Public Awareness and Perception of Socio-Economic Characteristic and Biogas in Gwagwalada Town Abuja, Nigeria

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Abstract: Energy is one of the three most fundamental necessities for sustainable development. The consistently expanding interest for energy to meets domestic requirement and the absence of environment friendly alternatives have devastating effect on the environment. Many studies have shown the importance of renewable energy sources that can militates against the negative consequences of using fuels that have an adverse effect on the environment; these include fuel-wood/charcoal which are commonly utilized in a majority of house-holds.

Thus this study was conceived to evaluate the socio economic feature and biogas awareness and perception in Gwagwalada town, Abuja**.** The methodology includes selection and analysis of administered questionnaires to selected study samples via a descriptive statistics method. The study reveals that more than half (60.0%) of the respondents have not heard about the biogas technology, while 40.0% have heard about the technology due to their age, sex, income level and educational experience.

Keywords: biogas, socio economic, sustainable development, Gwagwalada

1.0 INTRODUCTION

The importance of environmental sustainability however defined, as the foundation for social, institutional, and economic well-being, is becoming globally recognized in development approaches. What remains a challenge is the means by which the environmental sustainability can be best achieved with respect to a given geographical location and scenario (Anjaneyulu and Narasimha; 2005). In Nigeria today there are so many practices that are quite unsustainable to the environment. Environmental degradation, such as deforestation, desertification, waste dumping, wetlands destruction, intensive farming, air and water pollution, keep reaching unprecedented proportions. This is particularly evident in Gwagwalada town, Abuja, Nigeria, which is the study area in this work

The role of sustainable forms of energy in National development and GDP growth as well cannot be over-emphasized. Energy assumes a focal role in the national improvement process as a domestic need and central point of development, whose cost straightforwardly influences the cost of different products and enterprises (Amigun and von Blottnitz, 2008). It influences all parts of advancement, for example, social, monetary, political, and environmental, including access to wellbeing, water, agrarian efficiency, mechanical profitability, training, and other essential administrations that improve personal satisfaction. Guaranteeing the arrangement of satisfactory, moderate, proficient and solid top-notch energy administrations with least

unfavorable impact on the environment in an economical manner isn't just critical for improvement however urgent for African nations a large portion of which are battling to satisfy present energy needs (Amigun and von Blottnitz, 2008).

The goal of environmental sustainability is to minimize the causes of environmental degradations, to halt and, ideally, reverse the processes they lead to. In the short-term, environmental degradation leads to declining standards of living, the extinctions of large numbers of species, health problems in the human population, conflicts, sometimes violent between groups fighting for a dwindling resource, clean water scarcity and many other major problems.

Biogas technology is an environmentally friendly technology and it entails decomposition of organic materials, called Biomass, in anaerobic environment at a given temperature range by anaerobic bacteria resulting in conversion of the organic matter (biomass) into useable gas, mainly a mixture of methane and carbon dioxide commonly referred to as biogas (Parawira, 2009). This gas is suitable for cooking and lighting. Apart from the benefits of biogas for cooking and lighting, the effluent that comes as slurry is rich with various plant nutrients such as nitrogen, phosphorous, and potash, which are essential for plant growth. The slurry therefore serves as inorganic fertilizer which adds both micro and macro nutrients to the soil (Fisseha, 1991 and Fentaw, 2010). Biogas also improves the indoor and outdoor environments as the use would lead to reduction in the incidents of illness from burning of firewood and dung, and reduction in carbon emission as it would save the trees necessary to sequester more carbon from the atmosphere, abating soil erosion, desertification, loss of soil fertility, avalanches, and landslides (Marry *et al*, 2007).

Many studies state that one of the major causes of deforestation is the collection of firewood for use in rural areas. However, there are other drivers of deforestation which are often overlooked which include access to natural resources. While, it is questionable whether or not firewood collection is a major cause of deforestation, undoubtedly, it is a big contributor to the issue. Depletion of forests is serious issue in many of the rural areas in Nigeria and firewood scarcity in many parts is due to reasons other than collection of firewood, although firewood collection does indeed make the problem worse. This problem along with already depleted soils can lead to a situation where biomass waste that could be helpful in the restoration process is instead used as a domestic fuel. One of the pathways out of this cycle is through the introduction of modern, cleaner and higher quality fuels.

Moreover, the ever-expanding costs of oil based goods all around has made lamp oil, which is the most ordinarily utilized fuel for cooking and lighting unreasonably expensive to many, particularly the country tenants, (Ahmadu, 2009). This, thusly, moves a bigger level of the masses to look for answers for their energy needs from different sources which by and large are adverse to the environment. For instance, there was a 5.5% increase in the dependence on wood fuel for cooking between 2007 and 2008 (NBS, 2009). More so, 79.6% of the households depend on wood fuel for their cooking while kerosene, coal, gas and electricity comes behind from distant 18.5%, 1.1%, 0.6% and 0.2% respectively (NBS, 2009). Poorly managed forests have to shoulder immense burden to meet the increasing demand for energy caused by both the rising population and the lack of development of alternative energy resources.

Notwithstanding meeting the desperate requirement for squander treatment and reusing alternatives to improve a perfect environment, biogas preparing involves the recuperation of

significant worth from squandering items (i.e., waste to riches). In this manner, biogas innovation could be a fitting method for squandering the board, energy source, and riches creation. It is therefore that this exploration is attractive to diagram a course for manageable energy creation and usage while a cleaner and more secure environment is upgraded.

LITERATURE REVIEW

1.1 Socio-Economic Evaluation of Biogas Energy Production and Utilization

Several works of scholars on consumer behaviour has succeeded with regards to uncovering the multifaceted nature of elements engaged with the selection procedure with each investigation just adding to the current assemblage of information in the zone by recognizing new factors to be considered in the social capacity (Bekele, 2003). The unpredictability emerges from the area explicit nature of the issue and the decent variety of purchasers' conditions that make it hard to draw some sensible speculation. These distinctions regularly come from the variety in agro-environmental, financial, and institutional elements among nations, areas, towns, or even family units.

The adopter-discernments hypothesis battles that, in actuality, individuals consider numerous qualities in choosing a given innovation and the defense includes choices requiring investigation of an enormous number of unmistakable and immaterial characteristics of the innovation in a choice help environment (Chan et al., 2000). They state that customers, for the most part, have abstract inclinations for qualities of items and that their interest for a specific item is essentially influenced by their view of item ascribed that clients interface legitimately with the advancements and their impression of the specialized attributes could significantly affect its selection rates. The battle that clients will dismiss that innovation was not fit to their workplace and that which may meddle with different exercises considered progressively significant.

Defenders of the adopter-recognitions hypothesis attest that innovation clients are regularly not given sensible open doors for examinations and consultation on elective advancements expected for them. Therefore, client recognitions on different mechanical advancement alternatives are frequently to a great extent neglected which creates doubt in the innovation being advanced; influencing its reception rates. There is a substantial dependence on look into specialists in choosing innovation choices for general society. Given the intricate arrangement of elements impacting reception choices, master based surviving appraisals of innovation selection may prompt unreasonable and one-sided evaluations. This has prompted the acknowledgment that the appropriation procedure isn't just influenced by the mechanical qualities of the innovation, yet in addition, the financial and conduct characteristics of the innovation utilized. This move in the appropriation of standards is confirmed from the ever-expanding writing on factors influencing the selection of new advancements in ongoing decades. (Jones. 2006)

1.2 Biogas as Energy Source

Biogas is used for the most part for cooking and lighting while the slurry gives a decent Well spring of excrement for soil fruitfulness improvement. For operational biogas plants, family units utilize the slurry as manure for their harvests, particularly vegetables and natural products (Karki, 2009). With appropriate area and development of the biogas units, the slurry will uninhibitedly stream downstream to gardens. Slurry happens in the accompanying normal

structures: A light and rather strong portion, fundamentally straw or stringy particles which buoy to the highest point of the digester framing a filth, A fluid, watery portion staying in the center layer of the digester, A thick portion underneath which is the genuine slurry or muck, and and heavy solids, fundamentally sand and soil particles, which settle at the base of the digester. On average, farmers with at least four heads of local breed cattle can generate sufficient biogas to meet their daily basic cooking and lighting fuel needs (Ukpabi, 2010).

1.3 Energy Sector in Nigeria and Socio-Economic Development

Energy is a significant element for the improvement procedure of any nation. Energy utilization level is a decent marker of financial improvement level of a nation on the grounds that the energy segment has solid effect on destitution decrease through pay, wellbeing, training, sexual orientation and the environment linkages. In present day times, no nation has figured out how to generously lessen destitution without incredibly expanding the utilization of energy or proficiently using energy or potentially energy administrations. Truth be told, energy influences all parts of advancement – social, monetary and environmental (Amigun et al., 2008).

Thusly, the technique received by a nation in energy use is an essential apparatus in accomplishing monetary improvement since financial thriving and personal satisfaction of a nation are firmly connected to the degree of its per capita energy utilization. In this manner arrangement of sufficient, moderate, productive and solid energy administrations with least impact on the environment is critical. In any case, Nigeria, as in numerous other creating nations, while interest for energy is persistently expanding, it’s flexibly isn't expanding proportionately. Endeavors to expand energy flexibly in an offer to coordinate the expanding energy request must be looked for. Along these lines the utilization of creature and harvest squanders to support energy flexibly in Nigeria turns into a significant and promptly accessible alternative.

In any case, as in many creating nations, there is over-reliance on barely any traditional energy sources involving biomass (kindling, charcoal, crop deposits, and so on), oil based goods and network power as the driver of monetary turn of events. Biomass is the primary wellspring of energy for residential use, trailed by Firewood which is the most widely recognized cooking fuel, especially in rustic territories, and is for the most part utilized in the family units, than charcoal and low rate utilizing power.

1.4. Sources of Energy in Nigeria

Domestic energy can exist as renewable sources, which beings a flow or nature can be used over and over again or as non-renewable resources which are finite as their exploitation can lead to the exhaustion of supplies. Domestic energy used in urban households exists in various forms such as electricity, kerosene, fuel wood, liquefied petroleum gas (LPG), petrol gas and so on (Adegbulugbe, 1979).

A. Electricity Early in the 19th century a new form of energy was developed, electricity, the great advantage of electrical energy or electrical power as it is commonly called, is that it can transmitted easily over great distances. As a result, it is the most widely used form of energy in modern civilization (Jame 1996)

Overall hydroelectricity utilization arrived at 816 GW in 2005, comprising of 750 GW of enormous plants and 66 GW of little hydro establishments. Huge hydro limit totalling

10.9 GW was included by China, Brazil and India during the year 2005, yet there was an a lot quicker development (80%) in little hydro plants are by and by found (John 2007).

Hydroelectricity is major source of domestic energy supply and consumption in Nigeria, the hydro potential is estimated at 10,000MW, with a corresponding arrival average energy capacity of about 40,800 GWh (Esan, 1995). The consumption of electricity by different classes of consumers in the country has increased from less than 2000GWh in 1970 to about 8,500 GWh in 1989. In the 1970s, electricity demands double every five years and this increase slowed down in the latter half the 1980-1990 decade due to the downturn in the economy. The president Yardua led administration 2008 and production capacity of 10,000mega watt by the year 2010. Based on the World Bank's forecast growth in electricity paraffin in the United Kingdom and South Africa (not to be confused with the waxy solid also called paraffin wax or just paraffin). The term kerosene is usual in Canada, United States of America, Australia, New Zealand, and Nigeria and so on. Its heating value or heat of combustion is around 18,500 Btv/2b or 43.1 MJ/Kg. It is widely used to power jet-engine air-craft and also commonly used as a heating fuel (John 2007).

B. Kerosene The demand for kerosene (Nigeria National Petroleum Corporation, 1991) in Nigeria has rapidly increased in recent years because of its popularity as an affordable and available form of domestic energy in urban areas. The average consumption has been increased at about 14-16% per annum between 1975 and 1985. However, the growth rate dropped slightly about 12.5% in 1986 and 1990. It is important to note that kerosene is used for dual purposes, thus, apart from its use as domestic for cooking, lighting and so on, it is also used by aviation industry as aviation fuel. This has set a "stain'' on this energy form due to increased number of private airline operators in the country, in line with the privatization programs of the government.

Concurrently, the imbalance in kerosene supply in the country further aggravated by smuggling of the product across the borders to neighbouring countries where kerosene attracts higher prices in foreign currency and also the activities of pipeline vandals who destroy kerosene pipes to expunge kerosene. This usually result to loss of thousand tonnes of kerosene, ecological degradation and loss of life and valuables (Nigeria National Petroleum Corporation, 2005)

According to Osayuki (2005) the total installed capacity of the four Nigeria National Petroluem Corporation (NNPC) refineries in Nigeria is 2,7978,400 metric tones per annum which is not enough to satisfy the current demand of urban households and aviation industry. Presently the price of kerosene is fluctuating on an increasing scale.

C. Liqudifield Petroleum Gas (LPG) As indicated by John(2007), liquified gas (LPG) is a blend of hydrocarbon gases utilized in fuel fabricated during the refining of raw petroleum extricated from oil or gas streams as they rose up out of the ground. Also called cooking gas, liqudified petroluem gas (LPG) is an exceptional household energy source in urban territories as a result of its boss consuming attributes and limit of supplanting chlorofluocarbons as a vaporized charge and a refrigerant to lessen harm to the ozone layer. It assumes a noteworthy job in the household blend of both created and creating nations, assortments of LPG brought and sold incorporate blends that are fundamentally propane, blends that are basically butane and the more typical blends including both propane (60%) and butane (40%), contingent upon

the season-in winter more propane and in summer more butane. At ordinary temperatures and weights LPGF will vanish in view of this LPG is provided in pressurized steel chambers are not filled totally, regularly they are filled to somewhere in the range of 80% and 85% of their ability (John, 2007).

The installed capacity of the four NNPC refineries is 306,000kg of LPG per annum is quite enough to satisfy the current demand but because of the instable supply, inadequate distribution network and high cost of LPG appliances (cylinders and cookers), it enjoyed a low patronage in Nigeria (Osamor, 1991). The current demand in the country is about 12,000kg annually and it was projected to be 265,000kg in 2000 (NPC, 1991).

Nigeria's natural gas reserve has been estimated over 3 trillion standard cubic meters, NNPC and joint venture partners shell, Agip, Elf (Total) produces significant amounts of associated gas during the production of crude oil. However, about 75% of the associated gas is flared while the balance is either or treated to pipeline quality sold industries such as power Holding Company of Nigeria (PHCN) and others. The government of some Southern States in the country such as Bayelsa and Rivers are presently harnessing gas resource to power gas turbine engine, which generates and supply electricity.

D. Petrol Nigeria is a member of the Organisation of Petroleum Exporting Countries (OPEC) which she joined in 1971 (Ayodele, 2015) and it is also the sixth largest producer of crude oil in the world (Olajide and Odugenro,1999) Petrol dominated the energy consumption and accounts for 70-80% of the total commercial energy consumed in the country between 19790 and 1980. Petroluem reserves in the country are tenatively estimated at 70 billion barrels in 2001, probably as a result of recent developemnt in off-shore exploraition by the government. (Alepe, 2017). The supply of for domestic consumption takes into account the storage arrangements of oil marketing companies, as incidence of petrol supply within the country and allegation fingers are pointing to oil marketers who are accused of diverting flow of petrol producer to accumulate wealth at the expense of people's life. Another major reason affecting petrol supply in the country is government pricing policy system on petroleum products and also the activities of pipeline vandals who destroy oil pipes for extraction of causing disruption in the supply of petrol in the even of pipeline explosion, valuble and lives are lost due to this act of Mayhem (Osayuki, 2005).

E. Fuel Wood According to Matthew (2000), the chief use of the world's wood is not as building materials or paper but as fuel. Of the 4.4 billion cubic meters of wood harvested in 1996, close to 1.9 billion cubic meter are burned for cooking or not provide heat, or are used to make charcoal for latter burning (Food and Agriculture Organisation 1999).

However, in many developing countries of the world dependence on fuel wood is higher than developed countries. In countries like Nepal in Asia, and Uganda, Tanzania and Nigeria in Sub-Saharan Africa, fuel wood provides 80% or more of the total energy requirement. While in industrial countries, fuel wood contributes only about 3% of total energy supply. There are exceptions in Sweden and Fineland which accounts for more 16% of the total fuel wood supply in some central east European countries(FAO, 1999).

Fuel wood energy is obtained from trees, and Nigeria is blessed with a total land area of about 960,000km^2. An estimated 369,000 km^2 (about 40%) has been classified as forestland

with high forest zone of about 133,000km^2 and savanna woodland of about 227,000km^2 (FAO, 1979).

Majority of urban households in developing countries opt for fuel wood as a domestic source of energy for cooking, heating, boiling, drying and so on probably because it is the most efficient, available and affordable source of domestic energy. Some residents insist that no meal is more delicious than those prepared with wood (Osayuki, 2005). About 70% of the total domestic energy consumed in developing countris is of wood origin and over 80% of Nigeria populace uses fuel wood as a traditional energy source. Fuel wood extraction is a source of income generation and it also offers employment opportunity to many jobless individuals in the country. (Olajide et al, 1999b).

However, the excessive consumption of fuel wood and other traditional fuels is carried out at great cost to the individual, like community, the fuels is carried out at great cost to the individual, like community, the economy and environment as a whole. This is as result of reckless and uncontrolled exploration of fuel wood, which results to environmental degradation and up to currnet concern ̈global warming ̋. The individual is exposed to health hazards during the burning of fuel wood by releasing carbon dioxide, which is quite harmful to human health especially the utilization of fuel wood is not economically efficent because of its high cost presently and its effect on deforestation is economically destructive (Hosier, 2011).

The projections of global fuel wood consumption in 2000 range from 1.5 billion m^3 (a decrease of 16% from 1998 levels) to 4.25 billion m^3 (an increase of 136%) (Brooks et al, 1996). While the yearly utilization of fuel wood in the nation is assessed to run between 51-88 million m3 of which 80% is devoured as fuel wood to suggest a high accessibility and fuel wood utilization was anticipated to be 34.83 million m3 in the nation as at the year 2000 (Osayuki, 2005).

F. Charcoal Also known as ̈local gas̈ profoundly among producers of charcoal, it is a domestic energy source derived when wood is heated to about 25^{O}C (480^{O}F) thereby evaporating the moisture and volatile materials, leaving carbon inert materials in the form of charcoal. (Ayodele, 2015). Charcoal burns a luminous flame which is widely used as household fuel for cooking with charcoal stoves, ironing with local pressing irons and so on. Charcoal is well patronized by urban dwellers because it produces a blue somkeless flame and also it is convenient to transport when compared with fuel wood. Its potentials are quite high because of vast forest cover in the country. Specially charcoal is made from heatin selected trees species such as shea butter and so on. The business of production and sale of charcoal is quite lucrative as men and women engage in the processing, packing and selling of charcoal to earn a living. However, the consequences of charcoal exploitation include air pollution, deforestation, densification and so on can be obtained directly and indirectly to provide heat, lighting, and power from various sources as: hydropower, solar energy, geothermal power, wind power, nuclear energy, mechanical energy.

Energy Poverty in Nigeria

Indeed, even in Nigerian homes with electricity, the quality of service provided is often intermittent while growing increasingly very expensive, despite the fact that there is roughly three hours per day of power (electricity). There was price increase in electricity tarif at a time

when 92.4 percent of Nigerians live on less than $2 per day, and 70.8 percent live on less than one dollar per day. Andrew (2015)

The problem of energy poverty is not only to Nigeria only but to other developing countries of the world. According to the International Energy Agency 2017, "over 1.3 billion people are without access to electricity and 2.6 billion are without clean cooking facilities (charcoal and other forest products). More than 95% of these people are in sub-Saharan Africa or developing Asia and 84% are in rural areas." Though the problem is not unique to Nigeria, it does bring to light the global inequality behind the phenomenon of energy poverty despite Nigeria's status as a major energy exporter. Andrew (2015) It is seemingly paradoxical for a nation which began exporting large amounts of liquid petroleum gas through Chevron in 1997 to have a per capita liquid petroleum gas usage rate of 0.4 kilograms per second, one of the lowest in the region.

Fig 1: Energy Poverty in Nigeria

Sources: New York Times Photo: MAY 21, (2015)

Addressing energy poverty is a key point in the fight against global poverty. Greater access to alternative energy sources will reduce unnecessary deaths, such as the 95,300 Nigerian deaths which occur annually from smoke created by the use of solid biomass fuels. It will enhance the financial capabilities of those nations currently struggling to provide power to businesses. This, in turn, will expand the global community of consumers. Regardless, the importance of treating energy exporters as nations, and not simply as trade partners, remains a primary challenge moving forward in the fight against global inequality.

Empirical studies on awareness and perception of biogas technology alongside socio economic factors have yielded ambiguous results. While some studies found a positive relationship between biogas technology alongside socio economic factors (Arduin, Nascia and Zanfei, 2010; BenYoussef, Hadhri and M'Henni, 2010; Gallego et al., 2011), other studies have shown an insignificant or a negative correlation between them (Bayo-Moriones and Lera-

Lopez, 2007; Bocquet and Brossard, 2007). Furthermore, Hollestein (2014) maintains that the relationship is non-linear by asserting that income level has a positive impact on the adoption and use of biogas technology. Despite these studies, no logical conclusion has been reached as to the inherent factors that have motivated the use of a well awareness on biogas in the Nigerian. The findings of most research on biogas technology usage and its application have not identified the major factors that can be said to influence the adoption of alternative to biogas practice in Nigeria and particularly the study area, Gwagwalada. This gap in the literature is therefore the basis for this study.

The factors utilised for investigation were extracted from the literature review. The need to identify the household primary cooking fuel were adopted and modified from Sawyer and Crowston (2014). Determine the domestic energy expenses and income level were taken from Oladapo (2011). View respondent awareness and perception of biogas technology were modified and sourced from Asgarkhani and Young (2010) and Spanos, Prastacos and Poulymenakou (2002).

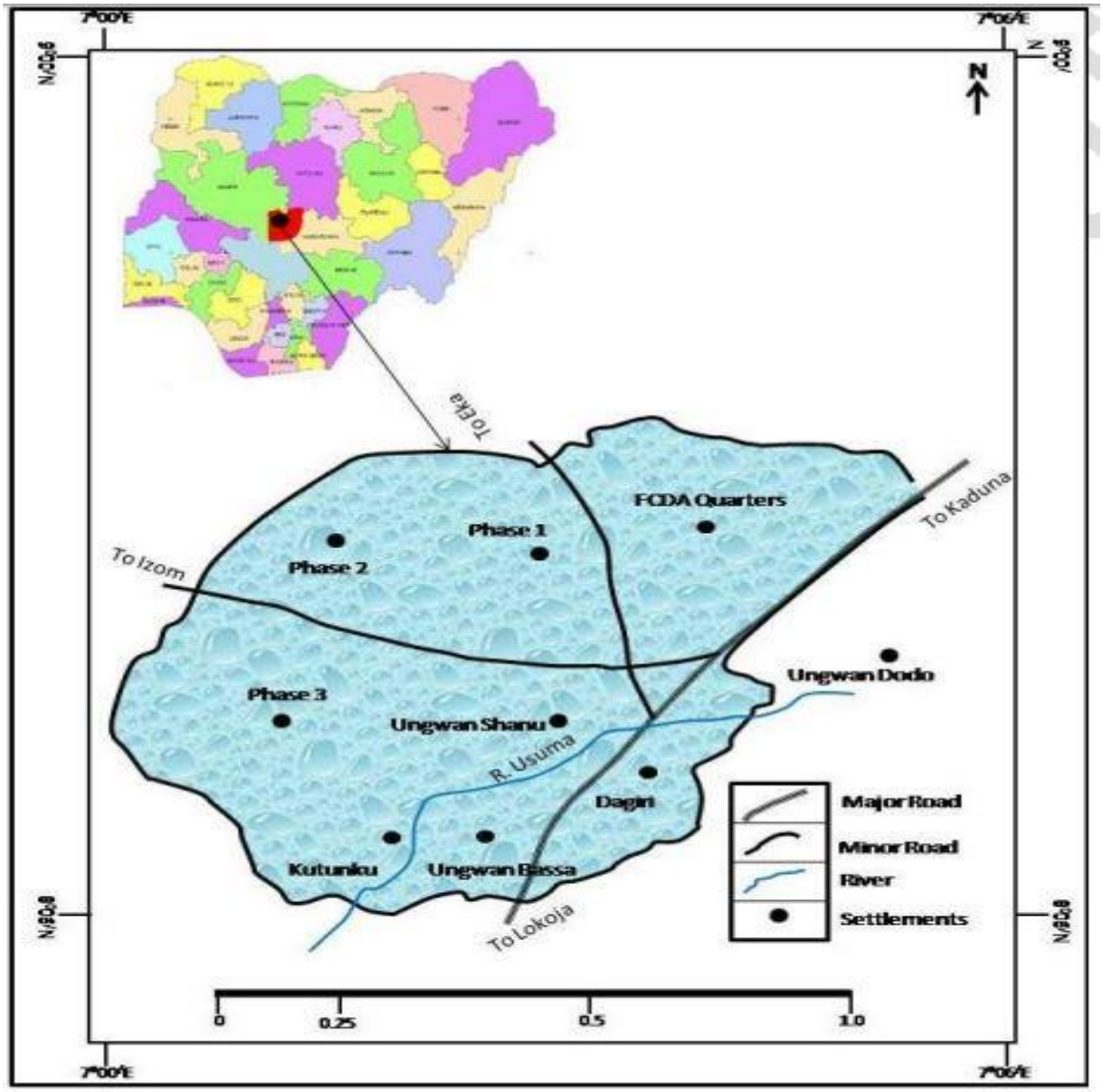
2.0 STUDY LOCATION

Gwagwalada town is situated about 54Kilometers away from the Federal Capital City and it is midway situated inside the FCT. It is situated on a trunk A2 Street along Kaduna-Lokoja Street and it is around sixty (60) kilometers west of the FCT. The Gwagwalada Urban, region is situated between scopes 8006'00"N to 9000'00"N and 7 000'00"E to 7008'00"Figure 1). It is limited by Kuje Area Council toward the East, Abaji Area Council toward the West, Kwali territory Council toward the South and Abuja Municipal toward the North East and Suleja Local Government in Niger State toward the North (Gwagwalada Master Plan, 1979). The investigation region has an all-out landmass of around 6,500 hectares (65km2) and with the fast pace of urbanization, formative procedures are presently occurring even outside the limit of the assigned urban region.

The population of Gwagwalada has been fast increasing as a result of natural (high fertility) reduction in death rate, and mass influx of people into the area, especially with its status as a satellite town in the FCT. Thus, because of the last movement of the seat of Federal Capital from Lagos to Abuja, its official populace figure of Gwagwalada Area Council is 157,770 of which 34216 is the number of inhabitants in Gwagwalada town (NPC, 2006). Gwagwalada is the second large city in Abuja with a total landmass of 65 square kilometres. It is located at the centre of a very fertile agricultural area with abundant clay deposit to its north-east and south-west (Mundi 2000 and Balogun, 2001).

Gwagwalada records the highest temperature during the dry season's months, which are generally cloudless. The maximum temperature occurs in the month of March with amount varying from 37^{o}C in the south west to 30 ^{o}C in the North-East. This is also the period of high diurnal ranges of temperature. By July to August diurnal range rarely exceed 70 ^{o}C according (Adakayi, 2000). A number of local soils have been identified within the study area such as alluvial soils. These soils are commonly found in the valleys of the main rivers and streams all over of the FCT. The soils are somewhat narrow in coverage with rivers and streams deeply entrenched in such areas (Balogun, 2000).

Fig 2. Map of Nigeria Showing FCT and Gwagwalada Town.



3.0 MATERIALS AND METHODS

The method adopted to carry out this research is discussed under the following sub headings; data types and mode of collection, sampling technique, questionnaire administration, data analysis and presentation.

3.1 Method of Data Collection

Valuable primary data regarding the selected case was gathered from key informants; National Biotechnology Development in the department of Environmental Biotechnology, Energy Vendors like the gas sellers, Kerosene hawkers, firewood sellers and the end users residents. Semi structured guidance questionnaire were developed to conduct interview which was beneficial to get information relevant to the study. Besides the interview, field visits were paid to various energy retail outlets. It helps the Researcher to observe the actual situation and to know people's perception about biogas production.

To gather information necessary for this research, informal research was conducted to obtain relevant information from literature. The study took advantage of reports articles from notable International and local journals, internet, published and unpublished thesis and dissertations.

3.2 Sampling Technique

Gwagwalada town is made up of several districts. Prominent among them is a planned settlements which is sub divided into phases; phase one, phase one low cost, phase 2 and Phase 3. Other lay outs include; Kontagora Estate. Surrounding settlements that sprawled out around these districts are Old kutunku, New Kuntunku, Passo, Angwan Dodo among others. Five out of these settlements were selected purposively considering their similarity and differences in structure and economic composition of the residents. Within the districts, Phase 1 low cost and Kontagora estates were selected, while within the sprawling settlements; Angwan Dodo, Passo and old Kuntuku were selected.

Different sampling technique methods were deployed depending on the unit of analysis and type of information required. Purposive sampling, a procedure which involves intentional selection was used at various stages of the research. This method was adopted with mainly the community leaders, fire wood vendors, kerosene and gas retail outlets, who were in a position to give information on specific areas of interest.

To sample the population in the Sprawling settlements, it was very difficult to be systematic due to the unplanned nature of the area. The houses are not arranged in any particular pattern and there is no existing map of the area. As a result of this some clusters were identified and a sketch map of each cluster was developed and 50 households were randomly selected each from Passo, Angwar Dodo and Old Kutunku.

In Phase 1 Low cost the house lay in rows and consists of mixed dwelling units of 1, 2 and 3 bedrooms detached bungalows. It is clustered on street basis. The settlement has a total of 28 streets with each street having about 14 houses. The questionnaires were administered on street by street basis a total of 40 Questionnaire were systematically administered within the Phase 1 Low Cost Housing. The same Procedure was also used to select 25 respondents in Kontagora Estate. Altogether a total of 200 respondents were selected for interview. See table 1.

Table 1. Sample Households

Gwagwalada District	**Number Of Respondents Selected**
Kontagora	20
Phase I Low-Cost	40
Kutunku	50
Passo	50
Angwan Dodo	40
Total	200

Source: Author's fieldwork 2014

A pre-test was conducted and the survey questionnaire was subsequently refined. The researcher hired some field assistants who helped the researcher in the questionnaire distribution. Each questionnaire took an average of 30 minutes to implement. The field assistants were instructed to interview the mother or wife in the household, if available, otherwise, the father

or husband or any adult who was available. The questionnaire collected information on the following: socioeconomic characteristics of the respondents, households' level of awareness and response to energy crisis, household level of energy consumption, and household awareness of biogas technology. A total of 215 questionnaire were distributed, however only 200 (86.6%) were analysed, the rest were either not returned or not properly filled.

4.0 RESULTS AND DISCUSSIONS

Below is the findings of the study and discussions of the results of people's socio economic feature and biogas awareness and perception

4.1 Social and Economic Characteristics of Respondent

The social and economic characteristic of the respondents includes gender, age, educational, household size distribution, main economic activities and average income of the respondents.

Table: 4.1.1 Gender Distribution of Respondent

Gender	Respondents	Percentage (%)
MALE	84	42%
FEMALE	116	58%
TOTAL	200	100%

Source: Field Survey (2014)

The table above indicate that the majority of (58%) of the households in the study area are female as compared to (45%) male. This has an implication on household decision making system, the decision on whether the household adopts biogas technology or not. This indicates that the energy source's environmental impact would have more effect on the women and invariably the children.

Table: 4.1.2 Age distribution of the Respondents.

AGE DISTRIBUTION(YEAR)	RESPONDENT	PERCENTAGE
20-30	68	34%
31-40	74	37%
41-50	44	22%
50-60	12	6%
Above 60	2	1%
Total	200	100%

Source: Field Survey (2014)

The result from the above table indicate that a majority of respondents were in the economically active age, that is 20-40years which relates to peak level of awareness of modern innovations. It implies that market development for biogas production and utilization can rapidly be achieved.

Table: 4.1.3 Educational Qualifications of Respondents

EDUCATIONAL QUALIFICATION	RESPONDENT	PERCENTAGE
PRIMARY	34	17%

SECONDARY	70	35%
TERTIARY	86	43%
OTHERS	10	5%
TOATL	200	100%

Source: Field Survey (2014)

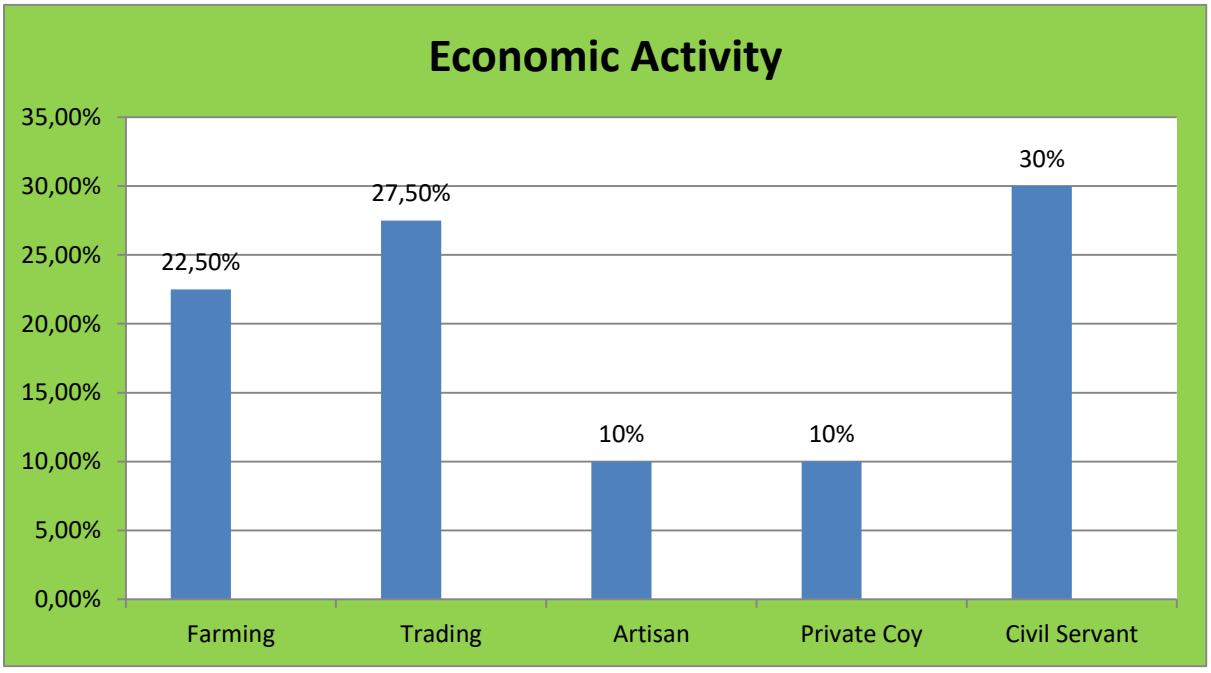
The table above indicates that a large part of the sample population can at least read and write, meaning that the individuals are trainable as far as biogas technology knowledge is concern.

Table 4.1.4: Household Size Distribution of Respondent

Household Size Distribution	Respondent	Percentage
1-5	132	66%
6- 10	64	32%
11- 15	2	1%
Above 15	2	1%
Total	200	100

Sources: Field Survey (2014)

Table 4.1.5 Main Economic Activity of Respondents



Sources: Field Survey (2014)

The major economic activity in the study area is Wage Employment as indicated by the result in the above bar chart. This indicates that besides deforestation, most of the waste dumped in the environment are generated at home as domestic organic waste necessary for production of biogas as alternative, accessible and cheaper source of domestic energy.

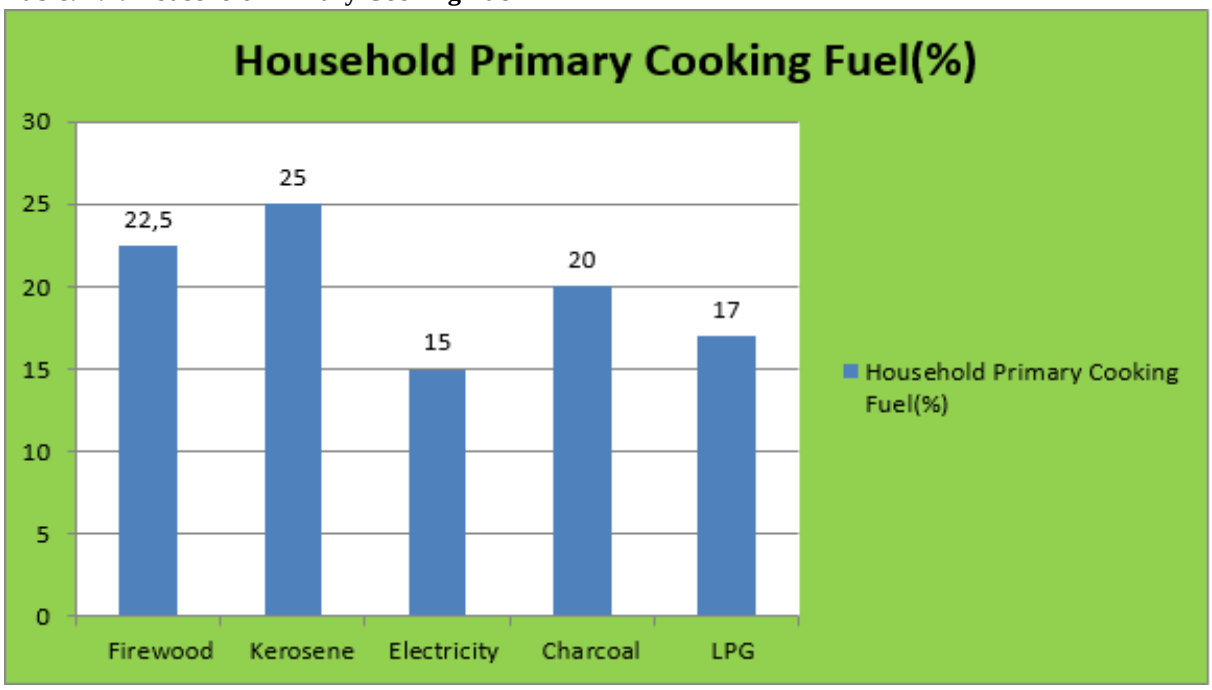
Table: 4.1.6 Average Incomes of Respondents

Income of Respondent(₦)	Frequency	Percentage
5,000- 20,000	82	41%
21,000-50,000	80	40%
51,000-80,000	12	6%
81,000-100,000	12	6%
Above 100,000	14	7%
Total	200	100%

Sources: Field Survey (2014)

The study tends to confirm that the majority are generally low and near middle income earners. This however would have an economic implication on the choice of domestic energy utilization and expected affordability of biogas.

Table: 4.2: Household Primary Cooking Fuel



Sources: Field Survey (2014)

The above indicates the main energy sources in the study area. The study reveals that majority of the respondents prefer kerosene as their fuel. Fuel wood (Firewood and Charcoal) is closely used as alternative. Considering the two sources, it is obvious that 42.5% of the domestic energy come from the forest. This implies that there is high degree of deforestation, carbon emission arising from burning the fuel wood and consequently a heightened environmental pollution. The reasons cited for cooking fuel preference are affordability, availability and accessibility.

Table 4.3: Main Energy Source and Income Level of Respondents compared

Source of Domestic Fuel	Respondents		Income Level	Respondents
Firewood	45		5,000- 20,000	82
Kerosene	50		21,000-50,000	80
Electricity	30		51,000-80,000	12
Charcoal	40		81,000-100,000	12
LPG	35		Above 100,000	14
TOTAL	200			200

Source: Field Survey (2014)

From the above table, fuel wood accounts for the highest proportion of domestic energy consumption in the study area. It is obvious that this domestic fuel is predominant among low income level earners. The table also indicate that several households also make use of Electricity for heating and lighting along with other domestic energy sources for cooking. Gas (LPG) is used by those of higher income level. High cost of gas and poor awareness and epileptic electricity supply were found to be deterring factor for the low use of these energy sources in the study area. Thus gas like Biogas which would be produced from thereby waste dump sites is deemed to be affordable and accessible and can be the reliable alternative energy source for environmental sustainability.

Table: 4.3.1: Household Monthly Spending on Firewood and Charcoal of Respondent

Estimated Expenditure (Naira)	**Angwar Dodo**	**Kutunku**	**Passo**	**Kotagora**	**Low Cost**	**Total**
Firewood	**No.50**	**No.50**	**No.50**	**No.20**	**No.30**	**200**
Below 2000	[24] 48.0	[24] 48.0	[22] 44.0	[5] 25.0	[13] 43.3	[88] 45.0
2000-3000	[16] 32.0	[18] 36.0	[15] 30.0	[7] 35.0	[9] 30.0	[65] 32.5
Above3000	[10] 20.0	[8] 16.0	[13] 26.0	[8] 40.0	[8] 26.7	[47] 23.5
Total	**50**	**50**	**50**	**20**	**30**	**200**
Charcoal						
Below 2000	[20] 40.0	[17] 35.0	[14] 28.0	**[6] 30.0**	[14] 46.7	[73] 36.5
2000-3000	[23] 46.0	[23] 46.0	[19] 38.0	[8] 40.0	[6] 20.0	[72] 36.0
Above 3000	**[7] 14.0**	**[10] 20.0**	**[13] 26.0**	**[6] 30.0**	**[10] 33.3**	**[55] 27.5**
Total	**50**	**50**	**50**	**20**	**30**	**200**

Source: Field Survey (2014)

The table depicts that use of fuel wood and charcoal has no bound in the study area with respect to income level. Residents of all income levels make use of these forest products as either a major source of energy or supplementary source to support large cooking in social functions and those who operate restaurants and canteens. Results in the table reveal that 45.5% spend below N2, 000.00 per month, while 36.5% spend the corresponding amount on charcoal. Those that spend above N3000.00 are relatively low.

Table 4.4.: Respondents Awareness and Perception of Biogas Technology in the Study Area

Respondents	Total	Awareness	
		Aware	Not Aware
Angwar Dodo	40	10	30
Kutunku	50	15	35
Passo	50	10	45
Kotagora Estate	20	15	5
Phase 1Low Cost	40	30	5
Total	200	80	120

Source: Field Survey (2014)

Findings in Table 4.3 show that majority 60.0% of the respondents have not heard about the biogas technology, while 40.0% have heard about the technology.

In summarizes the relationship between household characteristics and Awareness of biogas technology. These characteristics include age of respondent, education level of household head, household size and sex, can be said that the residential area is not of very much significance in the study because all settlements now harbor all categories of income level and occupational structure; rather, it was the level of education and income level.

Sex of Respondent and Awareness

Findings in table 5.1 indicate that the majority of the male respondent **(57)** comprising of 28.5% have heard about biogas technology before and also Majority of the female respondents (66) 33.0% have not heard about the Technology before the time of this research. This indicates that the technology has not received much publicity in the country.

Age of Respondent and Awareness

Findings in Table 4.4.1 also indicate that younger respondents **(51)** comprising 22.5% of respondents aged between **20 to 40** years old were more likely to have heard about biogas technology compared to older respondents aged above 40 years. The plausible explanation of this can be that younger people especially at tertiary level of education school age are more inquisitive to know about new innovations. They have more access to information through a variety of medium than the older ones especially in developing countries where economic hardship is prevalent.

Education Level and Biogas Awareness

The relationship between education and biogas awareness as indicated in the above table show that the majority of the respondents (47) 23.5% who have heard about biogas were those with tertiary education compared to those with secondary or other forms of education. This can be explained by the nature of education itself. Education opens an individual's mind to wide range of information and exposure. Comparatively, people who attained secondary and college education the Study area were more likely to be in wage employment like teaching, area council administration, private sector, police officers among others. People belonging to this category, firstly, most of them live in public or hired houses hence have no permanent premises, secondly being public or civil servants they are liable to be transferred to other work places, hence they are unlikely to invest in biogas technology which is a permanent and non-transferable structure as compared to those who own permanent premises.

Household Size and Biogas Awareness

The relationship between household size and biogas awareness is that households with many members are more concern about high cost of energy and are worried about an alternative also households with large size of family are more stricken with poverty and are associated with less education. It was expected they will not receive information more readily than those with smaller size of family.

Main Economic Activity and Biogas Awareness

The table indicate that a majority of those that are aware of biogas technology were those engaged in civil service compared to those engaged in farming and trading. This can be explained by the fact that biogas production in Nigeria is still at the policy level therefore more people in government employment are informed of the biogas plants at the pilot stage.

5.0 CONCLUSION AND RECOMMENDATIONS

This study should be embraced and adjusted and put into utilization as a team with organizations that are associated with advancing indigenous designing tasks that can tackle present issues. It had been seen that degree of salary, level of instruction, and age assume a critical job in the decision of energy used for cooking and other local purposes. Without the open attention to biogas innovation, its advantages, and entanglements, there will be no adequate premise to scatter biogas innovation at the grassroots level. Simultaneously, mindfulness inside the administration is fundamental since effects and parts of biogas innovation concern such a significant number of various legislative foundations (for example horticulture, environment, energy, financial aspects), it is important to recognize and remember all dependable government offices for the spread and mindfulness raising procedure.

The following recommendations are made for actions to be taken in order to promote and raise levels of Public Awareness and Perception of Socio-Economic Characteristic and Biogas in Gwagwalada Town Abuja, Nigeria, Enlightenment campaigns using media, for example, radio, TV, and handbills through indigenous dialects should be urged for individuals to get mindful about the reasonableness, wellbeing, and moderateness of biogas innovation advancements. The Federal government should encourage the use of National Orientation Agency (NOA) at the Area councils. Political leaders through policy reviews can promote the technology through media discourse and through incorporating the renewable energy policy in Government development plans. District councils should hire extension workers to educate community member on biogas efficiency. National Biotechnology Development Agency (NABDA), under Ministry of Science and Technology, will play coordination role to ensure sustainability of the environment and the implementation of the set strategies for the development of biogas sector in the country.

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Appendix 1

QUESTIONNAIRE

SECTION A

Personal Data

Please tick right as appropriate to your answer in the box provided:

1. Date of interview ……...……...
2. Name of the respondent ……..……...
3. Settlement …….
4. Sex: Male ( ) Female ( )
5. Marital Status: Single ( ) Married ( )
6. What is your highest level of education?
   (i) Never attended formal education ( )
   (ii) Primary School ( )
   (iii) Secondary School ( )
   (iv) Tertiary Education ( )
   (v) Others ( )
7. Main occupation of the head of household;
   (i) Farming ( )
   (ii) Trading.( )
   (iii) Civil Service ( )
   (iv) Others (specify) ( )
8. Household Income: What is your average income per year? (₦.....)

SECTION B

Awareness, Attitude and promotion of adoption of biogas technology

A. Awareness

21. Have you ever heard about the biogas technology?
    (i) Yes ( )
    (ii) No( )
22. Have you adopted biogas technology?

(i) Yes ( )
(ii) No ( )

23. Who gave you information about biogas technology for the first time?
(i) Researcher ( )
(ii) Extension officers ( )
(iii) Politician ( )
(iv) Neighbor, Relative, friend who adopted BT ( )
(v) National Biotechnology Development Agency staff ( )
(vi) Others (Specify) ……..

24. If you have not adopted biogas technology, give reasons;
(i) Do not see the benefit of biogas technology ( )
(ii) Shortage of household labour ( )
(iii) Plenty of fuel wood in the area am living ( )
(iv) High Technology costs ( )
(v) Not aware of the technology ( )
(vi) I find it not appropriate ( )
(vii) Others (specify)……

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