



MITIGATING THE IMPACTS OF GREENHOUSE GASES ON ENVIRONMENTAL SUSTAINABILITY- PEOPLE AWARENESS AND PREPAREDNESS A CASE STUDY OF ABUJA, NIGERIA

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ABSTRACT

There has been unprecedented rise in the concentration of atmospheric greenhouse gases with its concomitant deleterious effects on humanity and the planet. This study sought to determine the current level of awareness on the impacts of greenhouses gases and to gauge people's preparedness towards a carbon free environment, while it examined the challenges combating the new adaptation. This was questionnaire based cross-sectional study. The study was conducted among the residents of Federal Capital Territory, Nigeria. Purposive random sampling technique was adopted. A total of 564 participants were included in the study. The result showed that 54.6% of the respondents demonstrated excellent knowledge of the greenhouse gases, and its impacts. Larger proportion of the participants (66.13%) agreed to be utilizing high energy efficiency appliances (low energy consuming device); Similar proportion of the respondents (66.31%) reckoned public means of transportation as their main form of transportation and 13.5% of the participants assumed to be practicing afforestation. Less than 14% of the study population admitted to be using solar source /other renewable source of energy and fewer than 11% of the respondents engaged in effective waste reduction measures. Majority of the respondent identified inadequate power supply (42%), oil bunkering and gas flaring (28%) to be very important problem in combating the effect of greenhouses gases. The key measures to achieving a reduction in amount of greenhouses gases would include; improving the electricity grid, increasing transportation mode shift from automobiles to buses, developing policy to end or lessening gas flaring and implementing climate smart agriculture, and reforestation.

Keywords: *Awareness, Emission, Greenhouse Gas, Mitigation, Preparedness*

INTRODUCTION

Nigeria like every other country in the world has been severely impacted by the untoward effect of greenhouse gases (Sanya, 2011). These gases include CO₂, methane (CH₄), hydrofluorocarbons (HFCs), perfluorinated compounds (PFCs), water vapour and others (Missanjo & Kadzuwa, 2021, Sanya, 2011, Olaniyi et al., 2010, FMOH, 2010). Carbon dioxide is a principal greenhouse gas that has steadily risen over the year due to industrial revolution (Ozbayrak et al., 2011, Olaniyi et al., 2010). This emission is largely due to the combustion of fuels in electric power generation, engines, building heating, and industrial plants. In the same vein, methane emission is produced from degradation of biomass from agricultural activities and landfills in addition to the oil and gas industry, while hydrofluorocarbons and perfluorinated compounds are produced from industrial processes (Afnan et al., 2017).

In Nigeria, carbon emissions are those stemming from the burning of fossil fuels, consumption of solid, liquid and gas fuels, gas flaring and in the manufacture of cements (Macrotrend, 2021). Likewise, the increased number of factories, automobiles, increase population growth and energy consumption raises the amount of these gases in the atmosphere. There has been a steady increase in carbon emissions in recent times; carbon emission for 2016 was 108,420.00, representing 0.25 % increase from 2015, there was 4.15 % increase in 2017, while carbon emissions for 2018 were 130,670.00, a 15.72% increase from 2017 and its per capital emission in same year was far beyond stipulated average (Macrotrend, 2021).

Increase in the level of these greenhouse gases in the earth's atmosphere is behind the phenomenon of global warming as these gases can absorb infrared radiation, thereby trapping and holding heat in the atmosphere through a greenhouse effect. Hence, small changes in the atmospheric concentration of these gases can lead to changes in temperature that can make huge difference in environmental sustainability (Nalgundwar et al., 2014). The strength of the greenhouse effect depends on their ability to absorb energy and radiate it and also its atmospheric lifetime. This is expressed as Global Warming Potential (GWP), a measure of the radiative effect over a specified period of time, expressed relative to the radiative effect of carbon dioxide (EPA, 2022a). As the impacts of global warming is becoming more critical, The Nigerian government saw this as a huge problem and developed National Adaptation Strategy and Plan of

Action on Climate Change in 2011 with recommendations for improving adaptation for sectors including agriculture, coastal farming, forestry and energy production(FMOH, 2011). This was followed in 2020 with the release of a framework report for its National Adaptation Plan (NFME, 2020). The report outlines the guiding principles for Nigeria's adaptation plan, which include involving young people, focusing adaptation around communities and ecosystems and incorporating indigenous knowledge (NFME, 2020).

The Greenhouse Effects

Natural greenhouse effect is protective as it is required to maintain the stability of the earth temperature to maintain survival of the ecosystem; however, the challenges arose as a result of increase in the concentration of the greenhouse gases resulting in more heat trapping and the consequence rise in the temperature of the sea level(EPA, 2022b, Mann, 2021). The greenhouse effect occurs because the ultraviolet energy from the sun reaches the earth atmosphere. Some of the solar energy (heat) is absorbed, reflected or reradiated within the Earth's atmosphere(Mann, 2021). Ultraviolet radiation has a shorter wavelength and a higher energy level than visible light, while infrared radiation has a longer wavelength and a weaker energy level, about 30% of the radiation that reaches the earth is reflected out to space by clouds, ice, and other reflective surfaces(Mann, 2021). The remaining 70% is absorbed by the oceans, the land, and the atmosphere. In addition, the stratosphere of the earth contains a layer of ozone gas (O₃) that normally absorbs most of the harmful, shortwave ultraviolet radiation (UVB) from the sun, protecting earth's living organisms (EPA, 2022b). However, this protective shield has become thinner and thinner as the ozone layer thins; more UVB radiation reaches the surface of the Earth, resulting in global warming and climate change (Mann, 2021, EPA, 2022b).

Impacts of Greenhouse Effects

The current warming is producing negative impacts on natural and human systems, seriously impeding progress toward sustainable development. The global average temperature is 1°C higher than the pre-industrial level (BGS., 2022, Mann, 2021,). The rise in the sea level temperature accounted for increase heat wave; this has resulted in expected increase in airway and respiratory diseases(BGS., 2022). In the same vein, there has been resurgence in infectious disease such as cholera, malaria, meningitis, dengue, and Lassa fever and emergence of new infectious disease with

dangerous strain (Abdulkadir et al., 2017). There is profound impact on the processes of soil degradation (BGS., 2022, Mann, 2021,); Nigeria's northern region has experienced a steep rise in the frequency and duration of drought. This in turn has driven harmful dust, storms and desertification; while the total amount of rainfall has decreased in the southern region (Akande et al., 2017; Nkechi et al., 2016 Amanchukwu et al., 2015; Olapido, 2010). Individual rainstorms are becoming more intense (Haider, 2019, Oladapo, 2010). This has led to an increase in extreme flooding. There is also alteration in length of the growing season with proliferation of disease vectors resulting in reduction of productivity and food shortage (Haider, 2019, Oladapo, 2010).

How to Mitigate the Impacts of Greenhouse Gases

Various methods have been adopted to reduce carbon emission and the main strategies revolve around CO₂ capture, storage and sequestration (Zhongchao, 2014). The developed countries are innovating newer techniques of combating CO₂ emission such as the use of bioenergy for carbon capture and storage and the use of direct air capture (Zhongchao, 2014). Bioenergy for carbon capture utilizes biomass for industrial energy and immediate capturing of its emission before its release into the atmosphere, while direct air capture removes excess carbon from the atmosphere and store for future use (Zhongchao, 2014). These are at the early stage of development and require more research to understand its efficiency. However, simple affordable methods are available to mitigate this effect especially in developing countries like Nigeria, trees are very good at removing carbon dioxide from atmosphere via photosynthesis, we can thus leverage on the power of photosynthesis by restoring and expanding our forest reserve by encouraging afforestation (Dabas M, & Bhatia S., 1996). Integrating renewable and low-carbon technologies to supply buildings' energy needs will promote high energy efficiency system by replacing use of fossil fuels (USAID, 2019). We can reduce impacts of personal transports by creating efficient public transportation system, while pollution and waste reduction can be effected by enabling re-use and recycling measures.

Nevertheless, public acceptability is a strong factor to this transition as it can enable or inhibit the implementation. Whereas many studies conducted in Nigeria looked at awareness and impact of the greenhouse gases, this study sought to determine the current level of awareness on the impacts of greenhouses gases and to gauge people's preparedness towards

a carbon free environment, while it examined the challenges combating the new adaptation.

MATERIALS AND METHODS

This was questionnaire based cross-sectional study. The questionnaire was divided into three sections: first section focused on socio demographic profile of the respondents; section two examined the level of awareness of the participants on greenhouse gases and its impact; while section three examined respondent preparedness on mitigation and the challenges. The participants level of awareness on greenhouse gases was classified into three categories; Low, moderate and high.

- High level of awareness was defined as ability of the respondents to 1) Identify 3 or more examples of greenhouse gases, 2) Identify 3 or more consequence /effects of greenhouse gases and 3) Identify 3 or more methods to tackle it.
- Moderate level of awareness was defined as the ability of the respondents to; 1) Identify at least 2 examples of greenhouse gases, 2) Identify at least 2 consequences of greenhouse gases and, 3) Identify at least 2 methods to tackle it.
- Low level of awareness was defined as the ability of the respondents to;1) Identify at least one example or consequence of greenhouse gases and,2) Identify at least one method to tackle it

The study was conducted among the residents of Federal Capital Territory Abuja, Nigeria. A total of 564 participants were included in the study. Purposive random sampling technique was adopted. Each participant was given a self-administered pretested, predesigned questionnaire to solve on the spot. The purpose of the study was explained to the respondents and confidentiality was maintained. Responses thus received were evaluated. The data were summarized using percentages.

RESULT

564 participants for this study comprise 304 (53.9%) male and 260 (46.1%) females. Their ages were from 20 to 65. Majority of the participants were civil servants (37.94%) and students 30.67%). While, 53% of the respondents had or was undergoing tertiary education. 54.6% of the respondents demonstrated excellent knowledge of the example of greenhouse gases, the consequence and the methods to tackle greenhouse

effects, while 30.32% of the participants had good knowledge of the example of greenhouse gases, the consequence and the methods to tackle the greenhouse effects. Less than one third of the participants (15.07%) demonstrated low knowledge of the greenhouse gases and its consequences. See table 1.

Higher proportion of respondents (90%) that demonstrated high level of knowledge comprised mostly the students and civil servants, while the respondents that exhibit low to moderate level of knowledge were predominantly farmers (26.47%) and the traders 25.69%. See table 2.

Table 1 Social Demographic Profile of the Respondents

| | n=564 | % |
|--|---------------|-------|
| Age in years (mean) | 43.09 ± 21.54 | |
| Gender (Male) | 304 | 53.9 |
| Level | | |
| Primary | 86 | 15.25 |
| Secondary | 179 | 31.74 |
| Tertiary | 299 | 53.01 |
| Occupation | | |
| Civil servant | 214 | 37.94 |
| Students | 173 | 30.67 |
| Trader | 109 | 19.33 |
| Farmers | 68 | 12.06 |
| Level of knowledge of the greenhouse gas and effects | | |
| Low | 85 | 15.07 |
| Moderate | 171 | 30.32 |
| High | 308 | 54.61 |

Table 2 Level of Awareness of Greenhouse Gases and its Impact among Respondents

| Occupations | Low n (%) | Moderate n (%) | High n (%) |
|---------------|------------|----------------|------------|
| Traders | 28(25.69) | 34 (31.19) | 47(43.12) |
| Civilservants | 14(6.54) | 66 (30.84) | 134(62.62) |
| Students | 23(13.29) | 61(35.26) | 89(51.45) |
| Farmers | 18 (26.47) | 21(30.88) | 29(42.65) |

Table 3 Respondent preparedness towards carbon free environment

| Variables | C/servantsn (%) n= 214 | Farmers n (%) n=68 | Students n (%) n=173 | Traders n (%) n= 109 |
|---|---------------------------|--------------------------|----------------------------|----------------------------|
| Use of renewable energy such as solar | 42 (19.63) | 8 (11.76) | 3(1.7) | 24(22.02) |
| Use of low energy consuming electrical appliances | 155(72.43) | 42 (61.74) | 123 (71.10) | 53 (48.62) |
| Frequent use of public transport system | 114(53.27) | 58(85.29) | 123(71.10) | 78(71.60) |
| Practice afforestation | 27 (12.62) | 24 (35.29) | 12(6.94) | 14(12.84) |
| High daily consumption of fruits and vegetables | 62 (28.97) | 41 (60.29) | 62(35.84) | 68(62.39) |
| Engage in effective waste reduction measures | 26(12.15) | 5(7.34) | 14(8.09) | 15(13.76) |

Less than 14% of the study population admitted to be using solar source /other renewable source of energy. Rank high in this category was the civil servants(19.63%) and the traders(22.02%). Larger proportion of the participants (66.13%) agreed to be utilizing high energy efficiency appliances (low energy consuming device); rank high in this category were the civil servants (74.43%) and the students (71.10%). Similar proportion of the respondents (66.31%)reckoned public means of transportation as their main form of transportation. Fewer than 11% of the respondents engaged in effective waste reduction measures. 13.5% of the participants assumed to be practicing afforestation as shown table 3 and figure 1.

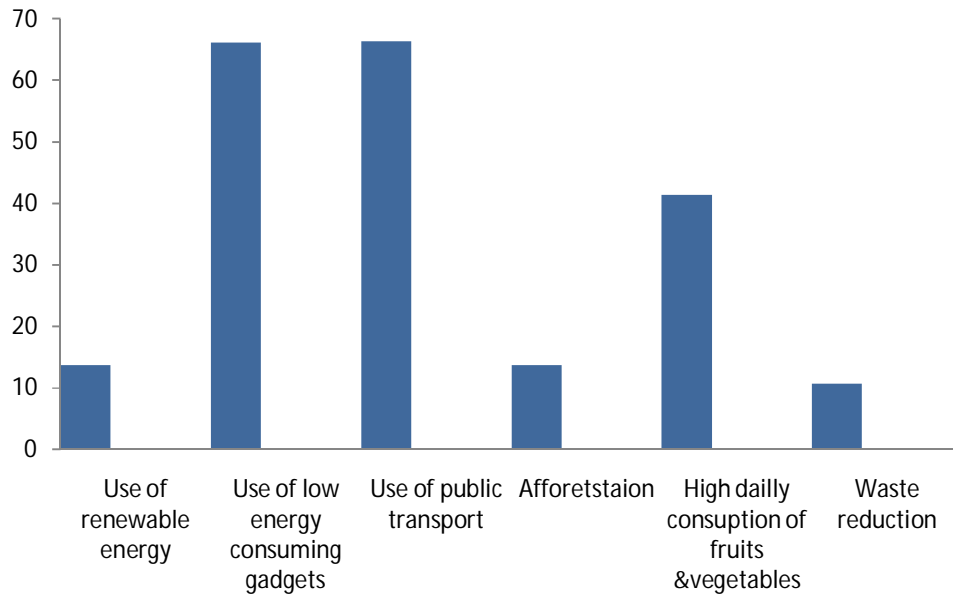


Figure 1:Percentage of respondents according to their preparedness towards carbon free environment

Majority of the respondent identified inadequate power supply (42%), oil bunkering and gas flaring (28%) to be very important problem in combating the effect of greenhouses gases. 14% of the respondents reckoned low level of awareness as another challenge towards mitigation against effects of global warming. Only 10% assumed non implementation of the policy by the three tiers of government to be a serious problem in tackling the effects of global warming. 6% of the participants agreed that mining contributed in no small measures to the greenhouse effects as shown figure 2.

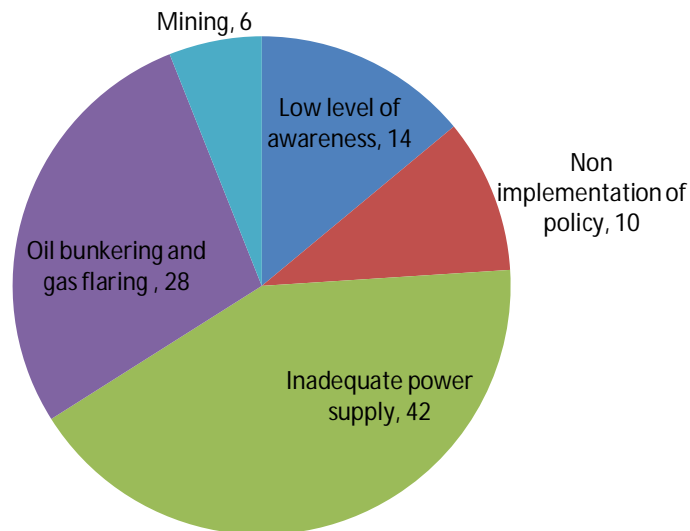


Figure 2: Challenges combating the new adaptation identified by the participants

DISCUSSION

We found a relatively higher proportion of individuals with moderate to high level of awareness of the greenhouses gases, causes and impacts, in contrast to the findings of Agboola and Emmanuel (2016), Odigo (2013), Ishaya and Abaje (2008), who reported a lower level of awareness among their respondents, this could be as result of the ongoing increased governmental campaign on the deleterious effect of the greenhouse gases and the need for individuals to take a proactive steps towards actualizing low/free carbon environments. This also showed that respondents are now more abreast of the adaptive measures to mitigate these effects. Another probable reason for this level of awareness may be attributed to the education composition of the respondents as majority of the respondent received tertiary level of education.

To forestall the effect of global warming the available options are mitigation to reduce further emissions and adaptation to reduce the impacts of global warming (Olaniyi et al., 2014). These measures include reduction in burning of fossil fuels, reduction of deforestation; increase in reforestation and afforestation. Others mitigation options include effective waste reduction and management, increasing intake of fruits and vegetable and cutting down on protein containing diets (EPA, 2022b, Olaniyi et al.,

2014). In this study, we found a good number of the respondents using public transportation system as their main means of transportation thereby reducing the amount of fossil fuel to be consumed if all respondents were to ride in their personal cars. The reason for this may not be far-fetched as it is more cost effective to use public transportation system than riding in a personal car. Similarly, a higher proportion of the respondents were found to be using low energy consuming gadgets and this may not be unconnected to current prepaid metering system.

The future of humanity and planets depends on how we produce energy; a reliable, affordable and decarbonized energy system is essential. Renewable energy are sources of clean energy that does not produce greenhouse gases or polluting emissions (IRENA, 2022, TVA, 200), however, the initial high cost of installation seems to be a limiting factor in using it (TVA, 2003). This may explain the reason why less than 25% of the respondents engaged in the use of renewable energy.

In addition, deforestation is a significant environmental issue due to excessive exploitation resulting from growing demand for land for other uses, including settlement development, logging, fuel wood extraction, transport facility development, and mining (USAID, 2019). Reforestation has been found to reverse the effect of global warming by cooling its cooling effects which will offset greenhouse heating; in our study we found a low proportion of respondents that engages in effective waste reduction management and afforestation. The likely explanation for this may be rapid land development taking place in the federal capital territory as a result of ever-increasing population growth and continuing relocation of head offices to Abuja by both government and private establishments.

The key barriers to reducing greenhouse gas emissions identified by the respondents include inadequate power supply, oil bunkering and gas flaring, non-implementation of policy and reduced level of awareness among the individuals in the community consistent with the findings of USAID (2019) and Oyedepo (2012). Less than half of Nigeria's population has access to grid-connected electricity. Electric power supply is inefficient and has limited industrial development; hence many Nigerians provide their own electricity for business and personal use by means of privately owned fossil fuel powered generators (Punch, 2016; Oyedepo, 2012). Exportation of crude oil constituted about 80% of Nigeria exports and because of insufficient oil field infrastructure, a very large portion of gas associated with oil production is flared into the

atmosphere generating a substantial amount of greenhouse gases, which when released directly into the air, traps heat in the atmosphere thereby contributing to global warming (USAID, 2019). Furthermore, the study also showed that governments are strongly lacking behind in implementing of policies that are environmentally friendly such as policy against gas flaring, oil bunkering and others. Concurrent insecurity and continuous pipes vandalization may be contributory to the delay in the implementation of such policy. This also re-emphasized the need for economic diversification towards environmentally friendly activities.

In conclusion, this study is a community survey, and the result could be a true reflection of the impacts of the greenhouse gases in the general population. While previous studies have focused on the level of awareness and impacts of global warming, this study examines the individual preparedness for combating the impacts of greenhouse gases while identified the key challenges facing the new adaptation, hence the findings here could be used to project on the areas to cover in future research. The key measures to achieving a reduction in amount of greenhouses gases would include; improving the electricity grid, increasing transportation mode shift from automobiles to buses, developing policy to end or lessening gas flaring and implementing climate smart agriculture, and reforestation.

Conflict of Interest

There is no conflict of interest.

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