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Assessment of the Effects of Automobile Emission in Abuja Metropolis

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Abstract

The study assessed the effects of automobile emission in Abuja metropolis. Three research questions guided the study. A descriptive survey research design was adopted for the study. The respondents of this study consists of 100 automobile vehicle owners resident in Abuja metropolis and 50 residential occupants selected using convenient sampling technique. A structured questionnaire was used to collect data for the study. Cronbach Alpha statistics was utilized to determine the reliability coefficient of the instrument which yielded a reliability coefficient of 0.78. Based on the findings conclusions were drawn and recommendations made amongst which are that, Government agencies concerned with automobile vehicle regulations must ensure that all vehicles regardless of type must pass the vehicle inspection and maintenance tests. The government should provide reliable and effective mass transit systems to reduce traffic congestion thereby reducing emission of harmful air pollutants to the environment, also there is need for proper road network and traffic management systems to reduce idling period for automobile vehicles on the road among others.

Keywords: Automobile, Automobile Emission, Environmental Pollution, Climate Change

Introduction

Pollution is the presence of a substance in the environment as a result of its chemical composition or quantity which prevents the functioning of natural processes and produces undesirable environmental and health effects. According to Janke (2004) pollution is an undesirable change in the physical, chemical or biological characteristics of the air, water or land that can be harmful to the health, survival or activities of humans or other living organisms. Environmental pollution on the other hand is the presence of unwanted materials in the environment that is harmful to both man, animals, plants and other species of the environment. It is the presence of chemicals in the environment which tends to change "negatively" the normal balanced system of the environment. Environmental pollution has been classified into different classifications which include: water pollution, air pollution, light pollution, sound pollution; soil pollution, dust pollution, thermal pollution and land pollution amongst others. According to report by the United States Environmental Protection Agency (2010) air pollution consists of gas and particle contaminants that are present in the atmosphere. These gaseous pollutants include sulfur oxides (SO₂), volatile organic compounds (VOCs), certain toxic air pollutants and some gaseous forms of metals. Particulate matter pollution (PM₁₀ and PM_{2.5}) includes a mixture of compounds.

Air pollution can be caused by the release of small particles or greenhouse gases into the atmosphere

mostly as a result of human activities. According to Gazali and Salami (2013) human activities have begun to affect the environment through the release of pollutants (known as greenhouse gases or global warming pollutants) that exacerbate the earth's natural greenhouse effect (The greenhouse effect is a natural process that plays a major role in shaping the earth's climate). These human activities include burning of fossil fuels (such as the combustion of fuel in a motor vehicle), deforestation and bush burning (Idowu, Ayoola, Opele&Ikenweawe, 2011). According to Saxena (2009) burning of fossil fuels have contributed to the enhancement of the natural greenhouses effect. This enhanced greenhouse effect stems from an increase in the atmospheric concentrations called greenhouse gases (GHGs). Lindley and McCulloch (2005) in their study "regulating to reduce emissions of fluorinated greenhouse gases" stated that the greenhouse gases in the atmosphere leads to climate change and that the major greenhouse gases emitted into the atmosphere through human activities are carbon dioxide, methane, nitrous oxide and fluorinated gases (hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride). Pearce (1999) in his third report on "green heat and power: eco-effective energy solutions in the 21st Century" also noted that the emission of air pollutants such as carbon dioxide and methane, which are GHGs play notable role in global warming, as they trap heat without returning them as infrared or thermal radiation thereby contributing to the emerging global hazard.

Since 1970 till date, transportations, in particular

the combustion of gasoline and diesel in vehicles, have received increasing attention as a source of air pollution at both local and global scales. Despite other sources of air pollution, the emissions from a motor vehicles' exhaust alone contains a variety of toxic pollutants. These pollutants according to Henry, Pan, James, Nicole, Maurico and Nick, (2004) are carbon dioxide (CO₂), carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x), sulfur oxides (SO_x), particulate matter (PMs) and volatile organic compounds (VOCs). According to Oguntoke and Yussuf (2008) over 500 million motor vehicles ply the roads globally. As a result of this, traffic related air pollution, traffic congestion, traffic control and road safety are major issues in developing countries such as Nigeria. This steady growth in vehicular population however will put huge environmental stress on local and global scales in various forms, particularly causing poor air quality (Suresh, Atul, Deewan, Tarannum, Sachchidanand, Sudhamayee, Manoj, Chate&Padmanabhamurty, 2009). Studies over the years have made us to realize that the presence of these pollutants in the environment or exposure to these air pollutants over a long period of time have varieties of negative effects on the health of both man, animal and the environment.

The city of Abuja is characterized like most urban cities by high flow of traffic during the daytime especially during morning and evening rush hours with each vehicle emitting gases (i.e. carbon monoxide, carbon dioxide, nitrogen oxide and particulate matter), though depending on the type of fuel used, type and age of the vehicles; traffic flow rate and speed of the traffic as well as environmental conditions in the city. These traffic-related pollution, traffic congestion and traffic control are major problems and needs to be checkmated in order to achieve ambient air quality and a safer environment. Therefore, this study is designed to assess the effects of automobile emission in Abuja metropolis.

Statement of the problem

The transportation sector is the most rapidly growing source of greenhouse gas emissions that is, emissions of chemicals that have the potential to contribute to global warming (Intergovernmental Panel on Climate Change, 1996). According to Lage and Matthew (2008) transportation sources were responsible for over 50% of carbon monoxide, over 30% of nitrogen oxide and almost over 25% of hydrocarbons in the atmosphere in 2006. Over the years' studies have shown that the use of automobiles worldwide is increasing and with these

rapid increase in the number of motor vehicles on the road and number of vehicle miles travelled, it is valid to say we are on a fast lane to uncontrollable air pollution. The air is a source through which a worrisome amount of pollutants emitted from motor vehicle enters into the human body either through the mouth, nose, ears, eyes or skin. These pollutants include carbon monoxide, nitrogen oxide, volatile organic compounds, particulate matter and sulfur dioxide; which have been shown to cause harmful effects on bone marrow, spleen, lungs, and lymph nodes amongst others. Some of these pollutants also affect the environment by polluting the soil and can potentially enter the groundwater.

Although there are great strides in cleaning up auto emissions, we are still driving more. The effects of motor vehicle emissions are far reaching. Due to emissions from motor vehicle: cardiovascular, nervous system and respiratory problems have been known to occur. It also contributes to the formation of ground-level ozone which irritates the respiratory system, causing coughing, choking, and reduced lung capacity (United States Environmental Protection Agency, 2010). It is against this backdrop that the study is designed to assess the effects of automobile emission in Abuja metropolis.

Purpose of the Study

The main purpose of the study is to assess the effects of automobile emission in Abuja metropolis. Specifically, the study sought to:

1. Determine the causes of automobile emission in Abuja metropolis
2. Find out the effects of automobile emission in Abuja metropolis
3. Identify the strategies for effective management of automobile emission in Abuja metropolis

Research Questions

The following research questions guided the study:

1. What are the causes of automobile emission in Abuja metropolis?
2. What are the effects of automobile emission in Abuja metropolis?
3. What are the strategies for effective management of automobile emission in Abuja metropolis?

Methodology

A descriptive survey research design was adopted for the study. Descriptive survey research design in the view of Nworgu (2006) is the study which aims

in collecting data on, and describing in a systematic manner the characteristics, features or facts about a given population. The study was conducted in Abuja metropolis. A total of 150 respondents, comprising of 100 carowners and 50 residential occupants in Abuja metropolis were selected using convenient sampling technique were used as the total population for the study. A structured questionnaire was the instrument used for data collection. The instrument was face and content validated by three experts from the Department of Industrial and Technology Education (Automobile Technology Option), Federal University of Technology Minna, Niger State Nigeria. To determine the reliability of the instrument, it was pilot-tested on 15 automobile vehicle owners in Minna and 10 residential occupants also in Minna that were not part of the study. Cronbach alpha was used to determine the internal consistency of the instrument and it yielded a reliability coefficient of 0.78. Thus, the instrument was considered appropriate for use by the researcher.

The questionnaires were administered by the researcher and the entire instruments were retrieved and analysed. A five (5) point rating scale was used to determine the level of agreement of the items in the instrument. The decision rule was based on theory of true class limits of numbers with numerical values ranging between 4.50 - 5.00 = Very Strongly Agreed (VSA), 3.50 - 4.49 = Strongly Agreed (SA), 2.50 - 3.49 = Agreed (A), 1.50 - 2.49 = Disagreed (D) and 1.00 - 1.49 = Strongly Disagreed (SD). Therefore, the mean responses of the respondents were interpreted based on the true class limits of numbers highlighted above. The data collected from the study were analyzed using mean and standard deviation. The mean was used for answering the research questions and standard deviation was used to indicate the extent of homogeneity of the responses to the items

Results

Research Question 1

What are the causes of automobile emission in Abuja metropolis?

Table 1: Mean Responses and Standard Deviation of Residential Occupants and Car Owners on the Causes of Automobile Emission in Abuja Metropolis

| S/N | Item | \bar{X}_1 $N_1=100$ | SD_1 | \bar{X}_2 $N_2=50$ | SD_2 | \bar{X}_t | SD_t | Remarks |
|-----|--|--------------------------|--------|-------------------------|--------|-------------|--------|---------------------|
| 1. | The use of automobiles has increased rapidly within the metropolis due to urbanization | 3.88 | 1.22 | 3.93 | 1.09 | 3.91 | 1.14 | Strongly Agree |
| 2. | People are highly exposed to motor vehicle emissions within the metropolis | 4.50 | 1.06 | 4.63 | 0.98 | 4.57 | 1.02 | Very Strongly Agree |
| 3. | Urbanization contributes to the increase in motor vehicle emission | 3.88 | 0.97 | 3.91 | 0.99 | 3.89 | 0.98 | Strongly Agree |
| 4. | Vehicles that are due for recycling contributes to increase in exhaust emission level | 3.50 | 1.08 | 3.67 | 0.91 | 3.35 | 1.00 | Agree |
| 5. | Smoke and air pollution is becoming a serious issue in Abuja metropolis | 2.73 | 1.21 | 2.57 | 1.12 | 2.65 | 1.17 | Agree |
| 6. | Lack of maintenance of motor vehicle results in higher exhaust emission | 3.63 | 1.15 | 3.45 | 1.06 | 3.59 | 1.11 | Strongly Agree |
| 7. | Motor vehicle emission are the major sources of air pollution | 3.21 | 1.09 | 3.25 | 1.03 | 3.23 | 1.06 | Agree |
| 8. | Importation of used cars contribute to higher exhaust emission | 2.86 | 0.98 | 2.89 | 0.93 | 2.88 | 0.96 | Agree |
| 9. | Residents living close to motor ways are highly affected by motor vehicle emissions | 3.46 | 1.04 | 3.64 | 1.08 | 3.55 | 1.06 | Strongly Agree |
| 10. | There is lack of concentration of exhaust pollutants within the metropolis | 2.10 | 1.12 | 2.00 | 0.97 | 2.05 | 1.05 | Disagree |

Notation

\bar{X}_1 = Mean Score of Car Owners, \bar{X}_2 = Mean Score of Residential Occupants, \bar{X}_t = Average Mean Score of the Respondents, SD_1 = Standard Deviation of Car Owners, SD_2 = Standard Deviation of Residential Occupants, SD_t = Average Standard Deviation of the Respondents, N_1 = Number of Car Owners and N_2 = Number of Residential Occupants

The analysis of the results in Table 1 revealed that almost all the items were adjudged as agreed with mean values ranging between 3.63 to 4.57. From the analysis the items that is very strongly agreed is that people are highly exposed to motor vehicle emissions within the metropolis. Other items that were strongly agreed are the use of automobiles has increased rapidly within the metropolis due to urbanization, urbanization contributes to the increase in motor vehicle emission, lack of maintenance of motor vehicle results in higher exhaust emission and residents living close to motor

ways are highly affected by motor vehicle emissions. Only one item was disagreed which is there is lack of concentration of exhaust pollutants within the metropolis with an average mean value of 2.03 based on the respondents' opinion. The standard deviations indicate the degree of homogeneity of the respondents' responses to the items in the Table with values from 0.96 to 1.17.

Research Question 2

What are the effects of automobile emission in Abuja metropolis?

Table 2: Mean Responses and Standard Deviation of Residential Occupants and Car Owners on the Effects of Automobile Emission in Abuja Metropolis

| S/N | Item | \bar{X}_1 N ₁ = 100 | SD ₁ | \bar{X}_2 N ₂ = 50 | SD ₂ | \bar{X}_3 | SD ₃ | Remark |
|-----|---|--|-----------------|---------------------------------------|-----------------|-------------|-----------------|----------------|
| 11. | Motor vehicle emission causes skin cancer in humans | 2.12 | 0.98 | 2.20 | 1.15 | 2.16 | 1.07 | Disagree |
| 12. | Long exposure to exhaust fumes damages the lung tissues | 3.87 | 1.00 | 3.77 | 1.09 | 3.82 | 1.05 | Strongly Agree |
| 13. | Pollutants resulting from motor vehicles destroys the ozone layer | 4.23 | 1.17 | 3.99 | 0.98 | 4.11 | 1.08 | Strongly Agree |
| 14. | Exhaust emission from motor vehicle causes most respiratory related diseases | 3.80 | 1.11 | 3.94 | 1.04 | 3.87 | 1.08 | Strongly Agree |
| 15. | Motor vehicle emission pollutants contributes to the formation of acid rain | 3.21 | 1.06 | 3.14 | 1.12 | 3.17 | 1.09 | Agree |
| 16. | Exhaust emission from motor vehicle causes widespread damage of crops | 2.88 | 0.96 | 2.82 | 0.99 | 2.85 | 0.98 | Agree |
| 17. | Exhaust emission causes brain problems | 2.28 | 1.06 | 2.30 | 0.91 | 2.29 | 0.99 | Disagree |
| 18. | Exposure to exhaust emission may | 2.52 | 0.97 | 2.66 | 1.12 | 2.59 | 1.05 | Agree |
| 19. | Aggravation of respiratory problems is caused by motor vehicle exhaust emission | 3.04 | 1.08 | 3.11 | 1.06 | 3.08 | 1.07 | Agree |
| 20. | Exhaust emission is a major cause of lung cancer | 3.50 | 1.21 | 3.62 | 1.03 | 3.56 | 1.12 | Strongly Agree |

Analysis of the mean responses of the respondents in Table 2 revealed that all items were adjudged as agreed with mean values ranging between 2.50 to 4.11. From the analysis it implies that long exposure to exhaust fumes damages the lung tissues, pollutants resulting from motor vehicles destroys the ozone layer, exhaust emission from motor vehicle causes most respiratory related diseases and exhaust emission is a major cause of lung cancer were the items that are strongly agreed as the health effects of automobile vehicle emission. Only two

items were disagreed these includes motor vehicle emission causes skin cancer in humans and exhaust emission causes brain problems with average mean value from 2.16 to 2.29. The standard deviations indicate the degree of homogeneity of the respondents' responses to the items in the table with values from 0.98 to 1.12.

Research Question 3

What are the strategies for effective management of automobile emission in Abuja metropolis?

Table 3 Mean Responses and Standard Deviation of Residential Occupants and Car Owners on the Strategies for Effective Management of Automobile Emission in Abuja Metropolis

| SN | Item | \bar{X}_1 | SD ₁ | \bar{X}_2 | SD ₂ | \bar{X} | SD ₃ | Remark |
|----|--|-------------------------|------------------------|-------------|-----------------|-----------|-----------------|---------------------|
| | | N ₁ = 100 | N ₂ = 50 | | | | | |
| 21 | Expansion of road capacity to reduce traffic congestion which will in turn reduce air pollution | 3.31 | 1.11 | 3.46 | 1.04 | 3.38 | 1.08 | Agree |
| 22 | Provision of public transportation systems to reduce use of private cars | 3.42 | 1.06 | 3.68 | 1.12 | 3.35 | 1.09 | Strongly Agree |
| 23 | Shift travel to less carbon-intensive modes (cycling, walking) | 4.43 | 0.96 | 4.62 | 0.99 | 4.53 | 0.98 | Very Strongly Agree |
| 24 | The use of efficient catalytic converters to reduce emission | 4.21 | 1.08 | 3.99 | 0.91 | 3.21 | 0.99 | Agree |
| 25 | Implement government policies against importation of used cars | 3.04 | 1.05 | 3.14 | 1.12 | 3.09 | 1.09 | Agree |
| 26 | Increase taxes payed on cars to limit buyers of so many cars | 3.00 | 0.98 | 3.14 | 1.16 | 3.09 | 1.07 | Agree |
| 27 | Adequate traffic control system should be implemented | 3.52 | 1.00 | 3.68 | 0.91 | 3.60 | 0.96 | Strongly Agree |
| 28 | The government should establish a body to oversee the serviceability years of motor vehicle on our roads | 3.21 | 1.17 | 3.23 | 1.12 | 3.22 | 1.15 | Agree |
| 29 | Proper maintenance of motor vehicles to reduce the exhaust fumes emitted | 3.73 | 1.11 | 3.80 | 1.06 | 3.76 | 1.09 | Strongly Agree |
| 30 | The use of exhaust gas recirculation systems | 3.20 | 0.80 | 3.14 | 1.11 | 3.17 | 0.96 | Agree |
| 31 | A law should be past that limits the number of cars per person | 3.04 | 1.04 | 3.11 | 1.09 | 3.08 | 1.07 | Agree |

The results Table 3 revealed that the respondents agreed with all items in the Table as the strategies for effective management of automobile emission with mean values ranging between 3.08 to 4.53. The item that is very strongly agreed is shift travel to less carbon-intensive modes (cycling, walking). Other items that are strongly agreed includes provision of public transportation systems to reduce use of private cars, adequate traffic control system should be implemented and proper maintenance of motor vehicles to reduce the exhaust fumes emitted based on the respondents opinion. The standard deviations indicate the degree of homogeneity of the respondents' responses to the items in the Table with values from 0.96 to 1.15

Discussions of Findings

The findings from Table 1 indicates that automobile emission in Abuja metropolis has increased which can be attributed to urbanization and industrialization, as a result of this there is the increase in the use of automobile vehicles. Utara, Nahu and Vansita (2012) stated that increase in population of an area as a result of urbanization would also result in a relative increase in the use of automobile vehicles which in turn would cause more air pollution in that area. The emissions from

these automobile vehicles has strongly influenced the air quality within the metropolis bearing in mind that automobile vehicle is a major source of air pollution.

in line with Suresh, Atul, Deewan, Tarannum, Sachchidanand, Sudhamayee, Manoj, Chate and Padmanabhamurty, (2009) stated that steady growth in vehicular population however will put huge environmental stress on local and global scales in various forms, particularly causing poor air quality. Residents however are greatly exposed to these emissions most especially those living close to motor ways. This is supported by Brunekreef, Janssen, De Hartog, Harssema, Knafe and Van Vliet, (1997) who reported that the impact of vehicular emission is high among residents living close (below 300m) to motorways. Lack of maintenance of vehicles by automobile vehicle owners, the continuous use of automobile vehicles that are due for recycling due to the fact that they have passed their serviceability years, amongst others has also contributed to the increase in air pollution currently faced within the metropolis. Supporting this, Udeozor and Nzeako (2012) expressed that used vehicles due for recycling having passed their serviceability years (5-25 years)

contributes higher amount of pollutants to the atmosphere than the automobile vehicles within 0-5 years, which implies that such vehicles are very harmful to the environment.

The findings in Table 2 revealed that automobile emission is responsible for aggravating certain respiratory related conditions such as asthma, damage to the lungs amongst others to individuals exposed to the emission. Long exposure to these fumes or emissions causes lung cancer and may shorten one's life span. The United States Environmental Protection Agency (2010) listed the health effects of automobile pollutants as aggravation of lung diseases, causes lung cancer, aggravates certain heart diseases, in worst cases causes' premature mortality amongst others. These emissions from automobile do not only affect human health directly but also indirectly that is the environment is also affected. The ozone layer is directly affected by exhaust gas emission, the formation of acid rain is also as a result of exhaust gas emission in to the atmosphere and widespread damage to crops and vegetation amongst other are the negative effects of exhaust gas emission to the environment. The United States Environmental Protection Agency (2010) also reported that ozone (which is formed as a result of chemical combinations between VOCs, NO_x and daylight) damages vegetation by visibly injuring leaves, reducing photosynthesis, impairing reproduction and growth, and decreasing crop yields. Ozone damage to plants may alter ecosystem structure, reduce biodiversity, and decrease plant uptake of CO₂.

The findings in Table 3 showed that in order to reduce exhaust gas emission from automobile vehicles certain measures or strategies should be implemented. Such strategies include: ensuring adequate traffic control system by the Government to reduce traffic congestion. Shopade (2010) agreed with this assertion by stating that since traffic congestion as the case may be is a classic demand and supply problem it may be solved by either increasing road capacity (supply) or reducing traffic (demand). Other measures include proper maintenance of vehicles by automobile vehicle owners, provision of efficient public transportation systems to reduce vehicles on the roads. This is supported by Vance and Hedel (2007) who stated that the design of a city and its transportation system or network determines whether residents are automobile dependent or has choices for other forms of transportation such as public transport modes such as rail and bus rapid transit schemes amongst others to reduce number of automobile vehicles on the roads. Improve traffic management

agencies efficiency to properly monitor vehicles on the roads. In line with this Oyeyemi (2015) however that enforcing traffic laws strictly without favour will enhance the livability of our cities. He also stated that traffic management agencies should collaborate with the Federal Road Safety Corps to enforce the laws, educate road users, clear the road of all sorts of obstructions and evolve strategies that will lead to safer road culture in Nigeria. In reducing emission using emission control systems the use of catalytic converters amongst others can be used to reduce exhaust gas emission from automobile vehicles. Also Salami (2007) affirmed that the use of catalytic converters make for a significant and easily applied method for reducing vehicle emissions which is generally being improved as the years goes by.

Conclusion

The emission of air pollutants from automobile vehicles such as carbon dioxide (CO₂), carbon monoxide (CO), nitrogen oxide (NO_x) and Sulphur oxide (SO_x) have contributed to the environmental harms and health problems in Abuja metropolis and Nigeria as a whole as indicated in this study. A lot needs to be done by the general populace, residents and automobile vehicle owners, the government as well as traffic management agency because as it stands everyone has a role to play in curbing these emissions: from maintenance of one's vehicle to provision of efficient mass transit systems and proper road network by the government.

Recommendations

The following recommendations were made based on the findings of the study

1. Government agencies concerned with automobile vehicle regulations must ensure that all vehicles regardless of type must pass the vehicle inspection and maintenance test
2. The government should provide reliable and effective mass transit systems to reduce traffic congestion thereby reducing emission of harmful air pollutants to the environment. There is need for proper road network and traffic management systems to reduce idling period for automobile vehicles on the road.
3. The general public should be enlightened by the appropriate authorities' such as Vehicle Inspection Officers (VIO) and Federal Road Safety Corps (FRSC) on the importance of maintaining motor vehicles to reduce the amount of exhaust pollutants to the environment. The Federal Government should implement a policy to curtail the importation of used cars that have passed its serviceability years into the country.

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