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# Evaluation of the Effects of Greenhouse Gases on Temperature Change in Kaduna State

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***Abstract*****—***In this research work, the Evaluation of the effects of greenhouse gasses on temperature change in Kaduna State was determined. The concentration of carbon dioxide (CO2) and Methane (CH4) was measured using Air quality monitor, methanometer and aeroqual series 500 gas meter. Accumulation of greenhouse gasses in the earth lower atmosphere pose significant danger to the environment and human health. Environment polluted by greenhouse gasses experience unpredictable climatic condition and rising temperature. The ozone layer is also affected by this toxic gasses from automobiles and industries. Highly vehicular and industrial areas were selected for the experiments. The experimental sites were Mando Motor Park, Nnamdi Azikiwe Express Way, Kawo Motor Park, Levintis Roundabout, Stadium Roundabout Kaduna, Kakuri Industrial Area Kaduna, Kongo Road Motor Park Zaria, Kafanchan Parking Garage, Command Junction Kaduna and Television Garage Kaduna. The major gasses detected during experiment were methane and carbon dioxide. The results obtained for both CO2 and CH4 were above safety limit of exposure when compared with Occupational Safety and Health Administration Standard (OSHA) and the Institute of Occupational Safety and Health United State of America. The maximum concentration recorded for CO2 and CH4 were 15100ppm and 1800ppm and the minimum concentration were 10500ppm and 950ppm respectively. The results obtained from most of the experimental sites were above 10000ppm for CO2 and 1000ppm for CH4 which are above the safe exposure limit according OSHA and NIOSH standard*.

***Keywords*****—** *Climate, Environment, Greenhouse Gasses, Temperature*.

## I. INTRODUCTION

In the 19th century, scientists realized that gasses in the atmosphere causes a greenhouse effect which affect the planet temperature. These scientists were interested chiefly in the possibility that a lower level of carbon dioxide gas might explain the ice ages of the distance past. At the turn of the century, svante Arrhenius calculated that emission from human industry might someday bring a global warming. Other scientists dismissed his idea as faulty. In 1938, G. S. Callender argued that the level of carbon dioxide was climbing and raising global temperature, but most scientists found his argument implausible. It was almost by chance that a few researchers in the 1950s discovered that global warming truly was possible. In the early 1960s C. D. Keeting measure the level of carbon dioxide and found that it was raising fast.

Man-made emissions of greenhouse gasses have increased by 70% (29 Giga Tons) in 1970 to 49 Giga Tons in 2004 of which 25 Giga Tons came from combustion of fossil fuels (OCED/ITF, 2009). In the developing world, level of traffic, motor park and industries are not excluded. However the share of emission from developing countries is expected to rise in the future because of the growing size of vehicle fleets and use of less efficient fuel burning technologies (IPCC, 1995).

The term greenhouse effect is used to describe the retention of heat in the earth's lower atmosphere (Troposphere) due to concentration of certain trace gasses and water vapor in the atmosphere. These gasses are generally known as greenhouse gasses or more specifically as radioactive gasses. Concentration of some them have increase steadily during the 20th century and into the 21th century, with carbon dioxide $CO_2$ rising from under 300ppm to over 400ppm. A large part of the increase in all greenhouse gasses is attributed to human sources that is it is anthropogenic, hence anthropogenic global warming. (World Nuclear Association, 2021).

Carbon dioxide $CO_2$ is responsible for 20% of the total thermal absorption. Natural sources of $CO_2$ include organic decomposition, oceanic release and respiration. Anthropogenic $CO_2$ sources are from activities such as cement manufactory, deforestation, and fossil fuel, combustion such as coal, oil and natural gas. Surprisingly 24% of direct CO2 emission comes from agriculture, forestry and other land use and 21% come from industry. (Cassiar et al, 2018)

Carbon dioxide is absorbed and emitted naturally as part of carbon cycle, through plant and animal respiration, volcanic eruptions and ocean atmosphere exchange (USEPA, 2021)

One of the most important human impact on the environment is the rapid increase in greenhouse gasses which include carbon dioxide ($CO_2$), Methane ($CH_4$), Nitrous Oxide ($N_2O$), and Fluorinated gasses (Giwa, 2014). Apart from global warming, greenhouse gasses are also responsible for the phenomenon known as ozone layer depletion. The rise in greenhouse gasses today is more than any time in the past because of the increases in the industrial activities (Houghton et al, 2001). Emission of greenhouse gasses is due to an increase dependence on machines and equipment that burn fossil fuels such as auto mobiles and generators as well as enhance chemical processes carried out in factories and power plants. Another source is burning of firewood, cooking, bush burning, and incineration of refuse (Calvert el at, 1993).

Of all the long time greenhouse gasses that are emitted by human activities, the one that have the largest climate impact are carbon dioxide, methane and nitrous oxide. While satellite data are used to monitor the atmospheric concentration of carbon dioxide and methane. It is not currently possible to measure atmospheric concentration of nitric oxide accurately in this way. Although all the three gasses are also monitored



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from the ground and through airborne platform measurement, the focus is on satellite-derived information (Nassar, 2017).
Different cities employ various approaches to estimate emission. Bangkok estimate emissions from fuels consumed within city boundaries, whereas Mexico City, London, New York and Midland use kilometers travelled by different categories of public and private vehicles to estimate vehicle emissions (Edoarbo et al, 2011).

The future emission can be estimated using national mobile inventory model (NMIM) this model is developed to estimate the current future emission inventories for road motor vehicles (USEPA, 2012).

The accumulation of greenhouse gasses in the atmosphere means that the average temperature are gradually rising and the rain is becoming more and more scarce in some areas of the world and also means that season and climate are becoming more and more difficult to predict. (Solomon et al, 2007).

Nowadays, more importance is being aimed at the environment and the various ways that can contribute to save the earth that is considered as a home to all the humans. A major factor that can help with this issue is waste management and recycling which is the issue of concerned. Waste management is broad term that includes many implications that goes from reducing waste, reusing and recycling all kinds of waste like glass, paper, aluminium, plastic, iron and other elements in order to increase the greenhouse gasses effects on earth. Additionally, the growing knowledge of waste management practices among people may have a significant impact on this problem. Eliminating the combustion of coal, oil, and eventually natural gas is the first hurdle. The inhabitants of wealthier countries practically eat, wear, work, play, and even sleep on the things made from such fossilized sunlight, making this the most difficult challenge. The same amenities are also desired and perhaps deserved by inhabitants of developing countries, thanks in large part to the energy contained in such fuels. Oil is the lubricant of the world economy and is essential for the transportation of both people and things. It is concealed in everyday items like plastic and corn. According to the International Energy Agency, coal is the primary source of about half of the electricity used globally, a number that is expected to rise. There are no ideal ways to lessen our reliance on fossil fuels, but every little bit contributes. For instance, carbon-neutral biofuels can increase food prices and cause forest degradation. Nuclear power does not produce greenhouse gases, but it does produce radioactive waste. Furthermore, even while investing in stronger insulation and other inexpensive, temperature-regulating measures can result in long-term cost savings, buildings contribute around one third of all greenhouse gas emissions worldwide. Even the most fuel-efficient vehicle's fuel economy can be decreased by terrible roads. In developing nations, investing in new infrastructure or drastically enhancing current roadways and transmission lines will help reduce greenhouse gas emissions and spur economic growth. The simplest strategy to reduce greenhouse gas emissions is to simply make fewer purchases.

Greenhouse have had a huge effects on climate change. We have been pouring more and more carbon dioxide and methane to the atmosphere causing the accumulation of greenhouse gasses in the atmosphere. (Montzka et al, 2010).

Incomplete combustion of fossil fuel lead to the release of carbon monoxide into the atmosphere which is a pollutant that affect the quality of the entire atmosphere (Odjugo, 2001).

Accumulation of greenhouse gasses in the earth lower atmosphere pose significant danger to the environment and the human health. Environment polluted by greenhouse gasses experience unpredictable climatic condition and rising temperature. The ozone layer is also affected by this toxic gasses from automobiles and industries. Human health are seriously affected by the greenhouse gasses. $CO_2$ concentration between 15000ppm to 80000ppm causes mild respiratory stimulation, increase heart rate, high blood pressure, dizziness, headache, shortness of breath and even death. Life is always uncomfortable in an environment polluted by greenhouse gasses.

Methane is highly flammable and explosive gas, quickly ignited when exposed to heat, sparks or flame. Any exposure to methane gas above 1000ppm is associated with health hazard such as respiratory problems, eyes irritation, and high blood pressure and affect blood circulations. The recommended exposure limit for methane according NIOSH is 1000ppm equivalent to 0.1% per volume of air during and eight hour working period.

## II. Materials and Method

The materials used in carrying out the experiment were GPS, Air quality Monitor (JSB-131, SC mode), Methane Sensor, Aeroqual Series 500 gas meter.

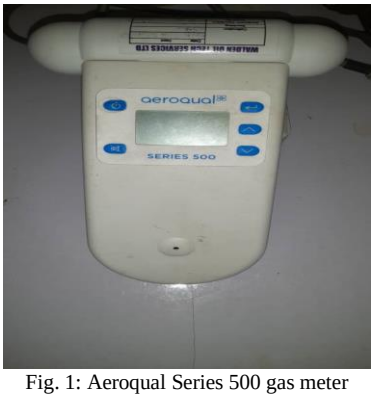

Fig. 1: Aeroqual Series 500 gas meter

Fig. 2: Air quality Monitor



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## III. The Study Area

The study was conducted in Kaduna metropolis and environs which is between latitudes 10°20' N and 10°37'N of the Equator and Longitudes 7° 22' E and 7°31'E of the Greenwich meridian. It has an average annual temperature and rain full 35% and 1016mm respectively with seven months rainy season (April to October) and five months dry season. The selected areas were Mando Motor Park, Nnamdi Azikiwe Express Way, Kawo Motro Park, Levintis Roundabout,

Stadium Roundabout Kaduna, Kakuri Industrial Area Kaduna, Kongo Road Motor Park Zaria, Kafanchan Parking Garage, Command Junction Kaduna and Television Garage Kaduna.

Which are most heavily polluted areas in terms of vehicular and industrial activities.

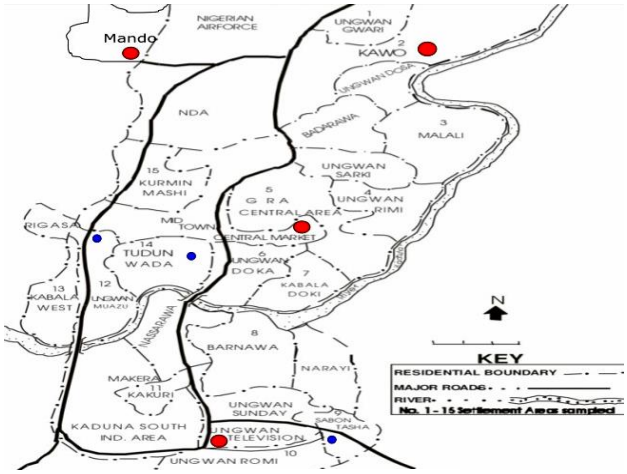


Fig. 3: Map of Kaduna metropolis

## IV. Methodology

The greenhouse gases measured were carbon dioxide, $CO_2$ and methane, $CH_4$. Carbon dioxide was measured using an air quality monitor (JSM-131 SC model) and methane $CH_4$, was detected and measured using methanometer and aeroqual series 500 gas meter with methane sensor. Average concentration was recorded in ppm. Each of the instrument was held at least 1m above the ground level to prevent background radiation from the ground. The concentration of the gasses were measured in the morning and evening hours. The readings were taken for 3days in each of the sites. The table below represents the concentration of $CO_2$ and $CH_4$ in ppm and percentage per unit volume of air across the sites.

TABLE I

| S. No | $CO_2$ Concentration from different site visited | | |
|---|---|---|---|
| | Sites | $CO_2$ (ppm) | % $CO_2$ |
| 1 | MMP | 12090 | 1.209 |
| 2 | NAEW | 11100 | 1.110 |
| 3 | KMP | 13200 | 1.320 |
| 4 | LRA | 12080 | 1.208 |
| 5 | SRAK | 15100 | 1.510 |
| 6 | KIAK | 13050 | 1.305 |
| 7 | KRMPZ | 12300 | 1.230 |
| 8 | KPG | 10500 | 1.050 |
| 9 | CJK | 11050 | 1.105 |
| 10 | TGK | 10100 | 1.010 |

TABLE II

| S. No | $CH_4$ Concentration from different site visited | | |
|---|---|---|---|
| | Sites | $CH_4$ (ppm) | % $CH_4$ |
| 1 | MMP | 1250 | 0.125 |
| 2 | NAEW | 1140 | 0.114 |
| 3 | KMP | 1300 | 0.130 |
| 4 | LRA | 1250 | 0.125 |
| 5 | SRAK | 1800 | 0.180 |
| 6 | KIAK | 1440 | 0.144 |
| 7 | KRMPZ | 1120 | 0.112 |
| 8 | KPG | 1100 | 0.110 |
| 9 | CJK | 1050 | 0.105 |
| 10 | TGK | 950 | 0.095 |

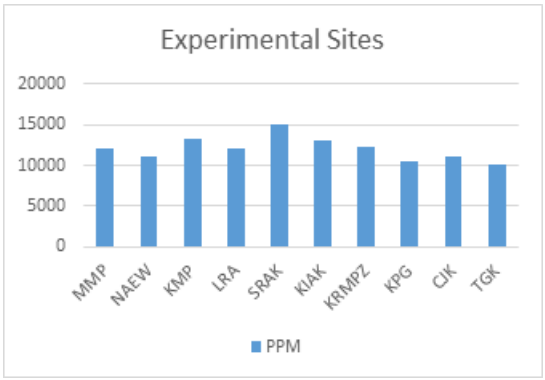


Fig. 4: Representation of $CO_2$ Concentration from the experimental sites

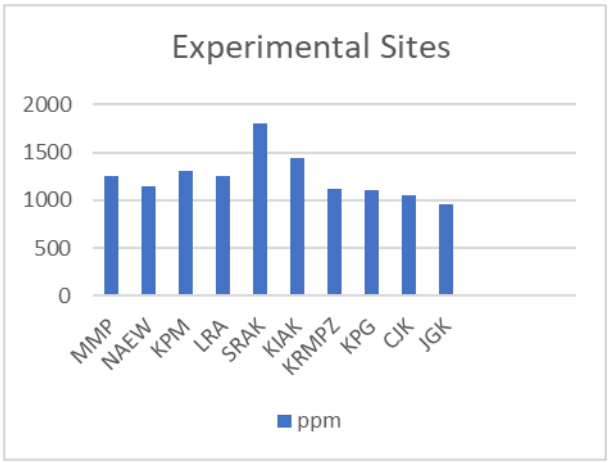


Fig. 5: Representation of $CH_4$ Concentration from the experimental sites

KEY:

| | | |
|---|---|---|
| MMP | - | Mando Motor Park |
| NAEW | - | Nnamdi Azikiwe Express Way |
| KMP | - | Kawo Motro Park |
| LRA | - | Levintis Roundabout |
| SRAK | - | Stadium Roundabout Kaduna |
| KIAK | - | Kakuri Industrial Area Kaduna |
| KRMPZ | | -Kongo Road Motor Park Zaria |
| KPG | - | Kafanchan Parking Garage |
| CJK | - | Command Junction Kaduna |
| TGK | - | Television Garage Kaduna |

The maximum concentration of $CO_2$ recorded was 15100ppm equivalent to 1.510% and the minimum concentration recorded was 10100ppm equivalent to 1.010% per volume of air. The cumulative average concentration is equal to 12057ppm equivalent to 1.206% per volume of air. These concentration in comparism with occupational safety and health administration (OSHA) which is 10000ppm (1%)



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called occupational exposure limit, there is an indication that the release of CO2 is increasing above safety level. Specifically, Stadium Roundabout Kaduna (SRAK) has the maximum concentration of $CO_2$ with the concentration of 15100ppm per volume of air equivalent to 1.510%.

The maximum concentration of $CH_4$ is 1800ppm equivalent to 0.180% and the minimum concentration is 950ppm equivalent to 0.095%. In all the areas visited the concentration $CH_4$ is above 1000ppm equivalent to 0.1% with the exception of Television Garage Kaduna (TGK) with 950ppm equivalent to 0.095%. The normal exposure limit recommended by the National Institute for Occupational Safety and Health Standard is 1000ppm equivalent to 0.1% during eight hours work period. This is an indication that the release of $CH_4$ within Kaduna and environs is increasing with increase human activities associated with the releases of greenhouse gasses.

## V. CONCLUSION

The results obtained have shown geometric increase in accumulation of greenhouse gasses within Kaduna metropolis and environs. This pose significant danger to the environment and human life.

In few decades to come, the concentration of these gasses will go beyond human survival and the environment will inhabitable. Hence the need for regulation and awareness by the appropriate authority on recycling and management of environmental pollution like greenhouse gasses. There is need for alternative for the toxic gasses used by industries and manufacturing of electric vehicles should be an alternative to those using fossil fuels. Afforestation should be enforced, deforestation should be prohibited within the state.

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