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Assessement of the Effects of Carbon Monoxide Emission on the Environment in Taraba State, Nigeria

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Abstract: *This study was designed to assess the effects of automobile emissions on People's Healthin Taraba State, Nigeria. The study answered research questions and tested one null hypothesis. These research questions showed the quantity of CO, NO_2 and SO_2 being emitted in Taraba state, the health effects of these emissions on the respondents and government measures necessary to reduce the effects of automobile emissions. The readings was taking each morning, afternoon and evening at six different road where there is high traffic concentration in the six study areas for three days. Q-Trak Plus IAQ Monitor was used to collect data on CO. The results revealed that the pollutants of CO,were above the FEPA minimum standard limit. Questionnaire was used to assess the vulnerable health effects of these emissions and the result shows that the respondents are beginning to feel the health effects of automobile emission in Taraba State. t-test was used to test the hypothesis.From this study, it could be concluded that the concentrations of CO,emitted in Taraba state is above the minimum set by FEPA and is dangerousThe following recommendation was made based on the findings of the study. There should be reliable and efficient mass transport system to reduce the number of motor vehicles and motor cycles on our roads and therefore reduce the emissions of CO.All motor vehicles and motor cycles moving on the road must pass vehicle inspection and maintenance test.*

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I. Introduction

Automobile emissionis emitted from "on-road" diesel engines (vehicle engines) or "nonroad" diesel engines (e.g., locomotives, marine vessels, heavy-duty equipment, etc.). Nationwide, data in 1998 indicated that diesel engine (DE) as measured bydieselparticulate matter(DPM) made up about 6% of the total ambientparticulate matter**(**$PM_{2.5}$) inventory (i.e., particles with aerodynamic diameter of 2.5 micrometers or less) and about 23% of the inventory, if natural and miscellaneous sources of PM2.5 are excluded. Estimates of the DPM percentage of the total inventory in urban centers are higher. For example, estimates range from 10% to 36% in some urban areas in California, Colorado, and Arizona. Available data also indicate that over the years there have been significant reductions in DPM emissions from the exhaust of on-road diesel engines, whereas limited data suggest that exhaust emissions from nonroad engines have increased.(U.S, 2002)

Automobile emission arises mainly from inefficient combustion of hydrocarbon fuels. Hydrocarbon gases easily unite with oxides of nitrogen (N_{Ox}) through photochemical reactions in sunlight to produce smog. N_{Ox} can combine with other organic substances in the atmosphere to create ozone, with devastating health effects on human being, vegetation and climatic stability. Hydrocarbon fuels also contain varying amounts of sulphur. The combustion of hydrocarbon (HC) fuels therefore has the potential of producing oxides of sulphur, which can combine with water in the atmosphere to form acids of sulphur. Automobile emissions significantly pollute air and require control (Karlsson 2004). With increasing concern for air toxics and climate modification caused by automobile emissions, the need for effective control is therefore important. There is therefore a great need for studies involving the effects of automobile emission. In recent years, there has been considerable research on vehicle emissions and fumes (Marshall, Riley, McKone and Nazarott2003). Carbon monoxide (C_O) causes blood clotting when it reacts with haemoglobin, and cuts the supply of oxygen in the respiration system after long exposure. This is a common occurrence in urban centres with a high level of commercial activity (Ackerman, Davies, Jefferson, Longhust and Marquez 2002)The worst levels of pollution are seen in such urban cities are densely populated with a low standard of living Automobile emissions present an important environmental hazard that needs to be investigated since it may shorten the lifespan of exposed people. Research has also indicated that the depletion of ozone layer is largely due to pollution from the use of automobiles,Gazali,(2014)

we have grown to accept the smell of engine exhaust as a part of everyday life our nation is experience an epidemic of illness made worse by air pollution. Government understanding of the severity of air pollution depends upon what is being monitored and where the monitoring occurs. Air quality varies across space and time, and is dependent upon climatic conditions. It is poorest, but may not be monitored, where traffic is most intense, normally where highways slow near urban areas, near construction sites, and where trucks, buses, and cars tend to concentrate and idle: schools, hospitals, shopping centers, truck stops, warehouses, ports and shipping facilities, oil tank farms, rail stations, bus terminals, and where gas and diesel powered vehicles are used within warehouses or ships. It should be noted that perfectly operating automobile engines would produce only water (H_2O) and carbon dioxide (CO_2) in the process of fuel combustion. However, in the real world of imperfect engines, improper fuel grades, lack of regular maintenance, physical ageing of engines, intensive use of vehicles and misuse of lubricants, all these factors combine to produce a constraint on perfect fuel combustion. The ultimate effect is the emission of CO, Hydrocarbons (HCs) and NOx from the exhaust system and engine parts of Automobile vehicles, particularly those using diesel as fuel. The danger posed by automobile emission should therefore influence environmental policy directed at improving the environment.Scientific experts now believe the nation faces an epidemic of illnesses that are exacerbated by air pollution. These illnesses include cardiovascular disease, asthma, chronic obstructive pulmonary disease, lung cancer, and diabetes.

The environmental costs of automobile emission are hard to measure and vary according to local conditions. Health cost estimates from local automobile emission in the Los Angeles region of the US in 1992 was reported to be $0.03 per vehicle-mile. McCubbin and Delucchi (1996) corroborated this fact, and stated further that health cost as a result of automobile emission could be as high as ten times that of cars and small buses. In both studies most of the health hazards are as a result of the increased mortality due to the presence of volatile organic compounds, NO_2 and SO_2 in the inhaled air. The rest of the hazards are due to minor illness from ozone (O_3), formed in the atmosphere from volatile organic compounds (VOCs) and N_{Ox}. Salami (2007) noted that vehicular emission has become the most complicated environmental challenges.Automobile emission also contributes to the environmental problems of acid rain and global warming". Automobile emission affects climate directly and indirectly through mechanisms that cause both warming and cooling of climate, and the effects operate on very different timescales. For instance, in the year 2000 as reported by (Schwela,2000) automobile emission has the largest effect on global mean temperature and this affect the climate in a variety of ways. The emissions consist of long-lived greenhouse gases mainly CO, short-lived chemically active gases (NOx, and VOCs) that indirectly lead to changes in greenhouse gases and emissions of short-lived aerosols and aerosol precursors (black carbon, organic carbon, and SO_2).

In comparing the total effects of automobile emission several issues need to be raised, some of which are scientific in nature, and some of which touch on value-related issues that go beyond what science alone can answer. The primary cause of the difficulties is the fact that the lifetimes/adjustment times of the various components span from hours to centuries, which raises two main questions, how does one compare hazard impacts that occur across different timescales? For example, how should the effects of emissions of black carbon aerosols that cause a large but relatively short-term warming be compared with the effects of CO which persists centuries after the time of emission? Short lifetimes mean indicates that the climate effects of some emissions can be very dependent on their location. This is particularly true for automobile emissions, which show large regional variations and operate in quite separate compartments of the atmosphere. Automobile emission contribute to greenhouse effect which is a natural phenomenon in which gases in the earth's atmosphere, including water vapour and carbon dioxide, trap radiation from the sun near the planet's surface. The greenhouse effect is necessary for the survival of life; without it, temperatures on earth would be too cold for humans and other life forms to survive. But human activities, particularly over the last century, have altered the composition of the atmosphere in ways that intensify the greenhouse effect. Since 1750, for example, the World Meteorological Organisation, (WMO, 2006) observed that the concentration of carbon dioxide (the leading global warming pollutant) in the atmosphere has increased by thirty five percent as a result of human activity. The Inter-Governmental Panel on Climate Change (IPCC) (2001) also stated that the current rate of increase in carbon dioxide concentration is unprecedented in the last 20,000 years; concentrations of other environmental pollutants have increased as well. According to the 2007 Assessment Report by the IPCC, the report indicated that the absence of emissions reductions has contributed to global temperatures and are estimated to increase by about 4°C, with the potential to go as high as 7°C or higher. This level of warming will have devastating effects on human life. By mid twenty first century, the report also indicated that more than a billion people will face water shortages and hunger, including 600 million in Africa alone. Weather extremes, food and water scarcity, and climate-related dangerous public health conditions are projected to drive the displacement of between 150 million and 1 billion people as global warming unfolds (IPCC, 2007b). The rate of economic growth in any nation is to some extent dependent on the health of the citizenry and cleaner environment, the importance of automobiles particularly in the urban area cannot be over emphasised but the danger pose by the effects of automobile emissions to the health and the environment has become a serious issues that need to be assessed.

In 2005, the World LP Gas Association conducted a research to identify the health effects of automobile emission and reported that cancers and bronchial illnesses, stemming from inhalation of fine particles in automobile emission, have been identified as being a health risk of great concern. Automobile emissions are also key constituents of photochemical smog, which has debilitating respiratory effects on the residents of many large urban areas. Some transport fuels also contribute to a long list of highly toxic air contaminants which, although present in very low concentrations, include known carcinogens and are now suspected to have links with many "20th Century" illnesses, including higher incidence of asthma and allergies.

In 2000 the World Bank summarised the airborne particle problem as follows:

"High concentrations of suspended particulates adversely affect human health, provoking a wide range of respiratory diseases and exacerbating heart disease and other conditions. Worldwide, in 1995 the ill health caused by such pollution resulted in at least 500,000 premature deaths and 4-5 million new cases of chronic bronchitis."

Erica, (2009) conducted a similar study on Vehicle Emissions and Health Impacts in Abuja, Nigeria. The Levels of CO, SO_2, and NO_2 was monitored at different intersection one day a week for one hour during morning, low traffic hours (9:00A.M.-1:30P.M.) and one hour during afternoon, high traffic hours (3:45P.M.-7:30P.M). Monitoring times was chosen to capture the range of daily exposure for traffic wardens. In total, 3 to 4 morning and afternoon measurements were conducted at each location over the course of 5 weeks. Questionnaires were also used to collect information on the health condition of the traffic wardens and the residence.

The study shows that:

- CO and SO_2 concentrations are significantly higher in the afternoon than in the morning
- An average afternoon CO concentration of 24ppm versus 16ppm
- afternoon, high traffic (39%) followed by no effect (33%)
- The large percentage of traffic wardens reported at least one symptom (70%, n=115), as well as the high prevalence for many of the reported symptoms implies that the general health status of wardens is poor and may relate to exposure.

The study made the following recommendations:

- Reducing emissions in commercial vehicles will likely have a significant impact on automobile emissions overall
- Government should work with the Road Traffic Workers union and educate them about the health consequences of pollution and the benefits of control

TABLE 1:Nigerian Ambient Air Quality Standard.

Pollutants	Time of Average	Limit
Particulates	Daily average of daily values 1 hour.	250 ug/m^3 *600 ug/m^3
Sulphur oxides (Sulphur dioxide)	Daily average of hourly values 1 hour	0.01 ppm (26 ug/m^3) 0.1 ppm (26 ug/m^3
Non-methane Hydrocarbon	Daily average of 3-hourly values	160 ug/m^3
Carbon monoxide	Daily average of hourly values 8-hourly average	10 ppm (11.4 ug/m^3) 20 ppm (22.8 ug/m^3)
Nitrogen oxides (Nitrogen dioxide)	Daily average of hourly values (range)	0.04 ppm-0.06 ppm (75.0 ug/m^3-113 ug/m^3)
Photochemical oxidant	Hourly values	0.06 ppm

Federal Environmental Protection Agency (1991).

TABLE 2: Guidelines for Nigeria Ambient Air Limits For Convectional Pollutants. Tolerance Limits for Ambient Air Pollutants

Pollutants	**Long–Term mg/m3**	**Limits (Hours)**	**Short- Term mg/m3**	**Limits +(mins)**
Carbon Monoxide	1.0	24	5.0	30
Hydrocarbons	0.01	24	-	-
Nitrogen Dioxide	0.085	24	0.085	30
Nitrogen Monoxide	0.4	24	0.8	30
Nitrogen Oxide	0.004	24	0.1	30
Oxidants	0.08	24	0.1	30
Sulphur Dioxide	0.05	24	0.5	30
Suspended Particulate	0.5	24	0.5	30

Federal Environmental Protection Agency, (1991).

II. Materials And Methods

This chapter describes the procedure and the method that was used in the research study.Research Design, Area of the Study, Population of the Study, Sample of the Study, Instruments for Data Collection, Validation of the Instruments, reliability of the Instruments, Method of Data Analysis.

Instruments for Data Collection

Q-Trak Plus IAQ Monitor, Model 8552 was used to measure C_O, The machine uses an electrochemical sensor with a range of 0 to 500ppm, a resolution of 0.1ppm, and a response time of 60 seconds. Its operating temperature range is between 5^0C and 45^0C (41^0F to 113^0F), and its humidity is between 5 and 95%.

Q-TRAK Plus IAQ Monitor

Q-Rae Plus Multi-gas Monitor, PGM-2000/2020, was used to measure and record NO_2 and SO_2 for research questions 2 and 3. NO_2 and SO_2 were measured by electrochemical sensors with a range of 0 to 20ppm and a 0.1ppm resolution. The sensor response time is 35 seconds for SO_2 and 25 seconds for NO_2. Its operating temperature is between -20^0C to 45^0C (-4^0 F to 113^0F) and its operating humidity is between 0% and 95%.

III. Method Of Data Analysis

The data collected for CO, with the use of computer analyser for research questions 1, was analysed using mean and statistics graph (bar chart) with excel computer software.

The data collected through the questionnaire for research null hypotheses were subjected to analysis using mean and t-test. The questionnaire used a four-point rating scale indicated as follows: Strongly Agree (SA) - 4 Points, Agree (A) - 3 Points, Disagree (D) - 2 Points and Strongly Disagree (SD) - 1 Point.

IV. Research Findings/ Discusion

What is the quantity of C_O emitted from automobile vehicles as emission in Taraba State?

To determine the quantity of $C_O$emitted in TarabaState, three days of readings were taken in the morning, afternoon and evening at six different junctions in each of the study area for three days. Three days mean computed are presented in Table 1 and Figure 1

Table 4.1:Mean Concentrations of CO Emitted in the Study Area of TarabaState.

DAYS	JALINGO	KARIMLAMIDO	GEMBU	BALI	TAKUM	ZING
DAY 1	11.23	13.7	11.10	11.33	11.10	9.81
DAY 2	11.82	12.81	11.30	10.01	10.90	9.95
DAY 3	12.55	14.11	10.60	11.01	10.83	10.23
AVERAGE MEAN	**11.87**	**13.48**	**10.99**	**10.78**	**10.9**	**9.99 (PM)**

Analysis of the result in Table 4.1 shows that the quantity of Carbon Monoxide (CO) measured in Jalingo, Karimlamido,Gembu,Bali and Zing were higher than the 10ppm minimum standard stipulated by the Federal Environmental Protection Agency, the reading of 9.99ppm in Zing is almost exactly as the standard.

Figure 1:Bar Chart Showing the Mean Concentrations of C_O Emitted in the Study Area of Taraba State.

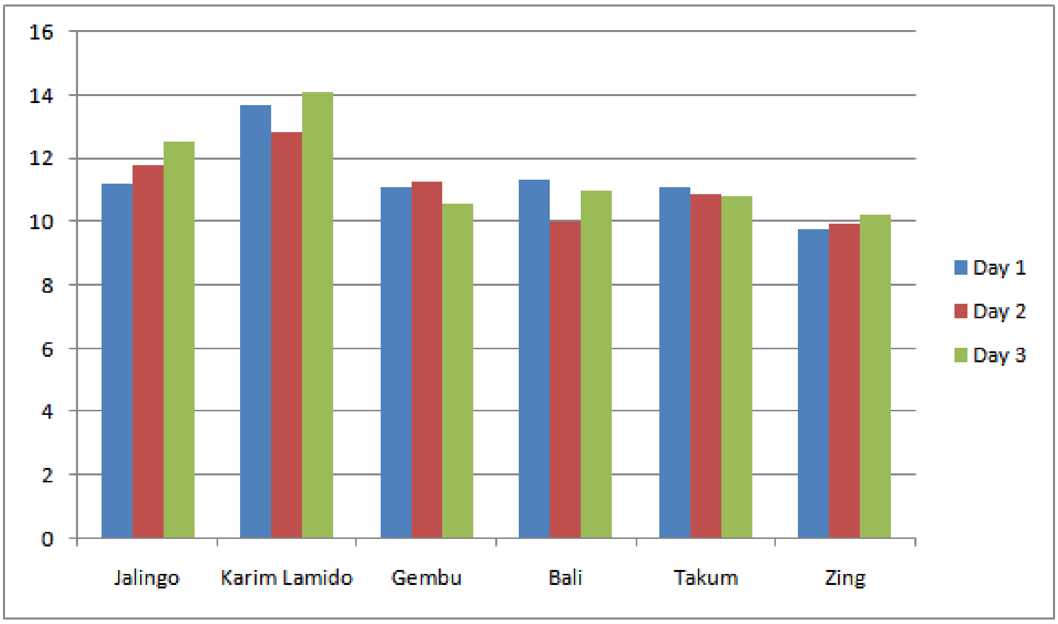

Figure 1. shows the details bar chart of the mean distribution of CO collected from the study area and the average mean for the study area with day 3 readings in Karimlamido showing the highest mean value of 10.23ppm and day one in Zingshowing the minimum mean value of 9.99ppm.

V. Discussion

The discussions of results for this study was organised and presented according to the research questions and hypothesis formulated and based on the findings for this study.

The quantity of carbon monoxide (CO) measured in Jalingo, Karimlamido, Gembu, Bali, Takum, and Zing out of the six study areas was higher than the 10ppm minimum standard stipulated by the Federal Environmental Protection Agency except inTakum, and Zing Kontagora that falls almost exactly as the standard. This is because these areas were more concentrated with transport activities from both motor vehicles and motor cycles. The result revealed that the higher the number of motor vehicles and motor cycles the higher the emission problems to the environment. Obajimi, (1998) supported this findings when he stated that in Nigeria, several rural towns that had in the past enjoyed fresh and dry air are currently experiencing air pollution problems. On the global sense, Seneca and Tausig (1994) arrived at the same conclusion that transportation is the major culprit of air pollution accounting for over 80% of total air pollutants. This is a clear indication that vehicle emissions are a major source of environmental problem and must be controlled if acceptable air quality is to be assured. In addition, there is numerous health problems associated with high concentration of these emissions. This findings of high concentration of CO was also confirmed by WHO (2000) with report that concentrations of CO are highest at near street intersections, in congested traffic, near exhaust gases from internal combustion engines and from industrial sources, and in poorly ventilated areas such as parking garages and tunnels.

VI. Conclusion

From the research, it could be concluded that the concentrations of C_O emitted in Taraba state is above the minimum set by FEPA and is dangerous. C_O has traditionally been the gas which has been the indicator for traffic pollution. It is toxic in low and high concentration leading to a wide range of health effects. NO_2 consist of nitric oxide and nitrogen dioxide formed by the reaction of oxygen and nitrogen within an engine's combustion chamber. While at a low level it affects the ozone which is directly harmful to human health by causing respiratory problems and reducing lung function. Although this study is limited, it does appear that residence of Taraba state have a high risk of health problems related to automobile emissions.

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