance include, water vapour, carbondioxide, methane, nitrous oxide, ozone and any fluorocarbons. According to (USGGES, 2004) that Green House Gas is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the GHG effect.

2.2. History of Built Environment

Early concepts of built environment dated to classical antiquity. Hippodamus of Miletos, known as the father of urban planning, developed Greek cities from 498 BC to 508 BC that created order by using grid plans that mapped the city. These early city plans eventually gave way to the city beautiful movement in the late 1800s and early 1990s, inspired by Daniel Hudson Burnham, a reformist for the progressivism movement who actively promoted a reform of the landscape in tandem with political change (CBM, 2012). The effort was in partnership with others who believed that beautifying American cities would improve the moral compass of the cities and encourage the upper class to spend their money in cities. This beatification process included parks and architectural design (ACBM, 2012). By mid century modernist indifferent design influenced the character of work and public spaces, followed by what Alexander describes as a late twentieth century revival of interest relating to the concept of place (including the built environment) and its relevance to mental health and other ficlds of study (Alexander, 2008).
Currently built environment are typically used to describe the interdisciplinary field that address the

design, construction, management and use of these manmade surroundings as an interrelated whole as well as their relationship to human activities over time (rather than a particular element in isolation or at a single moment in time). The field is generally not regarded as a traditional profession or academic discipline in its own right, instead drawing upon areas such as economics, law, public policy, public health, management, geography, design, engineering, technology, and environmental sustainability. Within the field of public health, build environment are referred to as building or renovating areas in an effort to improve the community's well being through construction of aesthetically, health improved and environmentally improved landscapes and living structures (REH, 2012). For example, community forest user group in Nepal is multidimensional institution, which serves good and services to the communities through natural resource management.

2.3. Public Health

In public health, built environment refers to physical environments that are designed with health and wellness as integral parts of the communities. Research has indicated that the way neighborhoods are created can affect both the physical activity and mental health of the communities residents (Renalds, Smih, and Hale, 2010). Studies have shown that built environments that were expressly designed to improve physical activity are linked to higher rates of physical activity, which in turn, positively affect health (Carlson, Aytur, Gardner and Rogers, 2012).

Neighborhoods with more waikability had lower rates of obesity as well as increased physical activity among its residents. They also had lower rate of depression, higher social capital, and less alcohol abuse. Walkability features in these neighborhoods safety, side walk constructions, as well as destinations in which to walk (Renalds, Smith and Hale, 2010). In addition, the perception of a walkable neighborhood, one that is perceived to have good sidewalks and connectivity is correlated with higher rates of physical activity (Carison, Aytur, Gardner and Rogers, 2012).

Assessments of walkability have been completed through the use of GIS programs. One such program, street smart walk score, is a walkability assessment tool which determines distances to grocery stores and other amenities, as weli as connectivity and intersection frequency using specific addresses (WSM, 2012). Assessments such as street smart walk score can be utilized by city and country planning departments to improve existing walkability of communities.

Public health also addresses additional components of built environments including bikebility and healthy food access such as proximity to grocery stores and community gardens. Bikeability refers to the access that an area has granted to safe biking through multiple bike paths and bike lanes (Horacek, White, and Greene, 2012). Both walkability and bikeability have been cited as determinates of physical activity (Cochrane and Davey, 2008).

Access to health food is also an important components of the built environment. A higher density of convenience stores has been associated with obesity in children (WHOA, 2003). In contrast, improved access to community supermarkets and farmers markets is correlated with lower overweight status (SNIPHH, 2006) specifically in low income neighborhood, the presence of a local grocery store is correlatcd with lower BMi/Overweight risk (Clarke et ai, 2008).

Community gardens are also considered a part of the built environment and have been shown to increase fruit and vegetable intake among gardeners (Cunningham and Michael, 2004) scholars say that community gardens have also been shown to have positive social and psychological impacts that lead to lower levels of stress, hypertension, and an improved sense of wellness, affecting the overall health of the individual and the community. The intersection of public health with other disciplines is evident in the design process of built environments which includes environmental planning, policy development and land use planning (Roof and Oleru, 2008).

Research suggests that people are more active in mixed use communities or those that incorporated retail and residential and density populated areas as well as those with good street connectivity (Stokols, 1992) those who preferred to walk and live in walkable environments often have lower obesity rates and drive less over those who preferred living in auto dependent environments (Oswald and Wahl, 2004) the strength of the evidence for reducing obesity through environment has been highlighted by the center for Disease control in its common community measures for obesity prevention project, which includes measures of health, food access and physical activity environments (Tes,2004).

2.4. Implications for Health Policy

Ideally, people do not need to move to be in a supportive environment, but there is a need for elder friendly knowledge, including terms of equity (Erkilic, 2011). Historically, policy makers have focused their attention on the study of long term care, social affairs and health care but the impact of built environment has rarely been investigated explicitly (Hunter, Sykes and Lowman, 2011). The evidence that has arisen during recent years has led to interest in and promotion of age friendly cities but there is need for policy implementation at a national and local level (Hunter, Sykes and Lowman, 2011). As clear associations are found, urban planning innovation should become a major aim for stakeholders considering expected aging predictions.

There is a need to agree on how to proceed with the built environment assessment, taking a broad approach and unifying theoretical framework to aid understanding (Kerr, Rosenberg and Frank, 2012). Neighborhoods change over time and an individual may move several time in life (Clarke and Nieuwenhuijsen, 2009). Wiles et al (2009) conducted a quantitative study that led to the definition of social space, capturing the elastic physical, imaginative, emotional and symbolic experience of and connections to people and place across time and on space (Wiles, Allen and Palmer, 2009).

Moreover, the association between the built environment and personal characteristics may have a dynamic interaction that has not been thoroughly explored (Menec, Means and Keating, 2011). It is important to take into account different levels (Housing, neighborhood, transportation since bias could occur as a result of focusing on a specific level (i, Fisher, Brownson, 2005).
However, in some health domains e.g (health and thermal insulation) only one level may suitable confounding factors (age, education, managing stress, health behaviors, religious coping, financial status e.t.c) which might be responsible for some of the results, should also be assessed (Huner, Sykes and Lowman, 2012).

2.5.Challenges of Built Environment

The pressure that man exerts upon nature for fulfillment of his needs is greater than ever and is escalating at an alarming rale. Whether one considers the availability of fresh water, resources, or ecological balance, the Millenium Fcosystem Assessment (MEA) study of 2005 has found that there has been a 62% decline over the last four decade, which in turn has brought about the undeniable realization that the system is under the risk of destructive and possibly inreversible changes. Another possible consequence of all this is the escalation of poverty on countries that rely on the resources produced by the collapsing ecosystem. According to the reports published by MEA, the ability of the global ecosystem to nurture future generations can no longer be counted upon.

From the environmental viewpoint, buildings account for nearly half of all energy consumption and raw material use around the globe. The 2008 building energy data book (USDE, 2008) says that commercial and residential buildings are held responsible for 39.7% of the energy consumed (residential 21.5% and commercial 18.26) globally and 76% of the electricity used and 15% of the total water consumed (Architecture, 2010). Building and construction sector takes up the lion share of resources for land use and material extraction, 50% of the world's raw material wealth.

Many the material are non renewable resources and are responsible for 36% of all waste generated worldwide (Graham, 2002). Some of the non recyclable materials such as lead based paints, asbestos, mould, wastes containing mercury, fluorescent bulbs, batteries pose serious environmental and health problems (Roodman and Lanssen 1995, Berge, 2000).

Hazardous waste must be disposed of in a separate landfill at a very high cost (Gockel, 1995). The building related activities globally also constitute roughly s of the total cO2 emission (Erlandson and Borg 2003, Li 2006). From the environmental perspective built environment account for 50% GHGs that is attributed to building, ozone depietion accelerated by 50% due to the population caused by buildings (WEED, 2000).

Many literatures on built environment has been written, but there is little or no documentation or empirical studies on effect of built environment GHG emission on the environment, hence the justification and the need to cover the gap constitutes the problem of the study.

CHAPTER THREE

STUDY AREA AND RESEARCH METHODOLOGY

3.1. Study Area

3.1.1. Location

Karu is a local government in Nasarawa State, centrai Nigeria. It is close in proximity to the Federal Capital Territory of Nigeria. It has an area of 21640km. Karu local govermment has its headquarter in New Karu Town. It was originally built to house the capital civil servant and lower income families. Karu L.G.A is Located at the intersection of latitude 6 35'N and 6 38' N of the equator and between longitude 8 32'E and 8 38'E of the Greenwich meridian. It is bounded by Kaduna State in the Noth, Keffi L.G.A and Kokona L.G.A to the East, Nasarawa L.G.A to the South and Federal Capital Territory Abuja in the West. See figure 3.1 Karu L.G.A is more or less a linear settlement. For the purpose of this study, three areas within Karu L.G.A will be examine. These areas are Karu metropolitan Mararaba Town and Masaka Town the distance from Karu metropolitan to Mararaba is about lkm while from the metropolitan to Masaka Twon about 3km. All this area are located on the major high way.

3.1.2. Drainage/Relief/Geology

The geology of the study area belongs to the category of younger granite on one hand, sedimentary rocks on the other hand. The sedimentary rocks called Karu formation may have suffered significant erosion which has reduced into the present surface area. There are some undulating hills around. The Karu formation is characterized by ferugenized standstones, loose sand, flaggy mudstones and clay stone found along the bank river Ado and Yanya Gwandara stream. The Karu formation is not fossilferous (Offodile, 1998).

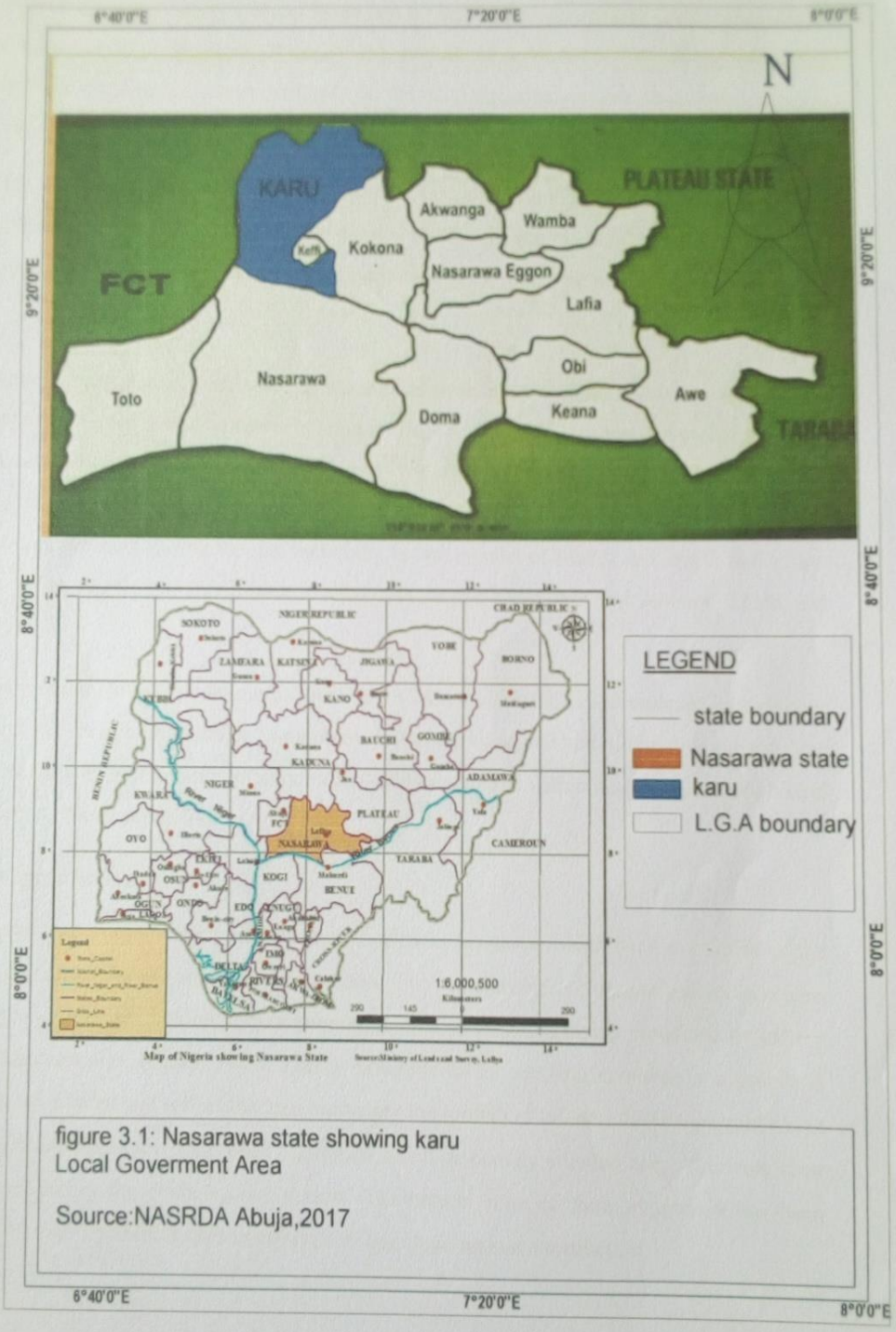

figure 3.1: Nasarawa state showing karu Local Goverment Area

Source:NASRDA Abuja,2017

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The relief of Karu is generally low and forms part of high plains of the Hausa Land-about 600mm above mean sea level. However, there are few pockets of areas with relief above 100m. The surface drainage of Karu depends generally on the relicf characteristics which include the ridge, slope and river.

The main drainage basin is River Ado and Yanya Gwandara stream. The river and stream dries up during the dry season. The area is poorly drained because it lack proper drainage systems. This exposes and makes the area prone to flooding and erosion hazard in the wet season.

3.1.3. Climate

The climate of the study area is influenced by the tropical continental air mass and is characterized two seasons. The wet season commences around Mid- April to the later part of October while the dry season spans from November to early April. The climatic belt is tropical sub-humid climate and is generally very warm and humid. The mean temperature ranges between 26'c and 30"c. Temperature are high during the day especially in the months of March and April, the hottest months being March and April while coolest months are December and January (Lyam and Marcus, 2007).

The mean annual rainfall is between 112omm and 150Omm, Rainfall is accompanied by lightning and thunderstorm of high intensity, particularly at the beginning and end of the rainy season. The study area has relative humidity of between 60 80% and it falls within the guinea savannah kind of vegetation (Akwa etal 2007)

3.1.4. Vegetation

The vegetation type in the study area lies within guinea savanna, which itself is a derive of the tropical deciduous forest excited centuries ago. The vegetation is characterized by southern savannah with interspersion of thicker grasslands, tree savannah, fringing woodland or gallery forest along the valley, (Lio eje 1985). This is sometime called parkland savanna or a woodland savannah, the rainfall and soil of the area encourage the growth of tall and thicker grasses, which are interspaced. There are occasional patches of forest or heavily wooded area. The trees shed their leaves during the colds by dry season. The natural state of these vegetation has been tampered by man's activities such as cultivation, over grazing and construction.

3.1.5. Soil

The predominant soil parent material in the study area and the state at large are drive from cretaceous sandstone, siltstones, shale, limestone and ironstone of the of the pre-Cambrian to Cambrian. They have been mapped as undifferentiated complex by the (geological survey, 1964).

Mock grade in Nasarawa State were grouped into three Litho logical groups predominantly, sandstone, shale and mixed deposit (land resources development center, 1968). These rocks are frequently overlain by gravely lateritic, iron pans probably formed in the tertiary era associated on concretionary gravels and accumulation of alluvial deposited in rivers flood plain. The climatic phenomena and rock grades have yield different soil types such as Oxisols, entisols, inceptisols, ulfisols, however with ultisol dominant in Karu L.G.A (Turku and ray, 2000).

3.1.6. Land Use/Population

The study area has population of 205477 according to National Population Commission 2006. It is the second largest Area in the state after Lafia, the headquarter of the state Karu L.G.A has grown tremendously, especially since the shifting of Lagos to Abuja, in 1992. The proximity of the study area to Abuja lead to this population pressure. The space is dominated by residential land use divided between the old city, migrant centers and new layouts (NPC 2006).

Like population, the land use in the urban Karu L.G.A has witnessed rapid growth and charges. The ancient part of the study area has growth originally without proper planning and control of the development. It is characterized by narrow streets, which are mostly inaccessible to vehicles, mixed land uses, and inadequate provision of social amenities and infrastructure.

The strategies location of the study area to her neighboring towns favor their mutual interrelations, coupled with accessible road network. Karu L.G.A is a linear settlement, which enhances her importance as market center involving indigenes and non indigenes. The non-indigenes traders are more than the indigenes probably because of orientation. Other people from various local governments also come to Karu to transact business. The establishment of some factories and industries as also enhances commercial activities in the study area such as sawmill class and Marble Industry, Shoe Factory.

The various commercial activities mentioned above have attracted tertiary services like communication, banking and insurance firms in the study area. Majority of the indigenes of Karu populace are engaged in agriculture with few ones who can secure facilities from their banks practices commercial farming, variety of crops are grown which include cassava, yam, groundnut, ice, maize, millet, beans, soya beans, guinea corn, beniseed, tomatoes, peper, sugarcane, mangoes, orange among others.

Majority of the land for agriculture is taking by built environment. Ranging from residential, building, schools, hospitals, industries, commercial areas, Banks, offices, filling stations, roads among others. Residential building takes the lion share of land space acquisition. The left over trees by the farmer has been cleared away by the activities of constructions. This has a negative impact on the weather of the study area.

3.2. Research Methodology

3.2.1. Reconnaissance Survey

Reconnaissance survey was first conducted as a preparation to the study between 21st June, and 25th June 2016 in the study area. During this reconnaissance survey, some of the area visited were residential both government and personal, hospital areas, commercial areas, industrials areas, schools and offices areas, National Population Commission, Karu Environmental Protection Agency (NSEPA), National Electric Power Authority (NEPA), Deparlment of Lands, Survey and Town Planning, (Karu L G. C). Heads of wards within the study area were not left behind.

The objective of this survey is to enable the researcher to establish a cordial working relationship with relevant personals, and stakeholders. It also determine targeted respondent needed in the study area. Sample size can also be determined and the number of assistants needed during the field work too.

3.2.2. Sources of Data

In order to obtain the needed information, the data will b collected or obtained in two sources namely

i. Primary Source of Date
ii. Secondary Sources of Data

Primary source of data for this study was obtained through questionnaires administration, interview and discussion with the respondents in the study area. Mobile gas sensor M.G.S, was used in detecting and measuring of the emissions.

The secondary data source was obtained from internets, workshop papers, seminar papers, journals, thesis, textbooks, NSPE, NEPA branch Karu, Department of Land Survey, and Town Planning Karu L. G. C and National population commission Kanu.

3.2.3. Field Work

These comprises the measuring of air pollution by mobile gas sensor from the built environment, administrating questionnaire copies to targeted respondent and interview with some personnels and stakeholders.

Polluted air from the built environment of Mararaba was measured in one hour for three days in one week for one month. The same procedures was adopted in measuring the gaseous pollutants at the built environment of Karu Metropolis and Masaka town. The instrument used for detecting and measuring the gasses are Hazdust meter HDI10 for PM, and micro gas alert meter for CO, CO_2, NO^2. See figure 3.2

Questionnaires were designed and administered to the respondents. The respondents are, head of sample household, stakeholders and sample personnel of the remaining areas of the built environment.

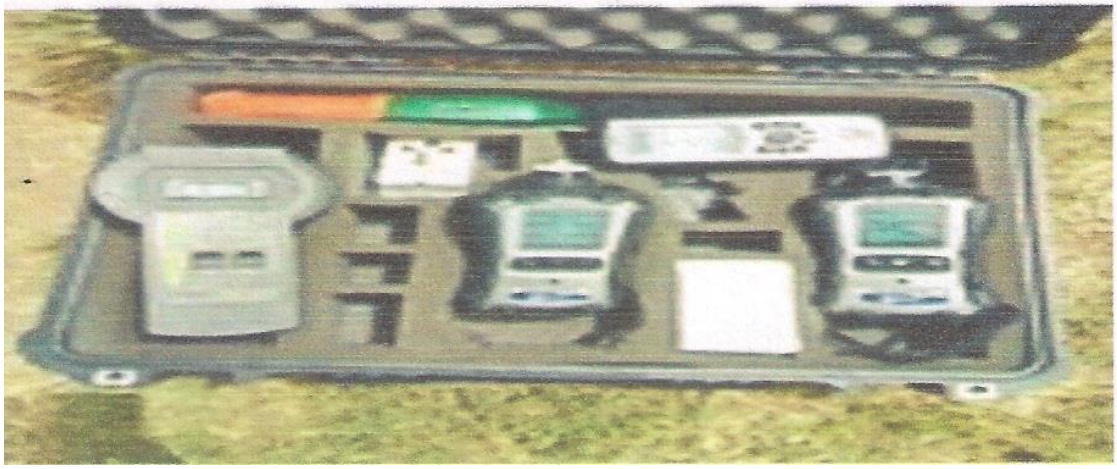


Figure3.2. mobile gas sensors

3.2.4. Sampling Method/Sample Size

Mobile gas sensor (MGS) for detecting and measuring the gaseous pollutants and questionnaire was used for this research. Two sampling techniques was employed, these include systemic and stratified sampling. Using both mobile gas sensor and administering of questionnaire, the study area was stratified into Industry, Highway, Commercial areas, Residential, Hospital/Clinic, School/Offices and others. Systematic method was adopted by taking the number of the buildings and dividing it by the sample size. Heavy traffic areas at the highway was selected.

3.2.5. Data Statistical Analysis Method

The following method of data analysis were adopted in the study to achieve the stated objectives and hypothesis.

Objective one and two was achieved using questionnaires and the statistical package for social science (SPSS Version 15) soft ware was used to analyzed all the data collected. The data will be subjected to descriptive statistic, tabular form with percentage and frequency.

Objective three (3) was achieved using mobile gas sensor and the comprehensive statistical software (SPSS Version 15) was used in the calculation of the statistical valves of the variables. Simple descriptive statistical of mean valves was adopted.

Objective four (4) was achieved using S.P.S.S version 15 software in calculating the mean value of the gaseous pollutants and comparing it with the standard giving to Nigeria.

3.3. Model

The procedure adopted in this research work forms the basis for deriving statistic of built environment green houses gas emission and subsequently in the overall findings. This model shows the step by step procedure taken to arrive at final result of the research work.

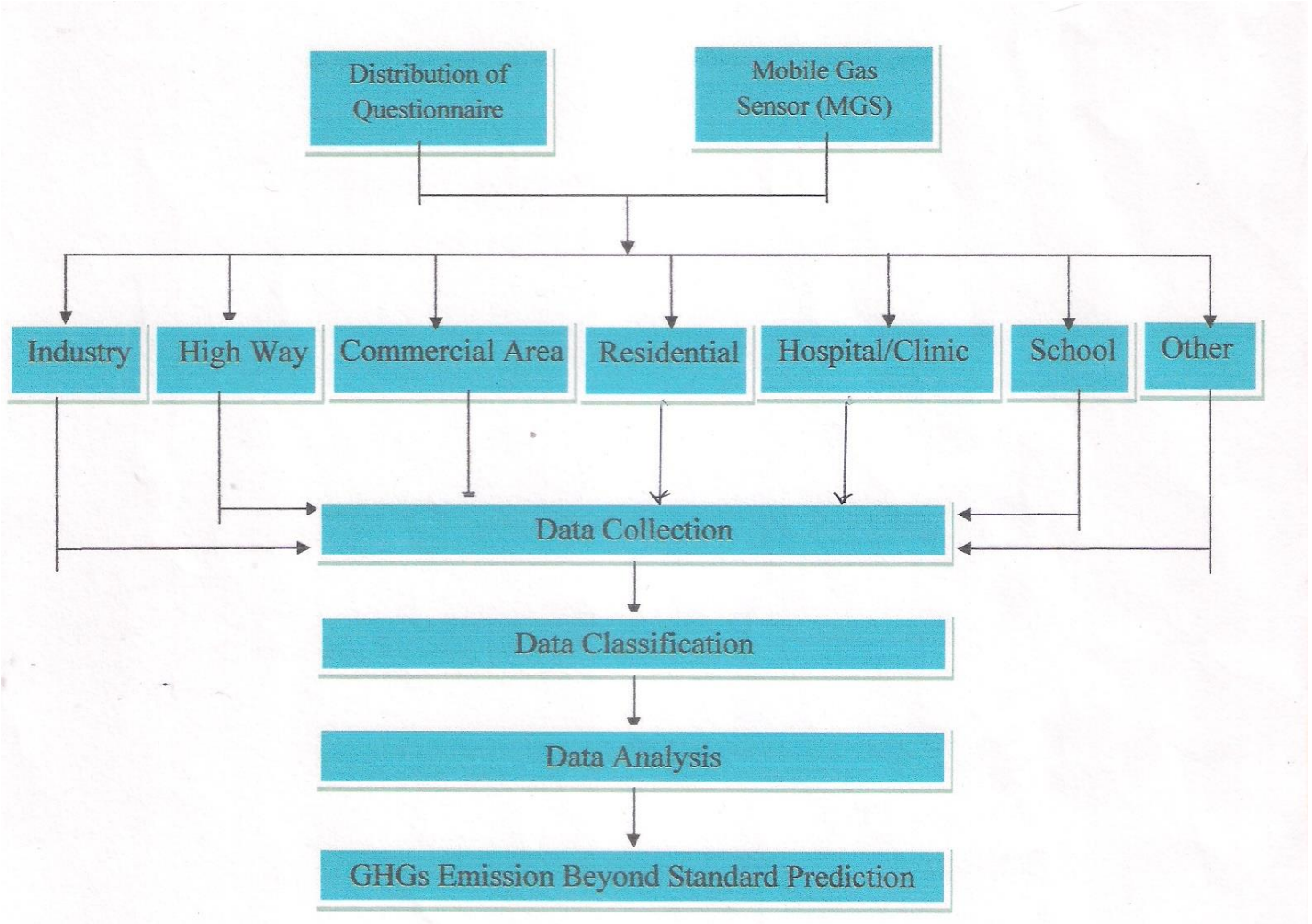


Figure 3.3. Model of the Study

Source: Field Work, 2017

CHAPTER FOUR

PRESENTATION OF RESULTS AND DISCUSSION

This chapter presents analysis collected from the field investigation. The data is analyzed through the use of statistical package for social sciences (SPS Version 15) software. The analysis and interpretation of data in this study are based on the objectives and hypothesis of the study. It comprises four parts. Parts one highlights the demographic characteristic of the people like marital status, Household size, occupational status and average total income per annum. Part two present data in respect of the sources that emit green house gas in the built environment. Part three measured the gaseous pollutants from the built environment. While part four assessed the effect of the gaseous pollutants on the air quality. The data is presented in descriptive and tabular form.

4.1. Demographic Characteristics of the Peopie in the Study Area

4.1.1. Marital Status of People in Mararaba, Karu and Masaka

The results shown in table 4.1. indicate that in Mararaba 13.3% of the households are single. 78.7% are married, 3.3% are divorced, While 4.7% are widow. In Karu 14.5% of the households heads are single, 78.7% are married, 3.6% are divorced while 3.2% are Widow. While in Masaka 23.1% of the household heads are single, 66.3% are married, 5% are divorced while 5.6% are widows. Each of the study areas accumulated percentage was 100%.

The Couples in Mararaba, has the highest percentage with 78.7%, followed by single 13.3%, widow 4.7% while the least percentage are those on divorced with 3.3%. In Karu couples have the highest percentage with 78.7% followed by single 14.5%, divorced 3.6%, while the least percentage are those on widow with 3.2%, while in Masaka couples have the highest percentage with 66.3% followed by single 23.1%, widow 5.6%, while the least percentage are those on divorced with 5%. This shows why the population in the areas is increasing in geometrical rate.

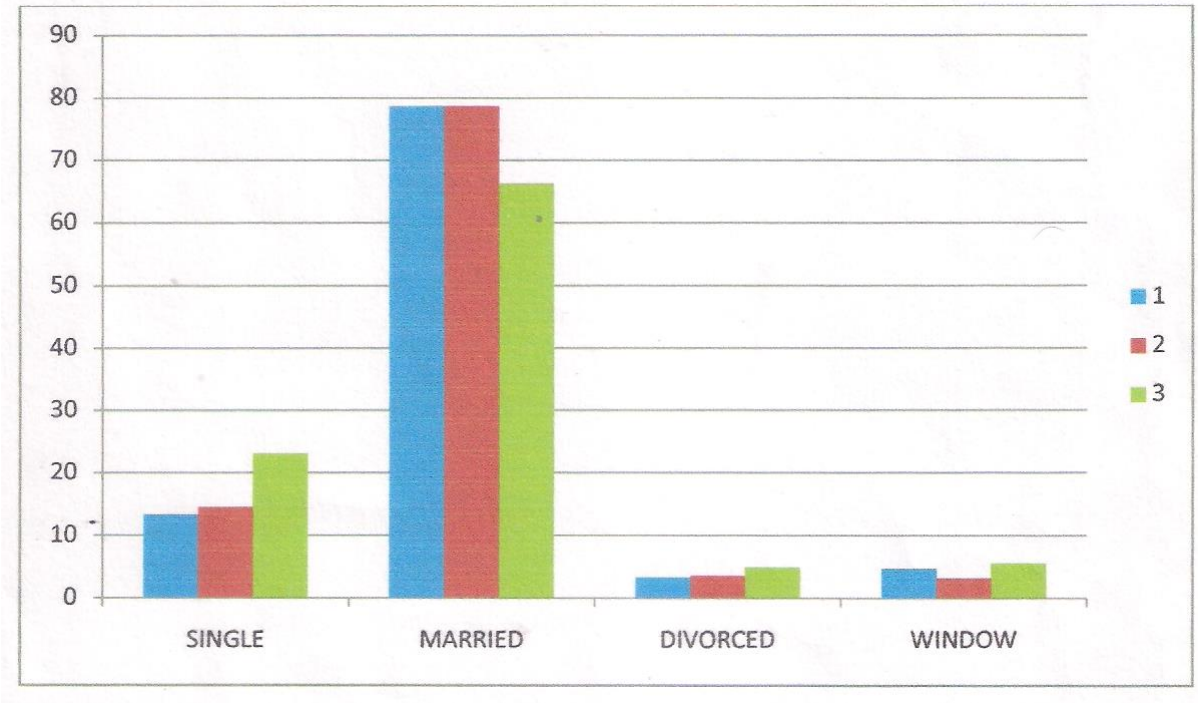


Figure 4.1: marital status within the study area

Key

1. Maraba

3. Karu

3. Masaka

Source: Fieldwork, 2017

4.1.2. Household Size in Mararaba, Karu and Masaka

The result in table 4.4 shows that in Mararaba 3% are household size of one persons, 6% are two persons, 21.3% are the household size of three persons, while 78% are the household size of four persons above. In Karu 1.8% are household size of one persons, 5.5% are two persons, 9.5%% are three persons while 83.2% are four person above, while in Masaka 3. 1% are household size of one persons, 11.3% are two persons, 20% are three persons while 65.6% are four person above. Each of the study areas, accumulated percentage was 100%.

The household Size in Mararaba with four persons above dominate the study area with 78% followed by three persons 21.3%, two person 6%, while the least are one person household size with 3o. in Karu household size with four persons above dominates the study area with 83.2%, followed by three persons 9.5%, two person, 5.5% while the least are one person household size with 1.8%. While in Masaka household size with four persons above dominates the study area with 65.6%, followed by three persons 20%, two persons 11.3%, while the least are one person household size with 3.1%. This facilitate the urbanization of the areas.

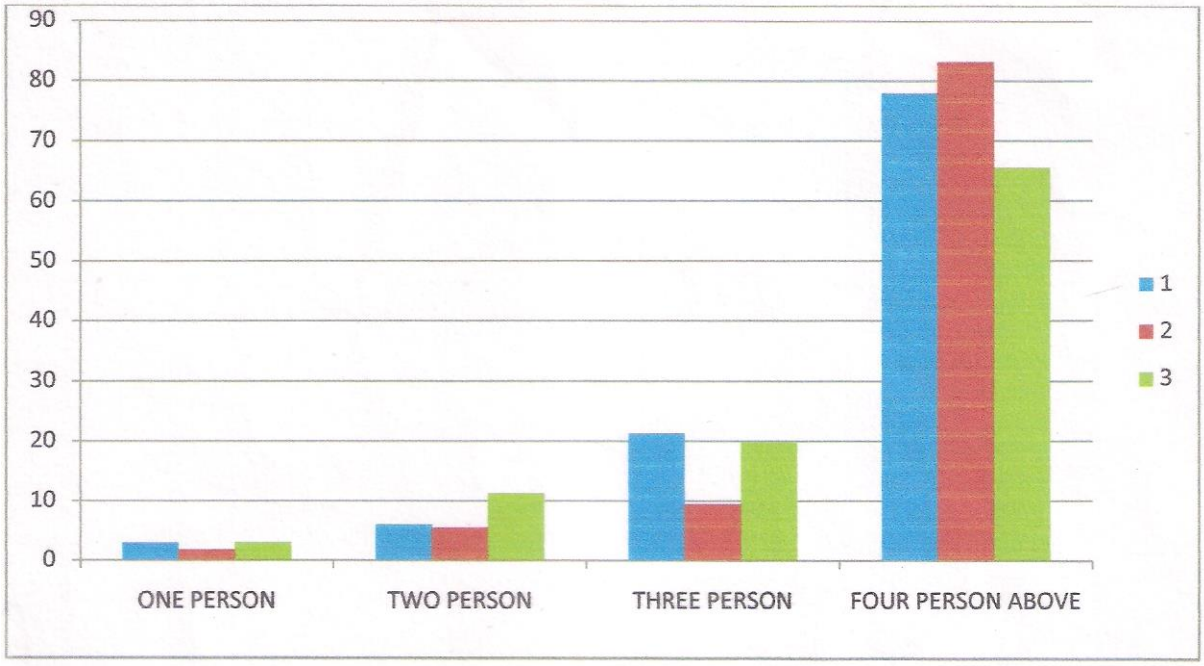


Figure 4.2: Household size in the study area

Key

1-Mararaba

2- Karu

3- Masaka

Source: Fieldwork, 2017

4.1.3. Occupational Status of the People in Mararaba, Karu and Masaka

Table 4.3 shows that in Maraba 34.7% were civil servant, 6% are private sector employee. 43.3% are self implored, while 16% are Artisan. In Karu 42.7% are civil servant, 5.5% are private sector employee, 34.5% are seff employee while 17.3% are Arisan. While in Masaka 30% are civil servant, 12.5% are private sector employee, 45% are self employee while 12.5% are Artisan. Each of the study area, accumulated percentage was 100%

The people that are Self Employed in Mararaba form the majority of the respondents in the study area with 43.3% followed by Civil Servant 34.7%, Artisan 16%while the least was private sector employee with 6%. In Karu Civil Servant forms the majority of the people in the study area with 42.7% followed by self employee 34.5%, Artisan 17.3% while the least are the private sector employee with 5.5%%. While in Masaka Self employee form the majority of the people in the study area with 45%, followed by civil servant 30%, while the least were private sector employee and Artisan 12.5%. The demand for more energy consumption and waste generation is encourage by this situation.

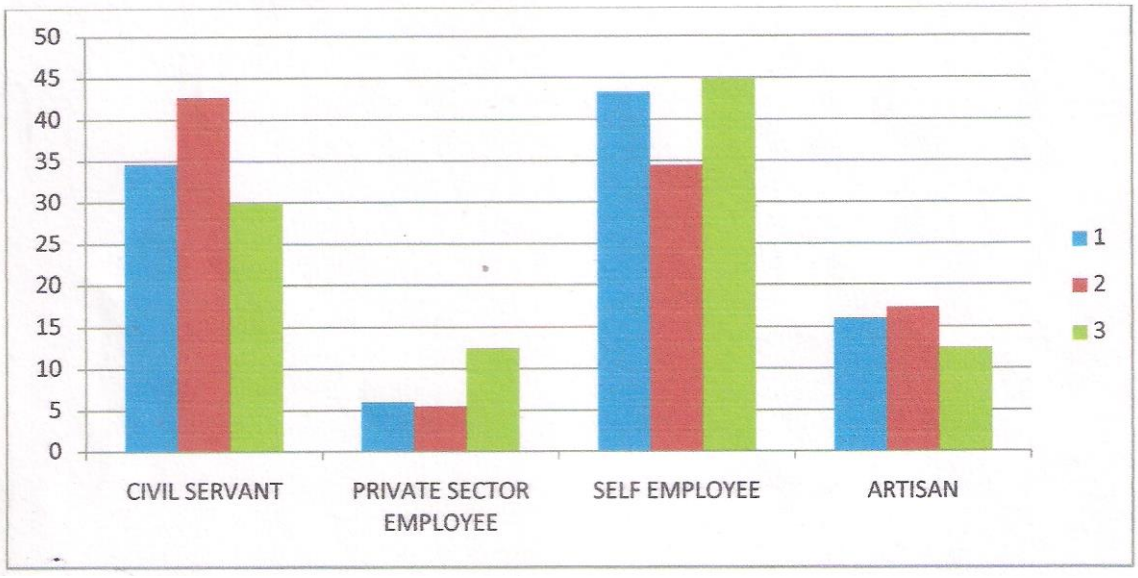


Figure 4.3 Occupational status in the study area

Key

1-Mararaba

2- Karu

3- Masaka

Source: Fieldwork, 2017

4.1.4. Average Total Income per Annum of the People within Mararaba

The result shown in table 4.4 indicated that in Mararaba 6% are households that earn less than ₦500,000 per annum, 20.7% are between ₦510,000 to ₦1,000,000, 33.3% are between ₦1,100,000 to ₦2,000,000 while 40% are ₦2, 100,000 above. In Karu 9.1% of the household earned less than ₦500,000 per annum, 22.7% are between ₦510,000 to ₦1,000,000 54.6% are between ₦1,I00,000 to ₦2,000,000 while 13.6% are ₦2, 100,000 above. While Masaka 7.5% of the household earned less than ₦500,000 per annum, 12.5% are between N510,000 to ₦1,000,000
37.5% are between ₦1,100,000 to ₦2,000,000 while 42.5% are ₦2,100,000 above. Each of the study areas, accumulated percentage was 100%.

The majority of the people in Mararaba earns ₦2,100,000 above with 40%, followed by ₦1,100,00 ₦2,000,000 33.3%, ₦510,000 20.7% while the least were those that earned less than ₦500,000 per annum with 6%. In Karu of the respondenis are between ₦1, 100,000 to ₦2,000,000 with 54.6%, followed by ₦510,000 ₦1,000,000 with 22.7%, ₦2,100,000 above with 13.6%, while the least are those that earned less than ₦500,000 per annum with 9.1%. While in Masaka majority of the people earms ₦2,100,000 above with 42.5%, followed by ₦1, 100,000- ₦2,000,000 with 37.5%, ₦510,000 - ₦1,000,000 with 12.5%, while the least were those that earned less than ₦500,000 per annum with 7.5%. This situation encourage more energy consumption and more waste generation.

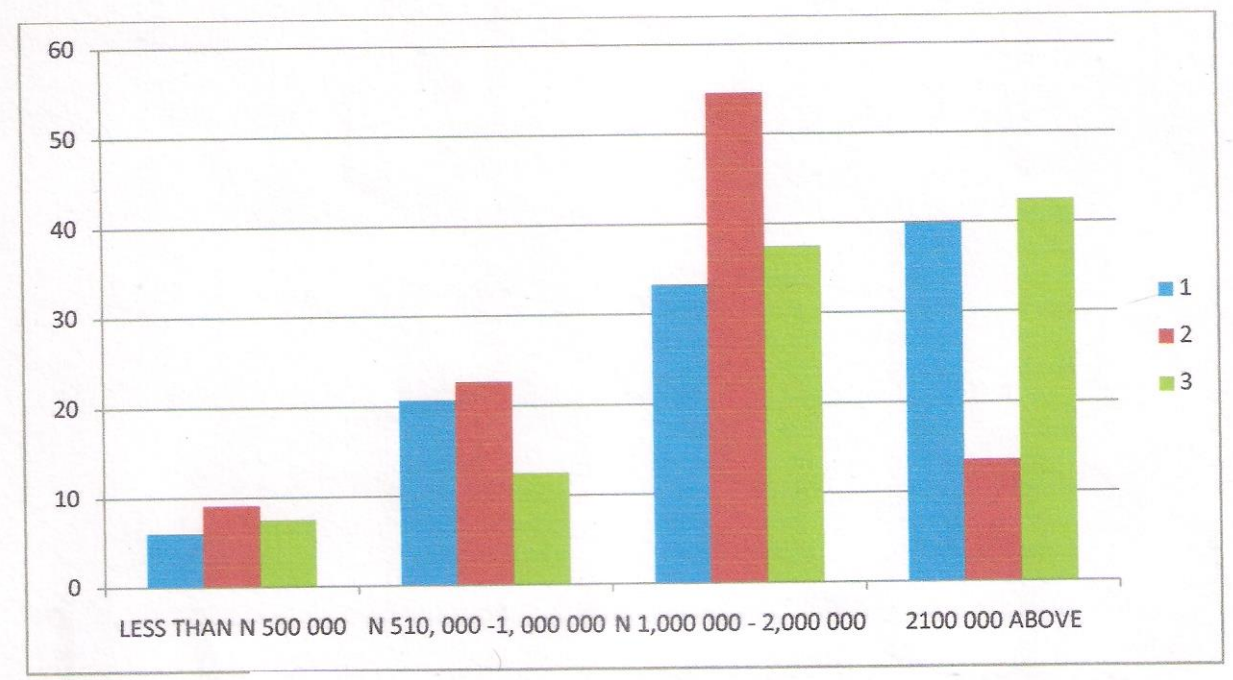


Figure 4.4. Average total income per annum of the people in the study area

Key

1-Mararaba

2-Karu

3-Masaka

Source: Fieldwork, 2017

4.2. Source of emitting or allowing radiation of G.H.G in the Built Environment

4.2.1. Source of Encrgy in Mararaba, Karu and Masaka

Table 4.5 indicate that in Mararaba 3.3% uses Electricity, 4% use generator, 73.3%% use electricity/generator, 2.7% use electricity/solar while 16.7% uses Electricity/Generator/Solar. In Karu 6.8% use electricity, 3.2% uses generator, 83.2% use electricity/generator, 2.3% use electricity/solar while 4.5% use electricity/generator/solar. While n Masaka 6.3% uses electricity, 3.1% use generator, 81.5% use electricity/ generator, 2.5% use electricity/solar while 5.696 use electricity/generator/solar. Each of the study areas accumulated percentage was 100%

Electricity/Generator in Mararaba electricity/generator are the major source of energy in the built environment with 73.3%, followed by electricity/generator/solar 16.7%, generator 4%, electricity 3.3% while the least was electricity/solar with 2.7%. In Karu electricity/generator are the major source of energy in the built environment with 83.2%, followed by electricity 6.8%, electricity/generator/solar 4.5%, generator 3.2%, while the least were electricity/solar with 2.3% While in Masaka electricity/generator are the major source of energy in the built environment with 81.5% followed by electricity 6.3%, electricity/generator/solar 5.68, generator 3.1% while the least were with 2.5%. electricity/solar Electricity and generator are one of the major contributor of carbon emission.

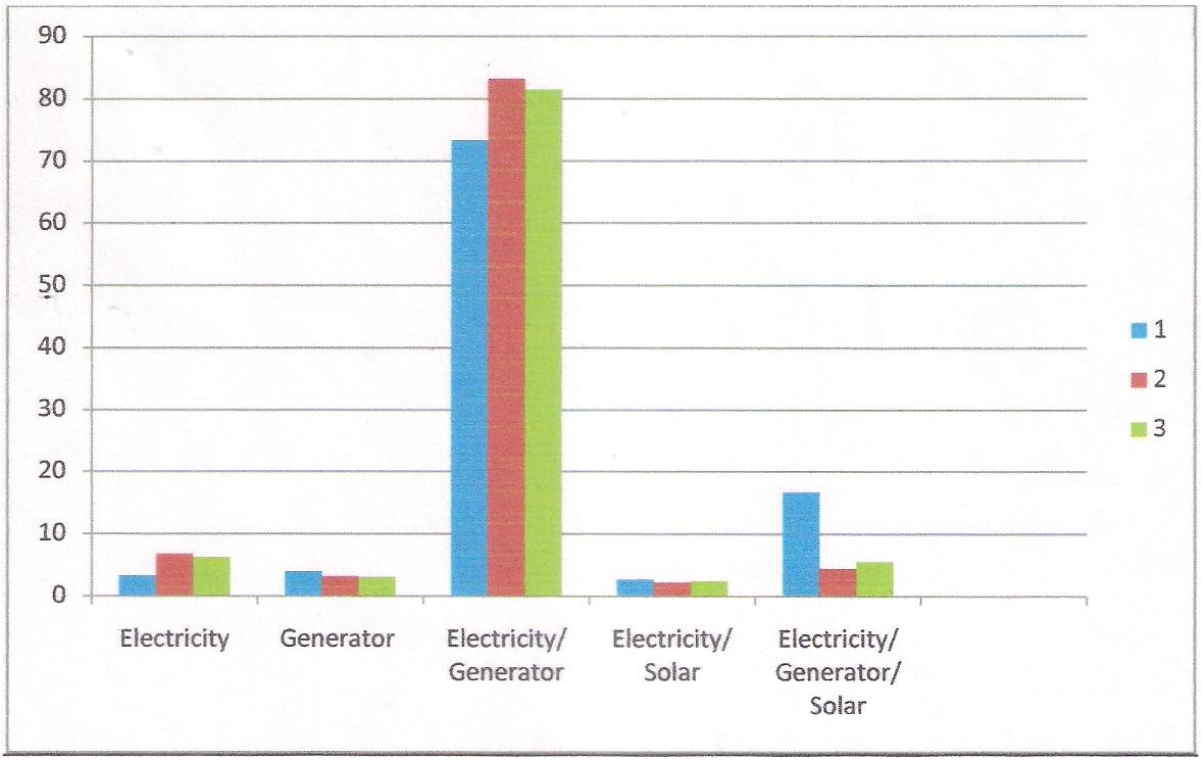


Figure 4.5: source of energy in the study area

Key.

1. Mararaba
2. Karu
3. Masaka

Source: Field work 2017

4.2.2. Type of Energy often use in Cooking/Production Mararaba, Karu and Masaka

The result in table 4.6 indicate that in Mararaba 67.7% of the people often uses fuel wood in cooking/production, 8.3% often uses gas, while 0.7% often use kerosene stove. In Karu 88.2% of the People often use fuel wood, in cooking/production, 3.6% often uses electricity, 6.4% often use gas while 1.8% often use kerosene stove. While in Masaka 87.5% of respondents often uses fuel wood, 4.3% often uses electricity, 6.9% often use gas while 1.3% often uses kerosine stove. Each of the study areas, the accumulated percentage was 100%.

Fuel wood in Maraba take the highest number of people with 67.7%, followed by gas with 23.3%, electricity 8.3% while kerosene stove took the lcast with 0.7%. In Karu Fuel wood took the highest responds with 88.2%, followed by gas 6.4%, electricity 3.6% while kerosine stove took the least with 1.8%. While in Masaka Fuel wood took the highest responds with 87.5%, followed by gas 6.9% electricity 4.3% while kerosine stove took the least with 1.3%. Fuel wood is a strong contributor of carbon emission than the other three sources.

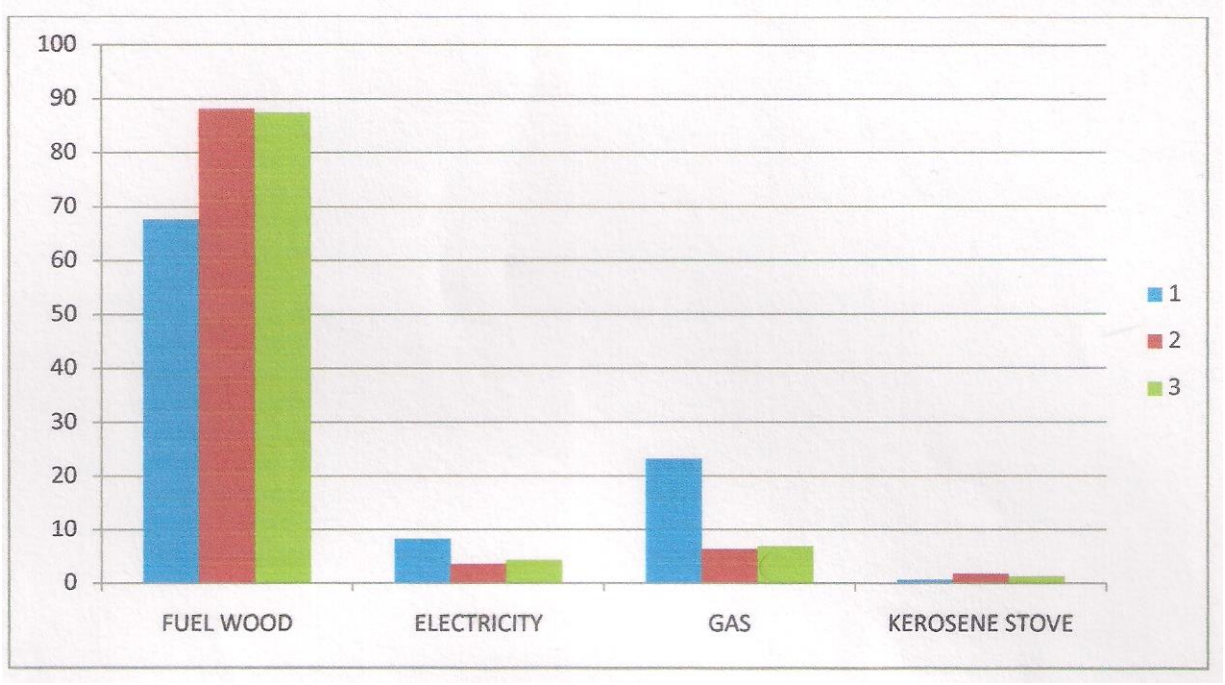


Figure 4.6: Types of energy often used in cooking/production in the study area

Key

1- Mararaba

2- Karu

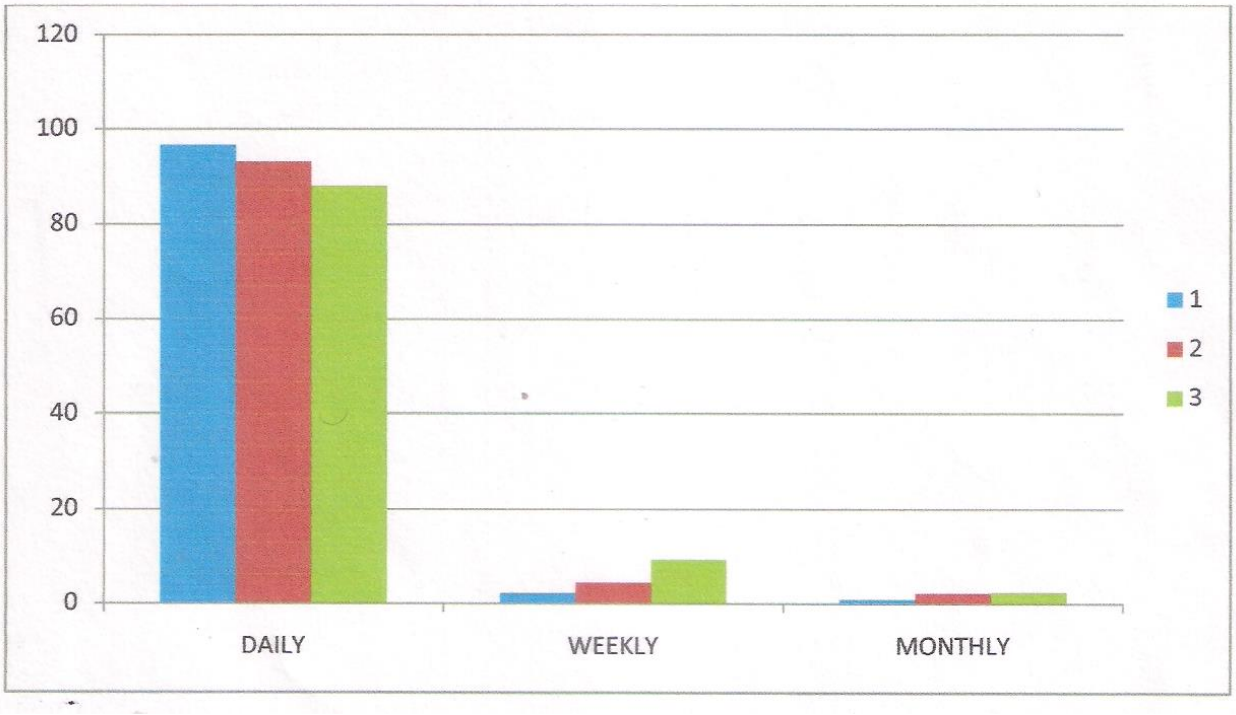
3- Masaka

Source: Fieldwork, 2017

4.2.3. Frequency of Waste Generation in Mararaba, Karu and Masaka

Table 4.7 shows that in Mararaba 96.7% generate daily waste 2.3% generate weekly waste, while 19% generate monthly waste. In Karu 93.2% generate daily waste, 4.5% generate weekly waste while 2.3% generate monthly waste. While in Masaka 88.1% generate daily waste, 9.4 generate weekly waste while 2.5% generate monthly waste. Each of the study areas accumulated percentage was 100%.

Daily waste generation in Mararaba is the highest with 96.7% followed by weekly generation 2.3% while monthly generation is the least with 1%. In Karu daily waste generation is the highest with 93.2%, followed by weekly generation 4.5% while monthly generation was the least with 2.3% While in Masaka daily generation is the highest with 88.1%, followed by weekly generation 9.4%,while monthly generation was the least with 2.5%. Waste of any kind contribute to G.H.G emission.



Frequency of waste generation in the study area.

Figure 4.7:

Key

1- Mararaba

2- Karu

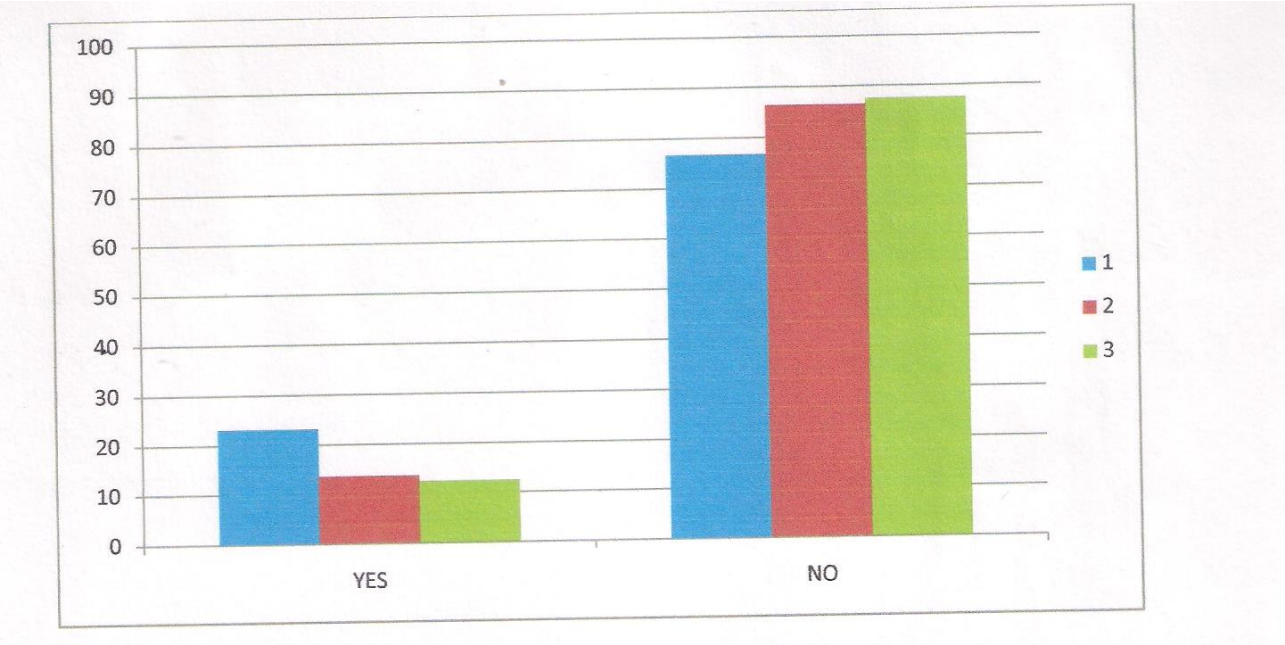
3-Masaka

Source: Fieldwork, 2017

4.2.4. Maintaining Vegetation after Construction in Mararaba, Karu and Masaka

The result in table 4.8 indicate that in Mararaba 23.3% maintained vegetation after construction, while 76.7% do not maintained vegetation after construction. In Karu 136% maintained vegetation after construction while 86.4% do not maintained vegetation after construction. While in Masaka 12.5%% maintained vegetation after construction, while 87.5% do not maintained vegetation after construction.

The highest in Mararaba are those that don't maintained vegetation is 76.7% while least is on those that maintained vegetation 23.3%. In Karu the highest on those that don't maintained vegetation is 86.4% while least are those that maintained vegetation 13.6. While in Masaka the highest projection on those that don't maintained vegetation is 87.5% while least was on those that maintained vegetation 12.5%. Absence of vegetation cover permit carbondioxide in the ground and around the built environment to radiate freely to the atmosphere.



Figures 4:8 maintaining vegetation after construction in the study areas

Key.

1. Maraba
2. Karu
3. Masaka

Source; Fieldwork, 2017

4.3. Determine the Green House Gas Emission from the Built Environment of Mararaba, Karu and Masaka

The gaseous pollutants measured as shown in table 4.9, in all the study areas the measurement varies. Some were the same while others were different. In Mararaba built environment, carbondioxide (Co) recorded highest by 450ppm at highway and least by 300ppm at others, carbonmonoxide (Co) recorded highest by 10.8ppm at highway and least by 4.5ppm at Hospital/Clinic Particulate matter (pm) recorded highest by 146.3 ug/m at the highway and least by 20.5 ug/ m at others, while Nitrogen dioxide (No_2) recorded the highest by 0.20ppm at highway and least by 0.02ppm at Hospital/Clinic. See figure 4.10 And in Karu Carbondioxide (Co_2) recorded highest by 400ppm at commercial area and see figure 4.11 least by 200ppm at school/office and others, carbonmonoxide (Co) recorded highest by 10.5ppm at highway and least by 4.2ppm at Hospital/Clinic, particulate matter (pm) recorded the highest by 82.8 ug/m at highway and least by 18.2 ug/ m al others while Nitrogen dioxide (Noz) recorded the highest by 0.20ppm at highway and school/office and least by 0.01ppm at Residential, Hospital/Clinic and others. While in Masaka Carbondioxide (Co_2) recorded highest by 400ppm at commercial area and least by 250ppm at others, carbonmonoxide (Co) is recorded highest by 10.5ppm at highway and commercial area while least recorded by 3.0ppm at hospital/clinic, particulate matter (pm) is recorded highest by 68.1 ug/m at highway and least by 20.4 ug/m' at others, while Nitrogen dioxide (No_2) recorded

highest by 0. 1lppm at highway and least by 0.01ppm at school/clinic and others. See figure 4.12

Table 4.9 Gasesous pollutants measurement in the study Area

Built environment	Co_2 (ppm) daily average hourly			Co (ppm) daily average hourly			Pm (ag/m3) daily average hourly			No_2 (ppm) daily average hourly		
	Mara raba	Karu	masaka	Mara raba	Karu	Masaka	Mara raba	karu	masaka	mararaba	Karu	Masaka
Industry	350	330	300	8.2	4.5	3.2	65.6	81.5	52.4	0.10	0.02	0.07
Highway	450	360	340	10.8	10.5	10.5	146.3	82.8	68.1	0.20	0.20	0.11
Commercial area	390	400	400	8.7	7.0	6.0	78.5	70.2	66.0	0.10	0.10	0.05
Residential	400	330	290	7.0	6.0	7.0	69.8	60.3	67.3	0.03	0.01	0.06
Hospital/clinic	340	290	280	4.5	4.2	3.0	64.6	61.5	54.0	0.02	0.01	0.02
School/office	350	200	265	8.6	5.5	4.5	64.8	79.5	59.8	0.10	0.20	0.01
	300	200	250	6.8	4.9	4.8	20.5	18.2	20.4	0.05	0.01	0.01
Others	300	200	250	6.8	4.9	4.8	20.5	18.2	20.4	0.05	0.0	0.01

Source: Fieldwork, 2017

Plate 4.1. Picture showing commercial area at mararaba with generators working
Source: Fieldwork, 2017

Plate 4.2. Picture showing dumps of refuse at karu highway along mararaba Road.
Source: Fieldwork, 2017

Picture showing residential building Mall. Isa's compound Tudun Wada at masaka
Source: Fieldwork, 2017

4.4. Assessing the effect of the Gaseous Pollutants on the Air Quality in Mararaba, Karu and Masaka

The concentration of gaseous pollulants like Co2, Co, Pm and No2 in the study areas were presented in table 4.10 in Mararaba Co has 74.2%, Co has 74%, Pm has 29.2%% and No2 has 150%. And in Karu Co2 has 60.8%, , Co has 61%, Pm has 26% and No2 has 125%. While in Masaka Coz has 59% Co has 62% Pm has 22.2% and No2 has 125%. Each of the percentages obtain is based on the Nigeria standard. See table in appendix B.

The highest gaseous polluianis base on permissible limit is No_2 with 150%, followed by Co2 with 74.2%, Co with 70% and least is Pm with 29.2%. And in Karu the highest gaseous pollutants base on permissible limit is Pm with I25%, followed by Coz with 60.8%, Co with 61% and the least is Pm with 26%. While in Masaka the highest gaseous pollutants based on permissible limit is No2 with 125%o, followed by Co with 62%, Co2 with 59.6% and the least is Pm with 22.2%. No2 exceed the maximum permissible limit Pm, Co2 and Co were below the limit, although $C0_2$ and Co have high percentage.

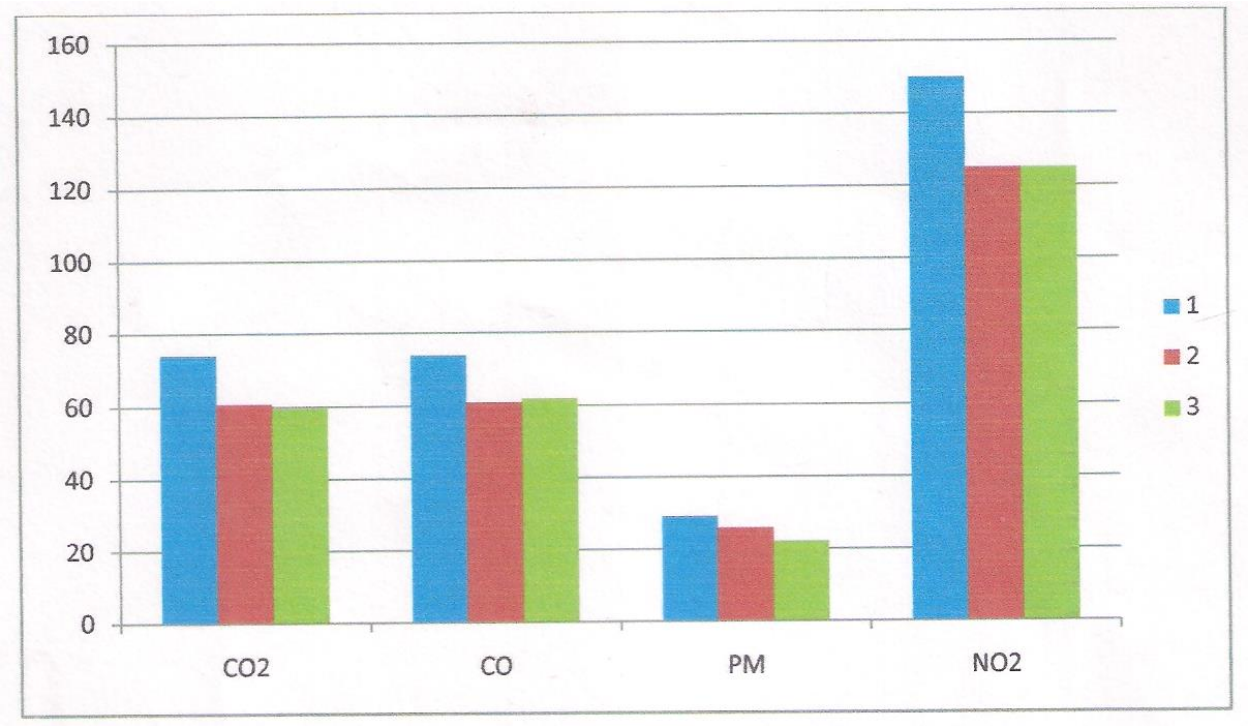


Figure 4.9: Gaseous pollutants assessment on the air quality in the study areas.

Key
1- Mararaba
2-Karu
3- Masaka.
Source: Fieldwork, 2017

4.5. Variation in GAG Emission Rate between Industry and Highway with the other five Built Environment.

The data on table 4.11 is obtained by taking the mean of the gaseous pollutants in the built environment of the areas. The result indicated that the mean of $C0_2$, Co, Pm and No_2 in the columns are 334.7, 7.4, 69.97 and 0.09 respectively. While in the row, the mean is 111.64 in industry and highway and 94.41 in the five other built environment.

The record on table 4.31 obtained by taken the mean of the gaseous pollutants in the built Environment. The result shows that industry and highway recorded the highest emission than the other five built environment with 111.64 and 94.41 row mean respectively. It also shows a significant concentration of the emission in the other five built environment, so this also contribute greatly on the concentration of the gaseous pollutant in the study area.

Table 4.11 Two-way Analysis of variance

Reasons	Gaseous rates in the study areas								Total
	Co_2	(Co_2)	Co	$(Co)^2$	PM	$(PM)^2$	No_2	(No_2)	
Industry. Highway	400 345 320	160,000 119025 102400	9.5 7.4 8.9	90.25 54.76 79.2	106 82.2 60.3	112.36 6756.8 3636.1	0.15 0.11 0.09	0.023 0.012 8.1	
	Σ=1065 $\bar{X}$=355	Σ 381425	Σ = 25.8 $\bar{X}$ = 8.6	Σ =224.21	Σ =248.5 $\bar{X}$ =82.83	Σ $\bar{X}$ =21628.9	Σ =0.35 $\bar{X}$ =0.12	Σ =8.14	Σ =1339.65 $\bar{X}$ =111.64
Five other built environment	360 294 289	129600 86436 83521	6.5 5.6 6.6	42.25 31.36 43.56	59.2 58 54	3504.6 3364 29.16	0.06 0.07 0.03	3.6 4.9 9	
	Σ =943 $\bar{X}$ =314.3	Σ =299557	Σ =18.7 $\bar{X}$ =6.2	Σ =117.17	Σ =171.2 $\bar{X}$ =57.1	Σ =9784.6	Σ =0.16 $\bar{X}$ =0.05	Σ =17.5	Σ = 1133.06 $\bar{X}$ =94.41
Total	Σ =2008 $\bar{X}$ =334.7		Σ =445 $\bar{X}$ = 7.4		Σ =419.7 $\bar{X}$ =69.97		Σ =0.51 $\bar{X}$ =0.09		1339.65+1 133.00 Σ=2472.71 $\bar{X}$=103.04

Source: Fieldwork, 2017

The test of ANOVA for variation between industry and highway with the other five built environment shows that there is significant variation since the result of the test of interaction is greater than one. Nevertheless, the concentration of the emission in the other five built environment is also higher. As such it also contributes to the concentration of the gaseous pollutants in the study area.

Table 4.12 Anova

Source of variation	Sum of square	Degree of freedom	Variance estimate
Total	458000199	23	19913.05.
Between sub class	450429.92	7	64347/13
Between column (gaseous rate)	446936.49	3	148978.83
Between row (region).	1778.31	1	1778.31
Interaction	1715.12	6	285/85
Error	7507.28	16	469.21

Source: Fieldwork, 2017

Test for the effect of Region on Gaseous Rate

$$\frac{\text{F- B/W rows estimate}}{\text{error estimate}}$$

$$= \frac{1778.31}{469.21} = 3.79$$

We concluded that regional factors do have some effect on the rate of gaseous pollutants.

4.6 Discussion of Findings

The study under socio-demographic characteristic of the respondents reveals that majority of the respondents were married. This has a great influence on the population growth. Household size of 4 person above were the most frequent occurring among the respondents in the study areas. This contributed immensely to the Urbanization of the area. Resulting in more waste generation and demand for high energy consumption in the areas.

Civil servant had a high percentage in the study area, thereby influencing the demand of more energy consumption and generation of more waste. Majority of the respondents in Maraba and Masaka earn ₦2,100,000 above per annum while in Karu the majority earns between ₦1,100,000 to ₦2,000,000 per annum. This has contributed to more consumption of energy and waste generation. Increasing in population, generate more waste and more demand n energy, which subsequently eriute more GHG.

Responds from the study areas shows that electricity/generator dominated the other sources of energy used and this is as a result of inadequacy of electricity. Thus, the two sources contribute to the carbon emission, but generator is worst than electricity. The product of generator as waste arc particulate matter, Nitrogen oxide, Sulphur oxide, Carbondioxide and toxic pollutants. Fuel wood occurred frequently than any other source of energy used in cooking/production in the surveyed areas. The level of our economic contribute to the usage of this source. Fuel wood is a strong contributor of carbon emission.
Daily waste generation has become the order of the day. As long as substance is use daily, it becomes inevitable for daily waste generation. The responds on maintaining vegetation after construction was less throughout the areas surveyed. Carbondindioxide in the ground easily radiate to the atmosphere as a result of the lost of vegetation. Looking at the percentage of electricity/generator used, fuel wood used, daily waste generation and maintaining vegetation after construction can influence high emission of GHG within the built environment.

The measurement of concentration of gaseous pollutants in the study area revealed that Co_2 is very high, though it is not up to the maximum permissible limit. Clearing vegetation during construction and not maintaining after construction has contributed greatly to the level of his emission. Since plants that will absorb Co2 are few in numbers.

Concentration of Co measured in the study area is very high, to the extent that places like highway in all the surveyed areas and commercial area in Masaka recorded above the maximum permissible limit and those that are below the limit are still danger to human health when staying under it for a long carbon emission is the most serious problem in ozone layer deflection smoke from engine or generator fuel wood and vehicles has attributed to Co concentration generators are mostly used due to the inadequate of electricity supply. Most of the cooking/production made in the study are by fuel wood or engine. Vehicle in the study areas also generate a lot of smoke.

Particulate matter (Pm) had the least concentration in the study areas since burning of fissile fuel is not taking place within the study areas. The concentration of No_2 in the study area is above maximum permissible limit the smoke from vehicle and engine attributed greatly to the concentration of this gas.

The difference in the GHG emission within the study area are largely due to the rate of Urbanization in the areas Mararaba has the highest population therefore recorded the highest emission while Masaka the least populated, recorded the least emission.

Despite the fact that highway and industry recorded the highest emission of the gaseous pollutants the other five built environment also have higher amount of G.H.G emission. The NOVA test reveal that there is a significant variation between highway and industry with the other five built environment.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1. Summary of Findings

The demographic characteristic of people in Mararaba, Karu and Masaka shows that in all the three areas surveyed, majority of the people were married. The data indicated 78.7%, 78.7% and 66.3% respectively in the areas, while the least of the people were divorced with 3.3%, 3.3% and 5% respectively. Household size of 4 person above were the most frequently occurring among the people in the study areas with 78%, 83.2% and 65.5% respectively. While the least of the people were one person with 3%, 1.8%% and 3.1% respectively.

Self employed forms the majority in Mararaba and Masaka with 43.3% and 45% respectively while in Karu, civil servant forms the majority with 42.7%, private sector employee were the least in the study areas with 6%, 12.5% and 5.5% respectively. Those that earns ₦2,100,000 above per annum were the majority in Mararaba and Masaka with 40% and 42.5% respectively, while those that earns between ₦1,100,000 to ₦2,000,000 form the majority in Karu. Earners less than ₦500,000 per annum were the least in the study areas with 6%, 9.1% respectively.

The most frequent sources of energy in the study areas were electricity/generator with 73.3%, 83.2% and 815% respectively, while the least were electricity/solar with 2.7%, 2.3% and 2.5% respectively. In terms of cooking/production, the highest sources of energy in the surveyed areas were fuel wood with 67.7%, 88.2% and 87.5% respectively, while the least were kerosene stove with 0.7%, 1.8% and 1.3% respectively.

Daily generation of waste took the lead with 96.7%, 93.2%% and 88.1% respectively while monthly generation took the least with I%, 2.3% and 2.5% respectively. Unmaintained vegetation after construction dominated the study areas with 76.7%, 86.4% and 87.5% respectively while the least were those that maintained vegetation after construction with 23.3%, 13.6% and 12.5% respectively.

The percentage of some gaseous pollutants or G.H.G measured in Mararaba, Karu and Masaka respectively are as follows; Co2- 74.2%, 60.8% and 59%. Co - 74%, 61% and 62%. Pm - 29.2%, 26% and 22.2% NO_2 - 150%, 125% and 125% among the GHG emission measured in the study areas, only No2 was above maximum permissible limits. Co2 and Co has a significant concentration while Pm was the least recorded. There is also significant concentration or the emission in the other five built environment.

5.2. Conclusions

The built environment GHG emission is without doubt a major contributor to global carbon emissions and has large impact on the natural environment, causing climate change and affecting human health. The impact varies from place to place, Higher urban areas has more impact than less urban areas. A significant concentration of the gaseous pollutant was recorded in all the built environment of the study area, nevertheless, the environment is still habitable.

The built environment of the study areas was stratified into industry highway commercial area, Residential, Hospital/Clinic, School/Offices and others. The emission assessment was that only No_2 is beyond the standard Coz and Co emission in near future will also be above the standard.
Due to tremendous growth in new infrastructural developments in transitional economics of developing countries and the insufficient and improper use of building stock universally, if no tangible steps are taken soon GHG emission from buildings will be more than double in the next two decades (Shubra, 2015).

The uptake of green building concepts and techniques is largely focused on eco-efficiency. Green buildings clearly reduce negative environment impact by being designed to reduce the quantities of materials and energy used by the building and to reduce the negative impact on ecology and human health.

5.3. Recommendation

Based on the research findings and conclusions carried at, the following recommendations are considered:

Adaptation of green building concept will minimizes the use of resources, reduces harmful effects on the environment and provide healthier environment. See Appendix C.

National Energy Policy that places emphasis on the exploitation of Nigeria's renewable and alternative energy sources (wind, solar and biomass) prepared by government through the ministry of science and technology should be actualize.

Promotion of environmental awareness and consciousness on the effect of GHG emission not only from industries and transports but in the other built environment like Residential, Hospitals, Commercial areas School and Offices. This could be done through the state government protection agency by organizing annual safety, Health and environmental week with local government of the state.

Promoting the use of clean fuel by encouraging a shift from kerosine and wood stove to gas-fired stoves through the reduction in the gas price.
The government should adopt the polluter pays principle in all the built environment, since there is a reasonable amount of the gaseous pollutant in each of built environment.

Re-use and recycling of built environmental waste has become more imperative because waste generation has been on the increase with increase in population and economic development and resources have been scarce making recycling as method of waste reduction at the source.

Government should establish a rating system that will evaluate the environmental performance of built environment, so that sustainability will be encourage.
Furthermore, government attention is needed on anthropogenic causes of GHG emission.

5.4. Contribution to Knowledge

The contributions of this work to knowledge are as follows:

The work has trace the sources of GHG emission from the built environment in the study areas.

It has also assessed the effect of some GHG emission on the air quality.

The work has also provide solution by adopting green building concept.

The work has also contributed to the existing body of knowledge because it will serve as a reference material.

5.5. Suggestion For Further Studies

For further research and policy making, should be aimed at the bigger question on how built environment green house gas can provide a positive environmental contribution to human.

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APPENDIX A

QUESTIONNAIRES FOR ASSESSMENT

NASARAWA STATE UNIVERSITY, KEFFI

FACULTY OF SOCIAL SCIENCE

GEOGRAPHY DEPARTMENT

Dear Respondent

I am a post-graduate student of the above mentioned institution carrying out research on the effect of built environment green house gas on the environment in Karu LGA of Nasarawa State Karu metropolitan, Mararaba Twon and Masaka Town are the area selected for this research.

I would appreciate your cooperation in answering this questionnaire to enable me obtain relevant and accurate information. I would also be grateful if you could complete the questions as soon as possible to enable the researcher collect it back on the spot. Any information given would be treated confidentially.

Thanks.

QUESTIONNAIRE FOR HOUSES HOLD HEADS

This questionnaire is meant for research purposes only. Your responses would be treated as confidential.

TOWN……
STREET…….
QUESTIONNAIRE TAG.....

Please tick the appropriate column that gives true information about you.

1. Sex: {a} Male ( ) {b} Female ( )
2. What is your Marital Status?
   - {a} Single ( )
   - {b} Married ( )
   - {c} Divorced ( )
   - {d} Widowed ( )
3. What is your Age?
   - {a} Below 20 ( )
   - {b} 21-30 ( )
   - {c} 31-40 ( )
   - {d} 41-50 ( )
   - {e} 51-60 ( )
   - {f}61-above ( )
4. What is your Religion?
   - {a} Islam ( )
   - {b} Christianity ( )
   - {c} Traditional ( )
   - {d} Others ( )
5. What is your Ethnicity?
   - {a} Gbagyi ( )
   - {b} ( )
   - {c} ( )
   - {d} ( )
   - (e) ( )
   - {f} Others ( )
6. What is the size of your house hold?
   - {a} One-Two Persons ( )
   - {b} Three - Four persons ( )
   - {c} Five- Six persons ( )

{d} Seven above ( )

7. Highest Educational Qualification.
   {a} Primary School Certificate ( )
   {b} Secondary School Certificate ( )
   {c} Tertiary Certificate ( )
   {d} Quranic/Bible School ( )
   {e} Non of the above ( )
8. What is your Occupation?
   {a} Civil Servant ( )
   {b} Private Sector Employee ( )
   {c} Self Employed ( )
   {d} Artisan ( )
   {e} Other {Specify} ( )
9. What is your average total income per annum?
   {a} Less than ₦50,000 ( )
   {b} ₦50,000 ₦250,000 ( )
   {c} ₦250,000 - ₦450,000 ( )
   {d} Above - ₦450,000 ( )
10. What are your source of energy?
   {a} Electricity ( )
   {b} Generator ( )
   {c} Electricity and Generator ( )
   {d} None of the above ( )
   {e} Solar Panel ( )
11. How often do you have electricity supply?
   {a) Daily ( )
   {b}Twice a week ( )
   {c} Once a week ( )
   {d} Occasionally ( )
   {e} Rationally ( )
12. How frequent do you used their source of energy
   {a} Daily Bases ( )
   {b} Weekly Bases ( )
   {c} Monthly Bases ( )
13. Rate the usage of the energy source by indicating 1 to the highest and then 4 to the lowest.
   {a} Electricity ( )
   {b} Wood fuel ( )
   {c} Generator ( )
   {d} Solar panel ( )

14. What are your electrical appliances?

{a} Pressing Stone ( )

{b} Grinding Machine ( )

{c} Refrigerators ( )

{d } Sound System ( )

{e} All of the above ( )

{f} Air conditioning/shaving machine ( )

15. How frequent do you use this appliances?

(a} On Daily Bases ( )

{b} On Weekly Bases ( )

{c} On Monthly Bases ( )

16. What type of energy do you often use in cooking'?

{a} ( )

{b} Electricity ( )

{c} Gas ( )

{d} Kerosine stove ( )

17. What is the rate of use?

{a} Half a truck for one week ( )

{b} Half a truck for two weeks ( )

{c} Half a truck for one month ( )

{d} A truck for three months ( )

18. How many grinding machine do you have in your compound?

{a} Non ( )

{b}1-2 ( )

{c} 3-4 ( )

{d} 5 above ( )

19. How frequent do you generate waste?

{a} Daily ( )

{b} Weekly ( )

{c} Monthly ( )

20. Is the waste generation increasing or decreasing?

{a} Yes ( )

{b} No ( )

21. How do you pack your refuse? In

{a} Refuse Bag ( )

{b} Drum ( )

{c} Refuse Bin ( )

{d} Others {Specify} ( )

22. Who provides the means by which you pack your waste?

{a} Self ( )

{b} NISEPA ( )
{c} Voluntary Organizations ( )
{d} Others {Specify} ( )

23. How would you describe the method of packing your household refuse?
{a} Very appropriate ( )
{b} Appropriate ( )
{c} Inappropriate ( )
{d} Very Inappropriate ( )

24. What is the main staple food consumed in your house?
{a} Cereals ( )
{b} Root Crops ( )
{c} Cereals and Root Crops ( )
{d) Package Food ( )
{e}Others (specify)…….

25. Classify your household refuse into the following categories.
{a} Food left-over ( )
{b} Papers and wraps ( )
{c} Vegetables ( )
{d} Plastics ( )
{e} Metals ( )

26. Which category best describes your households refuse?
Specify)…….

27. How frequently do you dispose your household refuse?
{a} Daily ( )
{b} Twice a week ( )
{c} Once a week ( )
{d} Monthly ( )
{e} Occasionally ( )
{f} Non of the above ( )

28. Where do you dispose your refuse?
{a} Open space ( )
{b} Designated depot/dump site ( )
{c}Unauthorized depot/dump site ( )
{d} Collection point ( )
{e} Others {specify}…….

29. How far do you travel to dispose your household refuse?
{a} Less than 50m ( )
{b} 50m to < 100m ( )
{c} 100m to < 150m ( )
{d} 150m to < 200m ( )

{e} 200m and above ( )

30. How frequently is refuse cleared from the central collection points?

{a} Weekly ( )

{b} Monthly ( )

{c} Quarterly ( )

{d} Occasionally ( )

31. How appropriate is the method of packing refuse from collection points?

{a} Very appropriate ( )

{b} Appropriate ( )

{c} Inappropriate ( )

{d} Very inappropriate ( )

32. The following are the major problems generally associated with disposal of household refuse?

{a} Dumping of refuse in an open space ( )

{b} Inadequate authorized dump sites ( )

{c} Infrequent clearing of dump sites ( )

{d} Most unauthorized dump site are inaccessible ( )

{e} inadequate number of personnel to handle waste ( )

the problems in terms of their seriousness. For example, the most serious problem should be rated 1, the next most serious should be rated 2 and so on

33. Do you clear all the vegetation cover on the site before construction?

{a} Yes ( )

{b} No ( )

33. Do you maintain the vegetation of the area after building construction?

{a} Yes ( )

{b} No ( )

34. Did you ever demolish your building?

{a} Yes ( )

{b} No ( )

35. How many cars do you have in your compound'?

{a} l-2 ( )

{b} 3-4 ( )

{c}5-6 ( )

{d}7-8 ( )

QUESTIONNAIRE FOR AN ORGANIZATION

The questionnaire is meant for research purposes only. Your responses would be treated as confidential.

ORGANIZATION .....
LOCATION……..
QUESTIONNAIRE TAG……

Please tick the appropriate column that gives true information about you.

1. Sex: {a} ( ) {a} Female ( )
2. What is your Marital Status?
   - {a} Single ( )
   - {b} Married ( )
   - {c} Divorced ( )
   - {d} Widowed ( )
3. What is your Age?
   - {a} Below 20 ( )
   - {b} 21-30 ( )
   - {c} 31-40 ( )
   - {d} 41-50 ( )
   - {e} 51-60 ( )
   - {f} 61-above ( )
4. What is your Educational Qualification?
   - {a} Non formal Education ( )
   - {b} Primary School ( )
   - {c} Secondary School ( )
   - {d} OND/NCE ( )
   - {e}HND/Degree ( )
   - {f} Postgraduate ( )
5. What is your Religion?
   - {a} Islam ( )
   - {b} Christianity ( )
   - {c} Traditional ( )
   - {d} Others ( )
6. What is your Ethnicity?
   - {a} Hausa ( )
   - {b} Igbo ( )
   - {e} Yoruba ( )
   - {d} Igbera ( )

{e} Others ( )

7. What is your post in the organization?

{a} Personnel ( )

{b} Security ( )

{c} Casual ( )

{d} Official ( )

8. What is the number of the staff in your organization?

{a} 15-30 ( )

{b} 31-45 ( )

{c) 46-60 ( )

{d}61-75 ( )

{e} 76-above ( )

9. What are your organization rendering?

{a} Production of goods {specify}……..

{b Sales of goods

{c} Education

{d} Health

{e} Services

10. What are the organization major source of energy (please indicate 1,2, 3, 4 in the descending order of use?

{a} Electricity ( )

{b} Generator ( )

{c} ( )

{d} Solar panel ( )

11. How frequent do you used these source of energy?

{a} Daily ( )

{b} Once in a week ( )

{c} Twice in a week ( )

{d} Monthly bases ( )

{e} Occasionally ( )

12. What is the mode of your operation'?

{a} Monday to Friday ( )

{b} Daily ( )

{c} Occasionally ( )

13. How do you pack your refuse? in

{a} Refuse bag ( )

{b} Drum ( )

{c} Refuse bin ( )

{d} Other {Specify}…….

14. How would you describe the method of packing your refuse?

{a} Very appropriate ( )
{b} Appropriate ( )
{c} inappropriate ( )
{d} Very inappropriate ( )

15. Classify your refuse into the following categories.
{a} Paper and wraps ( )
{b} Vegetables/food stuff ( )
{c} Plastics ( )
{d} Metals ( )
{e} Bantages ( )
Which category best describes your refuse {specify}.....

16. How frequently do you dispose your refuse?
{a} Daily ( )
{b} Twice a week ( )
{c}Once a week ( )
{d}Monthly ( )
{e}Occasionally ( )

17. Where do you dispose your refuse?
{a} Open space ( )
{b} Designated depo/dump site ( )
{c} Unauthorized depot/dump site ( )
{d} Collection point ( )

18. Do you have a waste conveying vehicle?
{a} Yes ( )
{b} No ( )

18. How frequently is refuse cleared from the central collection points?
{a) Weekly ( )
{b} Monthly ( )
{c}Quarterly ( )
{d} Occasionally ( )

19. How often do you have electricity supply?
{a} Daily ( )
{b} Twice a week ( )
{c} Once a week ( )
{d} Occasionally ( )

20. Rate the usage of the energy source by indicating 1, 2, 3, 4 from the highest to the lowest.
{a} Electricity ( )
{b} ( )
{c} Generator ( )
{d} Solar panel ( )

21. What is the rate of use?

{a} Hausa ( )

{b} lgbo ( )

{c} Yoruba ( )

{d} Igbera ( )

{e} Others ( )

APPENDIX B

Respondents from the study area, Gasesous pollutant assessment and compiling ambient air quality standard

Table 4.1 Marital Status in the Study Areas

Marital Status.	Mararaba		Karu		Masaka	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Single	40	13.3	32	14.5	37	23.1
Married	236	78.7	173	78.7	106	66.3
Divorce	10	3.3	8	3.6	8	5
Widow	14	4.7	7	3.2	9	5.6
Total	300	100	220	100	160	100

Source: Fieldwork, 2017

Table 4.2 Household Size in the Study Area

Household Size	Mararaba		Karu		Masaka	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
One person	9	3	4	1.8	5	3.1
Two person	18	6	12	5.5	18	11.3
Three person	39	21.3	21	9.5	32	20
Four person	234	78	183	83.2	105	65.5
Total	300	100	220	100	160	100

Source: Fieldwork, 2017

Table 4.3 Occupational Status in the Study Area

Occupational Status	Mararaba		Karu		Masaka	
	Freq.	Percent	Freq.	Percent	Freq.	
Civil servant	104	34.7	94	42.7	48	30
Private sector employee	18	6	12	5.5	20	12.5
self employee	130	43.3	76	34.5	72	45
Artisan	48	16	38	17.3	20	12.5
Total	300	100	220	100	160	100

Source: Fieldwork, 2017

Table.4.4 Average Total Income Per Annum of the People in the Study Areas

Average Total Income Per annum.	Mararaba		Karu		Masaka	
	Freq.	**%**	**Freq.**	**%**	**Freq.**	**%**
Less than ₦500	18	6	20	9.1	12	7.5
₦5,000-- ₦1,000,000	62	20.7	50	22.7	20	12.7
₦1,100,000-- ₦2,000,000	100	33.3	120	54.6	60	37.5
₦2,100,000 above	120	40	30	13.6	68	42.5
Total	300	100	220	100	160	100

Source: Fieldwork, 2017

Table 4.5: Source of Energy in the Study Areas

Source of energy.	**Mararaba**		**Karu**		**Masaka**	
	Freq.	**%**	**Freq.**	**%**	**Freq.**	**%**
Electricity	10	3.3	15	6.8	10	6.3
Generator	12	4	7	3.2	5	3.1
Electricity/generator	220	73.3	183	83.2	132	81.5
Generator/solar	8	2.7	5	2.3	4	2.5
Generator/Gen/solar	50	16.7	10	4.5	9	5.6
Total	300	100	220	100	160	100

Source: Fieldwork, 2017

Table 4.6 Type of Energy Often use in Cooking/Production in the Study Areas

Type of energy use in Cooking/production.	**Mararaba**		**Karu**		**Masaka**	
	Freq.	**%**	**Freq.**	**%**	**Freq.**	**%**
Fuel wood	203	67.7	194	88.2	140	87.5
Electricity	25	8.5	8	3.6	7	4.3
Gas	70	23.3	14	6.4	11	6.9
Kerosene stove	2	0.7	5	1.4	2	1.3
Total	300	100	220	100	160	100

Source: Fieldwork, 2017

Table 4.7: frequency of waste generation in the study areas

Frequency of Waste generation.	**Mararaba**		**Karu**		**Masaka**	
	Freq.	**%**	**Freq.**	**%**	**Freq.**	**%**
Daily	290	96.7	205	93.2	141	88.1
Weekly	7	2.3	10	4.5	15	9.4
Monthly	3	1	5	2.3	4	2.5
Total	300	100	220	100	160	100

Source: Fieldwork, 2017

Table 4.8: Maintaining Vegetation After Construction in the Study Areas

Maintaining vegetation After construction.	Mararaba		Karu		Masaka	
	Freq.	%	Freq.	%	Freq.	%
Yes	70	23.3	30	13.6	20	12.5
No	230	76.7	190	86.4	140	87.5
Total	300	100	220	100	160	100

Source: Fieldwork, 2017

Table Compiling Ambient Air Quality Standards

Pollutants	Time of Average	Nigeria Standard	USEPA Standard	WHO Guideline	European Commission Standard
Particulates	Daily average of daily values 1 hour	250ug/m^3 *600ug/m^3	150ug/m^3	50 ug/m^3	25ug/m^3
Sulphure Oxides (Sulphur Dioxide)	Daily average of hourly values 1 hour	0.01 ppm (26ug/m^3) 0.1 ppm (26ug/m^3)	0.5 ppm 0.075 ppm	20ug/m^3	125ug/m^3 350ug/m^3
Carbondioxide	Daily average of hourly	500 ppm	-	-	-
Carbon Monoxide	Daily average of hourly values 8-hourly average	10 ppm (11.4ug/m^3) 20 ppm (22.8ug/m^3)	9 ppm	-	10 ppm
Nitrogen Oxides (Nitrogen Dioxide)	Daily average of hourly values (range)	(75.0ug/m^3 – 113ug/m^3) 0.04 ppm	0.053 ppm	40ug/m^3	40 ug/m^3
Photochemical Oxidant	Hourly values	0.06 ppm			

Source: Field Work, Adesina 2016

APPENDIX C

PAPER PRESNETED AND REVIEW BY CHRISTIANA DU PLESSIS AND JEREMY GIBBERD ON GREEN BUILDING IN SOUTH AFRICA EMERGING TRENDS, MARCH 2009

Green building is no longer merely about technical and practical solutions to energy and carbon emissions reduction but has moved towards a philosophy of being in harmony with the national environment in terms of form and function. One technique that has gained popularity is that of using living or green roofs. A grecn roof is a roof of a building that is partially or completely covered with vegetations and soil or a growing medium planted over a membrane. This type of roof has several advantages including its beauty, its ability to assist the house with blending into the environment and providing climatic stabilization. A living roof reduces heating by adding the mass and thermal resistance valuc and cooling by evaporative cooling loads on a building, reduces storm water run-off, filters pollutants and carbon dioxide out of the air and increases wildlife habitat in built-up areas, among other advantages. It is believed that if 8% of roofing in the city is green then the ambient temperature in the city can be reduced by up to 2 degrees. That is significantly cuts the effects of global warming and city heat islands (Cooper, 2008). A well known example of a living roof structure is that of the school of Art, Design and Media at Nanvang Technological University in Singapole (figure3). The second example is at the Technical University of Delft, Holland (figure 2).

Figure 1. The school of art, design and media
At Nanyang Technological University in Singapore

Figure2. Technical University of Delhi, Holland

In South African, examples of green roof at Nelson Mandela Squire in Santon at the Grace hotel in rose bank and forum Homini at the cradle of human kind (figure 3)

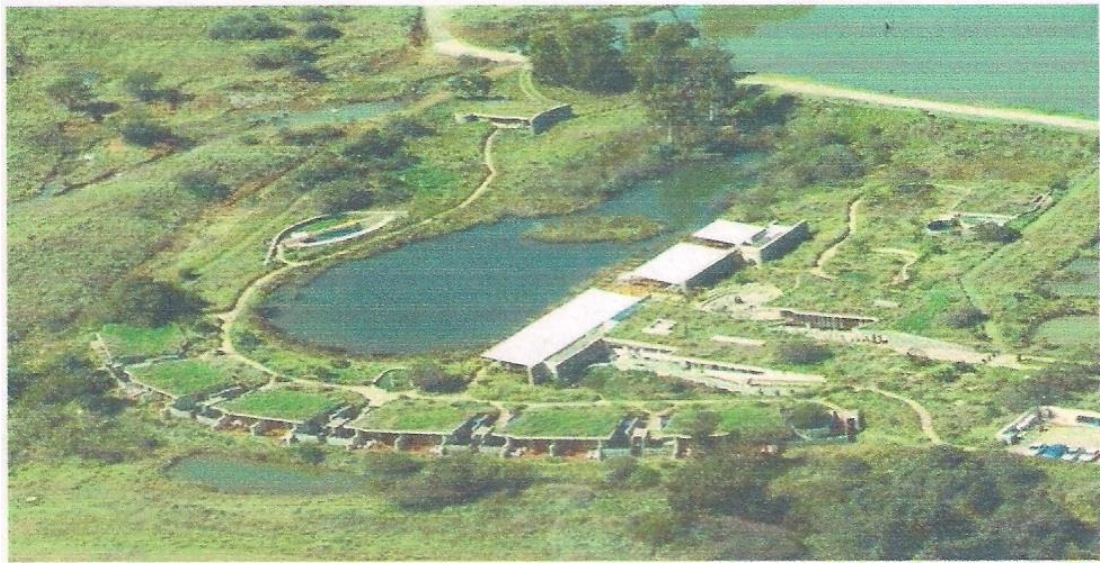

Figure3. living Roofs at forum Homini at the Cradle of humankind

Living walls are also called biowells or vertical gardens. Vertical gardens can be grown on just about any type of well with or without the use of soil and they can be placed both on out door and indoor walls. A popular example of a living wall is at the muse du quai branly, Paris, in France (figure 3). Active living walls are new, concept in which the living wall is integrated into a building's air circulation system. These walls attempt to make use of biofiltration and phytoremediation to draw air through the roof system of the wall. Beneficial microbes actively degrade the pollutants in the air before returning the now, fresh air back to the building interior.
Passive living walls do not have any means of moving the air into the roof system (http:llen.wikipedia.org/wiki/living wall).

Figure 4, the living wall on the muse du quai Branly, Paris, France
http://www.environmentalgraffiti.com/ecology/15-living-walls-vertial-gardns-sky-farms/1201