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Effect of Emission from Motorcycle as Public Transport on Climate Change

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ABSTRACT: The increasing population growth with progressive rate of urbanisation actually call for more transportation systems that meet the demand of people for easy movement at affordable cost. Hence, the need for motorcycle that serves as popular mode of transport and takes care of inadequacy of transportation in Nigeria. However, the study aims to address the emission challenges of this transport system through a proper analysis of emission from the system. It also takes account of the climatic effect of this emission on the weather variability at Ado Ekiti, in Nigeria. The method involves the use of stratified questionnaires and oral interview, online collection of weather variability and monitoring of emission from the exhaust of some selected commercial motorcycle using potable emission analyser. The results revealed that the high number of commercial motorcycles with long period of operation contribute immensely to the fuel consumption and promote the high percentage of greenhouse gas emission. The result no doubt tells much on the climate change particularly the pattern of rainfall which in turn lead to annual flooding nuisance in the city. The paper suggests proper physical planning measure that can promote pedestrian movement and development control mechanism that can equally reduce the environmental pollution of the motorcycle.

Keywords: Commercial Transport; Exhaust Emission; Flooding; Urbanisation; Weather variability

I INTRODUCTION

The rapid population growth and the high rate of urbanisation which manifest on the physical expansion of the cities contribute a lot to the increase in number of motorized vehicles.The rise in urban population will have a geometrical effect in the increased number of motorized vehicles in cities by 2050, aggravating the hazard even in countries with overall low motorization rates [1] For instance, the world vehicle population increased with 4.6 percent in 2016, making the global population of cars and trucks to stand at 1.3billion to double the volume of vehicles that were 670million in 1996 which is 20 years ago. This equally doubled the vehicles population of 342million in 1976. [2] The situation is not different in developing countries as the number of registered vehicles in India jumped from 10.6 million in 1986 to 40.9 million in 1998, at annual average growth rate of 12%. Likewise Nigeria equally experienced unprecedented 693% increase of vehicles from 1970 to 2010. [3].The Federal Road Safety Commission of Nigeria (FRSC) indicated that between 1999 and 2004 about six million vehicles (6,000,000) were registered in Nigeria while the estimated vehicle population in Nigeria as at 2018 was put at 11,760871 making 006 as vehicle population ratio. [4]. In most cities in the world, the road transport sector is the largest contributor of these urban air pollutants, as well as to high levels of carbon monoxide and hydrocarbons, among other substances. In fact, traffic emissions contribute about 50 - 80% of NO_2 and CO concentration in developing countries. [5]. [6] and [7]. These high levels contribute to various respiratory and cardiovascular illnesses. Various epidemiological studies have clearly linked transport-related contaminants to asthma, bronchitis, heart attacks, and strokes

However, the level of poverty particularly in developing countries calls for alternative mode of transportation which is cheap and affordable for the people to meet the increasing population growth and high rate of urbanisation. Hence, motorcycle is fast becoming a popular mode of transport for the people of developing countries [8].This made this paper imperative with the aims at alleviating the effect of motorcycle emission on climate change. The paper therefore focuses the on the operation of motorcycle as public mode of transport; the motorcycle emission; the weather

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variability and hypothesis testing as major variables for analysis.

II REVIEW OF LITERATURES

Motorcycle has now become a popular mode of public transportglobally, most especially developing countries. The names for this mode of transport varies across the countries. [9], [10]. Available records indicated that the global motorcycle population in 1989 was about 125 million units and in 2002 the population was about 255 million units or about 33 motorcycles per 1000 people. [11]. In Nigeria, it is equally noted that the number of registered Commercial motorcycles in Nigeria as at 2014 was about 8 million Premium Times 2014 and predicted to grow by a modest average of 2.8% per year while the number of motorcycles per person is predicted to rise from 0.32 to 0.34 in 2018. [4].

A combination of factors are also responsible for the use of motorcycles as means of intra-city transport in developing countries and Nigeria in particular. These include the provision of easy employment opportunity for the teeming number of unemployed youth, retirees and other quasi operator's desirous of augmenting their regular source of income. [12].The cheap and affordable mode of transport for the poor masses. [13]and the high profitability of commercial motorcycle operation. [14] Constitute another major factor.

The negative attributes of motorcycles as public modes of transport manifested in different dimensions. These include the high rate of accidents recorded daily across the country due to the impatience on the part of the bike riders, flagrant disregard for traffic rules and which are summed together as human vehicular and infrastructures factors. [15], [16].Another negative effect of the use of motorcycle for commercial transportation is its use for criminal acts such as murder, theft, handbag and mobile phone snatching, rape, kidnapping and ritual killings which are on the increase in Nigeria. [17], [18]. Aside from this, their members are also reported to be extremely violent, resorting to jungle justice to get easy passage of their erring members whenever the situation warrants. [19].The frequent occurrence of these crimes has become a major source of worry not only to the government but the generality of the masses.

As a matter of fact, the continuous increase in the number of motorcycles as public mode of transport has made their emissions to be one of the major sources of air pollutants in urban areas. This is because the emissions of burned and unburned lubrication oils from a single, two-stroke motorcycle is equivalent to one diesel-powered bus or truck when the HC emission is equivalent to 10 gasoline-powered cars. At the same time, four-stroke motorcycles emit only slightly more pollutants than gasoline-powered cars. [20]. It is also important to know that the most significant part of the total emission during a trip takes place during the cold phase when engine and catalyst are cold producing incomplete combustion causing high toxicity due to the presence of toxic VOCs. [21], [22]. In some Asian cities, motorcycle emissions significantly estimated to contribute as much as 40 percent of (PM), 50 percent of Carbon II oxide (CO,) and not less than70 percent of Volatile of Carbon (VOC). [23]. The motorcycles and moped contributions to CO and HC total emissions were estimated to be around 38 and 27 %, respectively, in 2010 at the city Genoa. [24].The research carried out to reduce motorcycle emission with electrolyser only reduce the value of HC, increase the value of CO and have no effect with CO_2. [25].

III. METHODOLOG

Study Area

The study area is Ado Ekiti in Ekiti State of Nigeria. The city is geographical located on latitude 7°4' north of the Equator and 5°15′ east of the Greenwich Meridian At the same time it is centrally and strategically located in Ekiti land to give way for maximum spatial interaction with all towns in the state. The city has four zones for the operation of motorcycle as public transport. The zones are Ado Central, Ayoba, Mojere and Olota as shown in figure 1 below

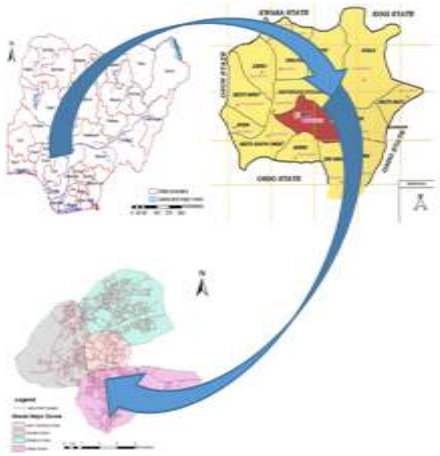

Figure 1 Geographic location of Commercial Motorcycle zones for operation at Ado Ekiti in Nigeria

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Background Information

The transformation of the city from Local administrative headquarters to State capital led to it rapid population growth and development. This actually made a city of less than 200,000 populations before the creation of Ekiti State in 1996 to rise to about 400,000 populations in 2006. [26].At the same time, the spatial expansion also increased from 19.6 km^2 in 1996 o 36.7 km^2 in 2006.[27].

The development equally contributed to the increasing rate of motorcycle as public mode of transport. For instance, the volume of registered Okada in Ado Ekiri which was about 623 in 1996 rose to 6042 in 2006 and over 8000 in 2016. [16].The data collected from the various zonal chairmen of the commercial motorcycle associations in 2018 revealed that the number of commercial motorcycles operating within the four zones of the city stood at 10,065.

Data sources

The data obtained through a primary source include background and operational modality of commercial motorcyclists, the various pattern and volume of their operation in the city as well as the emission pollution from the sampled motorcycles. However the population trend of the city together with the spatial expansion of the city including the climatic condition of the city in term of temperature and rainfall were all obtained through the secondary source.

Sample Technique

The primary survey was designed with 415 questionnaires for selected commercial motorcycle operators through stratified random sample technique across the four zones. The questionnaires contained sets of open and closed structured questions that collected data. Relevant data were equally collected from their associations in Ado-Ekiti. The research also made use of a potable Emission Analyser as a device to determine the amount of emitted CO_2, HC and O_2 by the selected motorcycles.

Data Analysis

The collected data were subjected to descriptive statisticalanalysis of tables and chart presentation together with the inferential statistics of Multiple Regression Analysis to test the hypothesis relationship of fuel and carbon dioxide emission

IV. RESULTS

The Background of Operators and Modality of Commercial Motorcycle operation Generally, the descriptive result for the operators of this mode of transport take into account the age marital status together with their mode and area of operation. The result revealed that most of these operators with 58.31 percent were within the age bracket of twenty five and fifty years of which not less than 30 percent are from Mojere zones. Those below twenty five years came second with 31.33 percent of which Ayoba has the highest percentage. It is also noted that 61 percent of these public mode of transport operators are married and form the majority as shown inTable 1. The table clearly showed that over 75 percent constituted the majority of public mode of transport operators have working period that fall between six and twelve hours per day. This category of public mode of transport operators consumed between 3 and 6 litres of fuel per day. At the same time, the percentage of those operating in not more than three zones formed the majority with 64 percent.

Table 1: Background of Operators and Modality of operation of Commercial Motorcycles.

Name of Zone	Respondents datas	Central		Olota		Ayoba		Mojere		Total	
		No	%	No	%	No	%	No	%	No	%
28.94Age	<25 yrs	17	4.1	36	8.7	47	11.33	30	7.23	130	31.33
	25-50 yrs	40	9.64	73	17.59	69	16.63	60	34.16	242	58.31
	>50 yrs	8	1.93	11	2.65	14	3.37	10	2.41	43	10,36
	Total	65	15.67	120	28.94	130	31.33	100	43.8	415	99.99
Marital status	Single	25	6.02	42	10.12	47	11.32	33	7..95	147	35.42
	Married	37	8.92	73	17.59	78	18.80	65	15.66	253	61
	None	3	0.72	5	1.2	5	1.2	2	0.48	15	3.61
	Total	65	15.66	120	28.91	130	31.32	100	24.09	415	99.99
Mode of Operation	<6 hrs	4	0.96	15	3.61	14	3.37	9	2.17	42	16.12
	6.12 hrs	49	11.81	87	20.76	95	22.89	81	19.52	312	75.18
	>12 hrs	12	2.89	18	4.37	21	5.06	10	2.41	61	14.69

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Fuel consumption	Total	65	15.66	120	28.74	120	28.74	100	24.10	415	100
	< 3 litres	5	1.2	17	4.10	26	6.26	16	3.86	64	15.52
	3-6 litres	48	11.57	75	18.07	70	16.87	61	14.70	259	62.41
	>6 litres	12	2.89	28	6.75	34	8.12	18	4.34	92	22.17
	Total	65	15.66	120	28.74	130	31.36	95	22.89	415	100
Area of Operation	Not > than 2 Zones	3	0.72	10	2.41	16	3.86	9	2.17	38	9.15
	Not > than 3 Zones	50	12.05	67	16.14	80	19.28	71	17.11	268	64.58
	All zones	12	2.89	43	10.36	34	8.19	20	4.82	109	26.27
	Total	65	15.66	120	28.74	130	31.36	100	24.09	415	100

The type of motorcycle as public mode of transport and emission pattern There are different types of motorcycles operating as public mode of transportin Ado Ekiti. However, the three prominent are Boxer, Suzuki and Jincheng with Boxer brand of motorcycle constituted the majority. Others which are very few in numbers include Honda, Qlink, Bajaj Nanfang and PremierR The distribution of these various form of motorcycles across the zones are shown in Figure. 2.

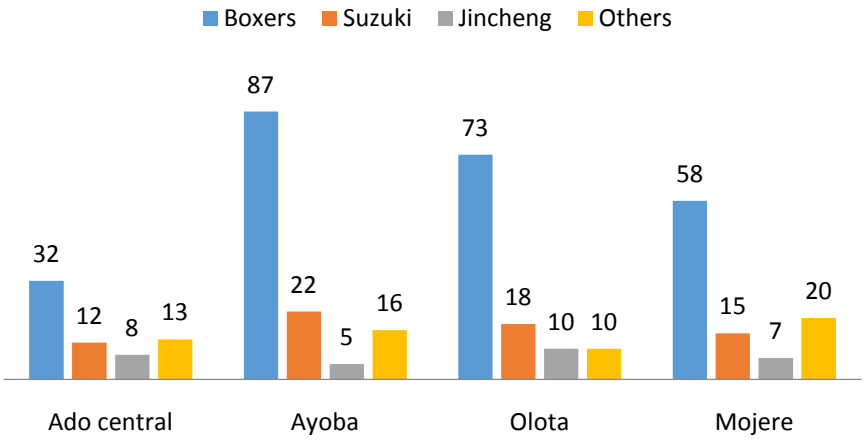

Figure. 2: The major types of motorcycles

The emission average in the Table 2 clearly showed that Boxer motorcycles have the least concentration of emission with CO 1.18%; CO_2; 16.97%; O_2 2.32% and HC 1175ppm while Suzuki type of motorcycles have the concentration of CO 1.80%; CO_2; 15.31%; O_2 3.57% and HC 5243.07ppm to emit the highest substances..

Table 2: The Emission Average of Motorcycle at Ado Ekiti

Type	CO (%)	CO_2 (%)	O_2 (%)	HC (ppm)
Boxer	1.18	16.97	2.32	1175.65
Suzuki	1.80	15.31	3.57	5243.07
Jincheng	1.47	15.32	2.81	3636.78
Others	1.25	15.75	3.27	2944.88

The weather variability

The online data collection of weather variability over time in Ado Ekiti which now presented as chart takes into account the temperature and rainfall pattern as indicated in Figure 3 and Figure 4 respectively. The city experienced a steady low temperature increase between 2010 and 2015. See Figure 3. It also witnessed a sharp fall on average temperature from 25.86 degree centigrade in 2014 to 25.33 degree centigrade in 2015 and also a rapid increase in temperature from 25.58 degree centigrade degree centrigate in 2017 to 26.25 in 2018 as shown in Figure 3. However, the graph of average yearly temperature indicated that the total annual average from 2010 to 2018 was 25.64 while the period

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experienced an increase of 0.61 in temperature, see Figure 3

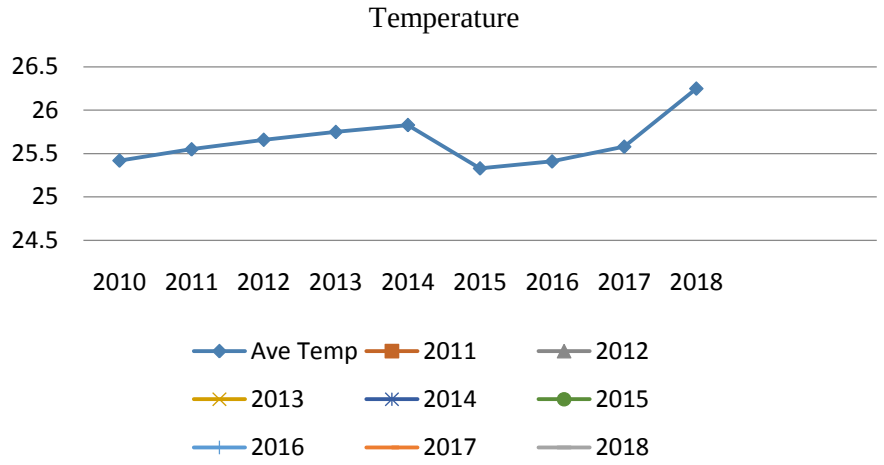

Figure. 3: Ado Ekiti Average Temperature Chart
Data source; World weather climate (2019)

There was undulated pattern of rainfall over the years as shown in Figure.4 However, the city witnessed a rise in rainfall of about 6omm and 87mm in 2012 and 2018, respectively.

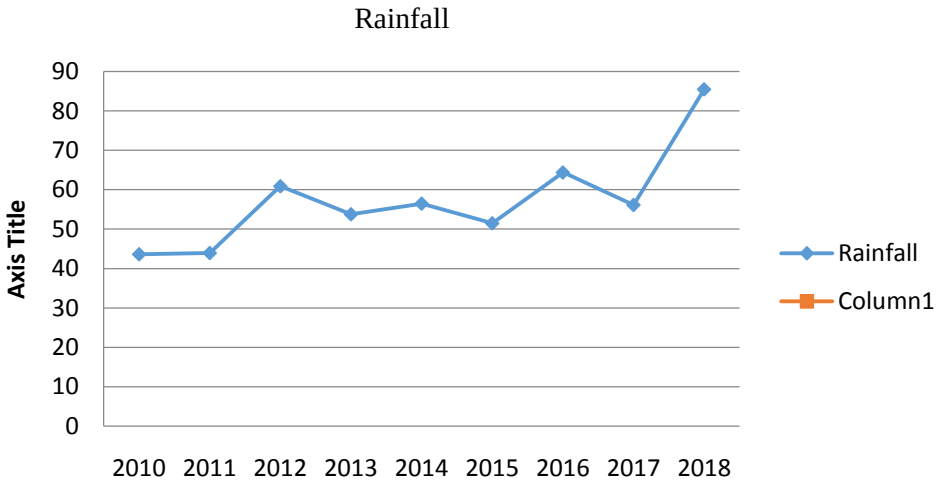

Figure. 4: The rainfall pattern chart
Data source; World weather climate (2019)

Regression analysis

The analysis of CO_2 emission and fuel consumption hypothesis is by multiple regression. The regression analysis is divided into three tables namely summary output, Anova and the P value table. The summary output in table3 indicated that the R^2 is 0.095723 which is about 10 percent.

Table 3: Summary Output of Regression Analysis

Summary output

Multiple R	0.309391
R Square	0.095723
Adjusted R Square	0.089613

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Standard Error	1.320054
Observations	150

The Analysis of variance (ANOVA) also has the significance F of 0.000117 as shown in table 4

Table 4: ANOVA of Regression Analysis

ANOVA	Df	SS	MS	F	Significance F
Regression	1	27.2975	27.2975	15.66662	0.000117
Residual	148	257.8962	1.742542	-	-
Total	149	285.1959	-	-	-

The regression analysis made the P value as indicated in table 5to be 0.000117

Table 5: The Regression Analysis P-value

	Coefficients	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**	**Lower 95.0%**	**Upper 95.0%**
Intercept	1.65697	0.325329	5.093218	1.06E-06	1.01408	2.299859	1.01408	2.299859
X Variable 1	0.338053	0.085408	3.958109	0.000117	0.169277	0.50683	0.169277	0.50683

V. DISCUSSION

The increasing population growth of Ado Ekiti after becoming the State capital contributed tremendously to the city physical expansion and development. This made the city to experience high rise of motorcycles as public mode of transport for easy movement. The rate of unemployment in Nigeria and Ekiti in particular where the group of (20-50) years formed 17.8 percent between 2008 and 2011. [3].made motorcycle as public mode of transport to be popular among the age group who are mostly married couples. Hence, operation of motorcycle for public transportis an economic cushion to alleviate poverty and harsh effects of unemployment, inflation and inadequate salary wages of a depressed economy. [28 This equally justified the explanation that with the growth in population, economic activities increased and led to more automobiles. [29]

Generally, readings from exhaust tailpipe of motorcycles in Ado Ekiti produced emission that are made up of CO with (1.18- 1.80) % and CO_2 having (15.31-16.97) % while Oxygen was between 2.32 and 3.57% and HC stood between 1175.65 and 5243.07 ppm. The fact that the P value of the regression analysis was less than 0.05 made H0 hypothesis to be rejected and considered the relationship between the fuel consumption and CO_2 emission to be correlated at about 10 percent This is also in agreement with the finding of [30],where test of Pearson Correlation Coefficient for age and CO_2 of petrol engine vehicles showed a very low negative correlation (r= -0.27). As a matter of fact, the long working hours of many of these mode of transport operators who are mostly married couple contributed a lot to the fuel consumption of their motorcycles. This is simply because the total period of operation has positive influence on the fuel consumption. In addition the population size of motorcycle owners as well as average distance covered contribute to the fuel consumption, [31].The situation where a motorcycle in Ado Ekiti consumes an average fuel 3.56 litres per day and a litre of fuel (petrol) is estimated to generate 2.3kg of carbon dioxide, [32] makes average motorcycle to generate 8.2kg of carbon dioxide per day.

However the increasing registration of this mode of transport from 6042 in 2006 to 10038 in 2018 makes the annual registration to stand at 338. The increasing population trend of motorcycle as public mode of transport over the years is directly contributing about 2,800kg of CO_2 as annual addition to the atmosphere and to some extent, influence the weather variability in term of temperature and rainfall. This justified Parida, et al. 2005 opinion cited by [33].that the global increase in temperature and changes of other climatic variables such as rainfall and evaporation are as a result of greenhouse gas emission As a matter of fact, the temperature rise of 0.6^0 C and increase in volume of rainfall from 6omm to 87mm which the city witnessed between 2012 and 2018 is the manifestation of the annual recurrence of flooding. Several studies have adduced extreme rainfall to be

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the major cause of flood worldwide. Such studies include [34], [12].

This phenomenon has damaging effects on the residents and the public where properties worth millions of Naira were destroyed. For instance, in 2018, one of the major highway that connect the city with Ekiti State University was flooded to the extent that one lane became impossible for motorist, cyclists and pedestrians to use, seefigure 5 below

Figure 5: Flooding on Iworoko Highway 2018

Similarly the heavy rainfall of 2019 made flooding to damage the bridge at Ureje along the Federal Polytechnic road. This also constituted a threat to motorists, cyclists and forced many people to be pedestrians as shown in Figure 6 below.All these phenomenon corroborated the statement that flooding and erosion normally contribute to the economic short fall of a country [35].

Figure 6: The Flooding on Ureje Bridge 2019

VI. CONCLUSION

The study generally noted that the form and pattern of urbanisation at Ado Ekiti contributes to the increasing rate of motorcycle as public mode of transport and adds a lot to the fuel consumption. The effect of which is the addition of more amount of CO_2 emission and other particulates to the atmosphere. This no doubt has not only polluted the air we breathe but has much impact on the climate change that affects the pattern of rainfall and the consequent flooding menace in the city.

The conflicting interest associated with this mode of transport call for serious concerns of holistic, sustainable and comprehensive approach. Hence the paper considers the need for government as a matter of necessity to come up with policies that can avoid, shift and improve the current state of mode of transport. The proactive strategy is to ensure the use of motorcycles of less pollutants emission to reduce the fuel consumption and air pollution. Another approach is to integrate other modes of transport with motorcycle as public transport to check the increasing trend of the business which is not conducive for the city. At the same time make sure that each mode has their major area of operation. Government must also put in place a strategy that will promote the beautification of the city by landscaping of open spaces and major roads to make it a green city. Finally, there must be adequate provision of major land uses such as schools markets and hospitals and essential facilities within the walking distance of

residential neighbourhood to reduce vehicular movement and promote pedestrian movement

REFERENCES

[1]. World Bank, Urbanization dynamics and Policy frameworks in developing East Asia (English), East Asia Infrastructure Department urban development. Washington, DC: working papers; no. 8 **2004**

[2]. Susan Petit, World vehicle population, Ward**2017**

[3]. National Bureau of Statistics. Annual abstract of statistics, Federal Republic of Nigeria Abuja

[4]. National Bureau of Statistics. Road Transport data, Federal Republic of Nigeria Abuja

[5]. L. Fu, "Assessment of Vehicle Pollution in China," Journal of the Air and Waste Management, Vol. **51**, Issue.**5**, pp. **658 – 668. 2001**

[6]. S. Goyal, "Understanding Urban vehicular Pollution problem vis-a-vis Ambient air Quality. Case study of Megacity, Delhi, India," Environmental Monitoring and Assessment, Issue.**119**, pp.**557-569**, **2006**.

[7]. UNFPA, Unleashing the potential of urban growth State of World population **2008:**

[8]. World Health Organization, World report on road traffic injury prevention summary World HealthOrganization, Geneva, Switzerland**2004**.

[9]. J, Howe, "'Filling the middle': Uganda's appropriate transport services." Transport Reviews, Vol. **23,** Issue. 2, pp.**161-176**. **2003**.

[10]. A. T. Yaw, K. A. Daniel, "Motorcycle Taxis in Public Transportation Services within the Accra Metropolis." American Journal of Civil Engineering. Vol. **2** Issue **4** pp. **117-122**. **2014**

[11]. US Census Bureau, International Data Base, Washington, DC, **2004**,

[12]. O. I. Ogunrinola, "Global economic Crisis and career Aspirations among 'Okada' riders in Nigeria: the Influence of Apprenticeship skills training." Business and EconomicsResearch Journal, Vol. **2**, Issue.**3**, pp. **51-67**. **2011**

[13]. F. F. Asekhame, M. D. Oisamoje, "Ban on Commercial Motorcycle Operations in Benin City, Nigeria: An Appraisal of the Benefits and Business Opportunities". Journalof Developing Country Studies, Vol. **3**, Issue. **14**, pp. **10-17**, **2013.**

[14]. J. O. Fasakin, "Some Factors affecting daily Profits of Commercial Motorcycles in Akure, Nigeria," TransportPolicy, Vol. **8**, Issue. **1**, pp. **63-69, 2001.**

[15]. O. O. Oladipo, "The Development and Impact of Motorcycles as means of Commercial Transportation in Nigeria," Research on Humanities and Social Sciences, Vol. **2**, Issue. **6**, pp. **231-239**, **2012**.

[16]. S. Adeoti, A. Peter, "Assessment of Factors of Motorcycle Accident in Urban Centre: A Case Study of Ado-Ekiti. Ekiti State, Nigeria,"Journal for Studies in Management and Planning, Vol. **3**, Issue 13, pp. **170-177**, **2017.**

[17]. J. K. Ukwayi, A.M. Ogaboh, C. E. Michael, "Public Perception of the Involvement of Commercial Motorcyclists in Crime in South-South Nigeria," International Journal of Humanities and Social Science Invention, Vol. **2** Issue **7**, pp. **21-31**, **2013**

[18]. P. Nwankwo, C. Okorie, O. Onyekachi, "Kidnapping: Political and Economic Motive". Christian Bulletin, Vol.**18**, Issue. **4**, pp.**56 – 72**, **2008**.

[19]. D. A. Newton, "Crime on Public Transport: Static and Non-Static (Moving) Crime Events". Western Criminology Review. Vol. **5**. Issue. **3**, pp. **25 – 42**, **2004**

[20]. CAIP, Motorcycle Emission, Chemonics international, inc.usaid/egypt, office of environmentusaid contract no. 263-c-00-97-00090-00, (2000).

[21]. C. T. Chang, B. Y. Chen. "Toxicity Assessment of Volatile Organic Compounds and Polycyclic Aromatic Hydrocarbons in Motorcycle exhaust". Journal of Hazard Material, Vol,**153**:**1262–12692008**

[22]. P. Iodice, A. Senatore, "Road transport emission inventory in a regional area by using experimental two-wheelers emission factors" Lectures notes in engineering and computer sciences, 2013 World Congress on Engineering, London, UK , pp.**681-685**, **2013.**

[23]. Y, Shu, N. Lam, M. Reams, A new Method for Estimating Carbon dioxide Emissions from Transportation at fine Spatial scales. Environmental Research Letters. Vol. **5**. Issue. **10**, pp.**1-92010**

[24]. P. Iodice, A. Senatore, Exhaust emissions of new high-performance motorcycles in hot and cold conditions International Journal of Environmental Science Technology, vol. **12** pp. **3133–31442015**

[25]. A. Gusti, S. Nurato, I. Titia, "Exhaust Emission Analysis on Motorcycle with Fuel and Gasoline Mixture of H_2O Electrolysis".World Chemical Engineering Journal Vol.**1**, Issue.**4**, pp. **35 – 39**. **2017**
[26]. FGN 2006 Population and Housing Census Official Gazette of January 19, **2007**
[27]. Oriye, Olusegun., Urban Expansion and Urban Land use in Ado Ekiti, Nigeria. American Journal of Research Communication, Vol.**1**, Issue. **2**, pp.**128-139**, **2013**.
[28]. A, Kumar, Understanding the converging role of Motorcycle in Africa Cities. A political Economy Perspectives. SSATP Discussion Paper No. 13 Urban Transport Services. Washington, DC. **2011**.
[29]. T .A. Ogunmodede, G. Adio, A. S. Ebijuwa, S. O. Oyetola, J. O. Akinola, "Factors Influencing high rate of Commercial Motorcycle Accidents in Nigeria," American International Journal of Contemporary Research, Vol**. 2**, Issue.**1**, pp. **130 – 140,2012**.
[30]. Y.S. Ismaila, B.O. Bolaji, O. R. Adetunji. N.O. Adekunle. T. A. Yusuf. N.O. Sanusi, "Vehicular Emissions of Petrol and Diesel Engines," International Journal of Engineering ANNALS Fac Eng Hunedoara, Vol. **11** pp. **177-180**, **2013**.
[31]. C. O. Orubu, "Using Transportation Control Measures and Economic Instruments to reduce Air pollution due to Automobile Emissions," Journal of Social Science. Vol. **8**, Issue. 3, pp. **227 – 2362004**.
[32]. AutoSmart, "Learn the facts: fuel consumption and CO_2," Natural Resources Canada,**2014**
[33]. J. T. Owolabi, "Trend Analysis of Rainfall and Temperature in Ado Ekiti Ekiti State Nigeria". International Journal of Geography and Environmental Management, Vol. **2**, Issue. **2**, pp.**16-30**, **2016**
[34]. T.O. Odekunle, "Rainfall and the Length of the Growing Season in Nigeria."International Journal of Climatology Vol. **24**, pp. **467-479**, **2004**.
[35]. P. Suarez, W. Anderson, V. Mahal, T. Lakshmanan, "Impacts of Flooding and Climate Change on Urban Transportation: A system wide Performance Assessment of the Boston Metro Area, "Transportation Research Part D: Transport and Environment. **10**. pp. **231-2412005**.