International Journal of Science and Technology (STECH)
Bahir Dar- Ethiopia

Vol. 4(1), S/No 9, February, 2015: 58-78
ISSN: 2225-8590 (Print) ISSN 2227-5452 (Online)
DOI: http://dx.doi.org/10.4314/stech.v4i1.6

Transport and the Environment: Towards Reducing Road Traffic Emissions in Nigeria

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Abstract

In Nigeria much attention is given on general industrial pollution and pollution in oil industries with little reference on damage of pollution caused by mobile transportation sources of air pollution. The situation of increased pollution from mobile transportation sources is on the increase in per capital vehicle ownership, thus resulting to high congestion on Nigeria city roads and increase in the concentration of pollutants in the air, consequently, increasing health risk on human population. The paper therefore examined the concept of pollution and agents of pollution. Attention was given to air pollutants with particular reference to vehicular pollution. This paper suggested that for Nigeria government to avoid negative effects of transport on urban environment should broaden and intensify environmental policies to meet the needs of the present without compromising that of the future generation.

Key words: Environment; emissions; transport; reducing; Nigeria.

Introduction

The growth of transport has undoubtedly brought many economic and health benefits. But it has brought problems too which are now leading to environmental crisis, crisis of energy, air pollution and congestion. It is not only the transport industry's current size that makes it so environmentally crucial but another essential factor is its continued rapid growth. Developed countries already have extensive transport infrastructure – roads, railways, air ports, bus systems and so on yet many are still planning further expansion (WHO, 2002; CEC, 2002, Atubi 2009a).

The air has been severely polluted in the villages, towns and cities where most of the world's population live. Though the word 'smog' was coined in the United States, photochemical smog due to vehicle emission is now turning many megalopolises both in developed and the developing world into virtual disaster areas. Population in an increasing number of areas are regularly exposed to air pollution, levels above limits set by the World Health Organisation (WHO, 2002, Borzel, 2002; Robinson, 2004).

In the city centres, especially on highly congested streets, traffic can be responsible for as much as 90-95% of the ambient CO levels, 80-90% of the NOx and hydrocarbons, and a large portion of the particulates, posing a significant threat to human health and natural resources (Savile, 1993). Recently, problems caused by atmospheric particulate matter in urban air have received greater attention. Various health effects attributable to PM have been documented (WHO, 1999; Brunekreef and Holgate, 2002). The most conclusive evidence has been provided by cohort and time series studies that have linked elevated concentrations of PM to increased morbidity and mortality (Dockery et al, 1993; Pope et al, 1995; Katsouyanni et al, 1997; Samet et al, 2000). Several studies have assessed the health effects of particles expressed as the risk per unit mass/m^3 of PM_{10} or $PM_{2.5}$. However, these studies suggest that fine particles ($PM_{2.5}$) arising mainly from man-made sources are more harmful than coarse particles (Schwartz et al, 1996; Laden et al, 2000; Mar et al, 2000; Hopk et al, 2002; Pope et al, 2002).

In recent years, there has been considerable research on vehicle emissions and fumes (Bailey, 1995; Lilley, 2000; Marshall et al, 2003; Ababio, 2003; Cadle et al, 1997a, 2000, 2001, 2003 and 2004). Pollution from motor vehicles has become an issue simply because of the steady increase both in the number of vehicles in use and the distance travelled by each vehicle each year. The number of vehicles kilometre driven in the world rose significantly for the past three decades (Tan, 2006). As a result of these increases, the use of motor vehicles now generates more air pollution than any other single human activity. It is the fastest growing source of CO_2 and in urban areas, accounts for the bulk of emissions of CO, HC, and NCOx. Unfortunately, vehicle emissions present an important environmental hazard that needs to be investigated, since it may shorten the life span of exposed people. Vehicle emissions significantly pollute air and require control (Karlsson, 2004). Resuspension of accumulated crustal due from the streets due to traffic and winds is a specific problem in sub artic urban areas where sanding of streets and studded tyres are used during the cold season.

Governments around the world have instituted vehicle emission limits to try and control transport air pollution. Table 1, shows selected countries legal limits for nitrogen oxides.

Table 1: Legal exhaust emission limits for cars in selected countries

Country	Year	NOx	Hydrocarbons	CO	Particulates
Australia	1986	1.93	0.93	9.3	
Brazil	1990 1992 1997	2.0 1.4 0.6	2.1 1.2 0.3	24.0 12.0 2.0	
EC Countries	1993	-	1.11	3.16	0.18
EFTA Countries	-	0.62	0.25	2.1	0.124
Hong Kong	1992	0.63	0.26	2.1	
Japan	1978	0.25	0.25	2.1	
Mexico	1990 1991 1993	2.0 1.4 0.62	1.8 0.7 0.25	18.0 7.0 2.11	
South Korea	1987	0.62	0.25	2.11	
Taiwan	1990	0.02	0.75	2.11	
USA	1987 1994-6	0.62 0.25	0.25 0.24	2.1 2.1	

Source: Enviro 13, Swedish Environment protection Agency (May, 1992)

Hydrocarbons, carbon monioxide and particulates limits are being made still tighter in many countries.

Energy and the regulation of air pollution remain the biggest areas of research activity though. Numerous companies and research institutions are experimenting with petrol additives or substitutes designed to cut air pollution or to take transport beyond its dependence on fossil carbon fuels (see table 2). Some of the new technologies are more experimental than others. In Brazil, cars have been running on a petrol ethanol blend since 1975, liquefied petroleum gas is used routinely in Italy, Japan and other countries. Fuel oxygenates petrol additives are in wide spread in the United States (UNEP, 1993; Chapman and Hall, 1992).

Air is made up of 78% nitrogen, 21% oxygen, less than 1% carbon dioxide, and trace amounts of other gases. The World Health Organization (WHO) (1997a) defines air pollution as substances put into the air by the activity of mankind into concentrations sufficient to cause harmful effects to health, property, and crop yield or to interfere with the enjoyment of property. Air pollution is the contamination of air by discharge of harmful substances, which can cause health problems including burning eyes and nose, itchy irritated throat and breathing problems (USEPA, 1994). The amount of pollutants released to the atmosphere by fixed or mobile man-made sources is generally associated with the level of economic activity (Kanyoke, 2004).

Table 2: Comparison of alternative transport fuels

Fuel	Adequate Resource Base	Manageable Fuel Properties	Green house Gas and other emissions	Feasible hard ware modifications	Cost comparative (currently)	Available (market ready)	Effect of existing regulations
Compressed natural gas	+	+	+	+	+	+/-	-
Liquefied natural gas	-	-	+/-	+	+	+	-
Methanol	-	-	+/-	+	-	-	-
Ethanol (maize)	-	-	+/-	+	-	-	-
Ethanol (woody biomass)n	+	+	+/-	+	+/-	-	-
Reformulated gasoline	+/-	-	+/-	+	+	-	+
Oxygenated (MTEB/ETBE)	+	-	+/-	+	-	+	+
Electricity	+/-	+/-	+/-	-	-	+/-	+
Hydrogen	+	+/-	+/-	-	--	-	+
Solar energy	+	+/-	+	-	-	-	+/-
Fuel cells	+	+	+	-	-	-	+

\+ Advantageous - Disadvantageous

+/- Both advantageous and disadvantageous

Source: Steering and New Course, Union of concerned scientists (1991)

Air Pollution

Air pollution can be classified into natural air pollution which includes windblown dust, volcanic ash, and gases, smoke and trace gases from forest fires, and anthropogenic air pollution which includes products of combustion such as nitrogen oxides (NOx), carbon oxides (COx, sulphur dioxide (SO_2). Traffic is responsible for as much as 90—95% of the ambient CO levels, 80—90% of the NO and hydrocarbons, (Savile, 1993). The main sources of air pollution which are man-made relate to transportation, industry, combustion fuels, industrial processes and use of pesticides (see Table 3).

Table 3: Common pollutants, sources and characteristics

Pollutants	Description	Sources
Carbon monoxide (CO)	Colourless, odourless gas	Vehicles indoor sources, including kerosene, wood burning, natural gas, coal, or wood-burning stoves and heaters
Lead (Pb)	Metallic element	• Vehicles burning leaded gasoline • Metal refineries
Nitrogen Oxides (NO_x)	Gaseous compounds made up of nitrogen and oxygen	• Vehicles • Power plants burning fossil fuels • Coal – burning stoves
Ozone (O_3)	Gaseous pollutant	• Vehicle exhaust and certain other fumes • Formed from other air pollutants in the presence of sunlight
Particulate matter	Very small particles of soot, dust, or other matter, including tiny droplets of liquids	• Diesel engines • Power plants • Industries • Windblown dust • Wood stoves
Sulphur dioxide (SO_2)	Gaseous compound made up of sulphur and oxygen	• Goal burning power plants and industries • Coal – burning stoves • Refineries

Source: WHO (2000) and USEPA (2003)

More specifically the pollutants include suspended matter, sulphur dioxide, nitrogen dioxide, hydrocarbons and ozone due to population growth, urbanization, industrialization and increased use of motor vehicles. Similarly the WHO (1997b) analysis identified problems of limited capacity in terms of funding, equipment and human resources to measure, assess, control and mitigate air pollution; inadequate information on air pollution and its impacts; limited public awareness and limited enforcement of existing national, regional and international legislations.

There are three broad sources of air pollution from human activities; stationary or point, mobile, and indoor air pollution. Industries, power plants, etc are the causes of stationary air pollution, whereas indoor air pollution refers to pollutions from open fires for cooking and heating. It is mostly a problem in developing countries, and its effect become intense in rural areas. Mobile or vehicular air pollution is particularly a serious problem in urban areas (Kathuria, 2001).

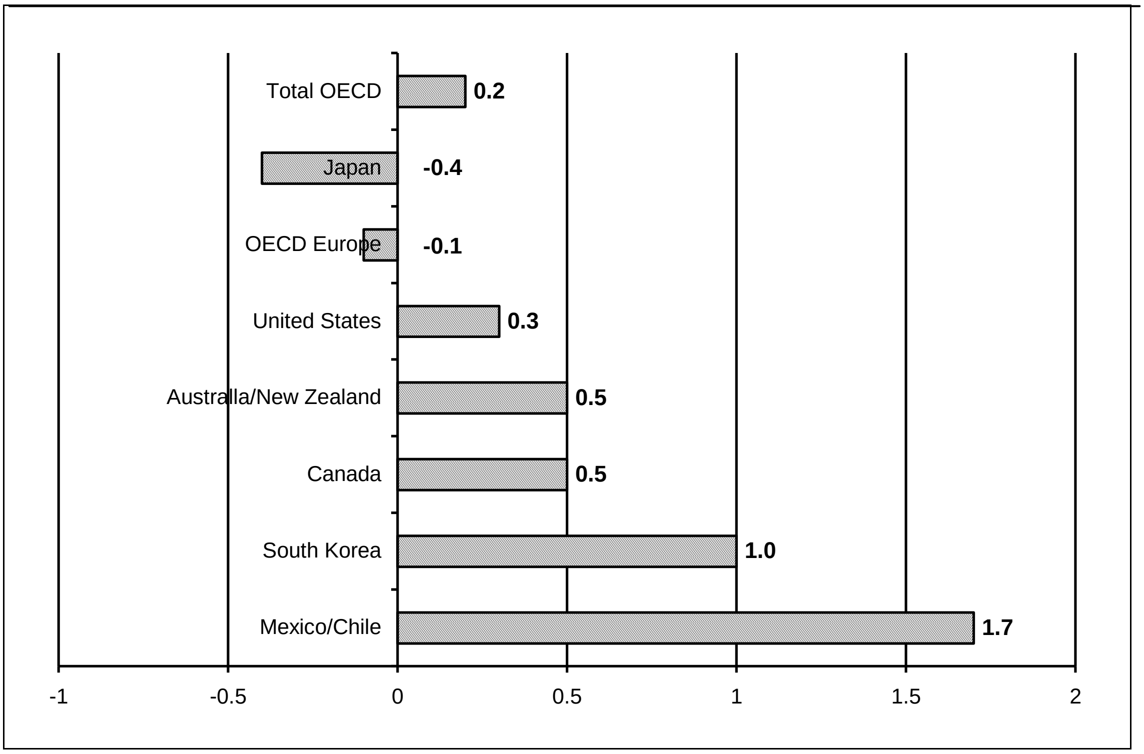
Types of Air Pollutants

Pollutants can be classified as either primary or secondary. Usually, primary pollutants are substances directly emitted from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulphur dioxide released from factories. Secondary pollutants are not emitted directly but they are produced by reactions between primary pollutants. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone (UNEP, 2004). Ozone gas is not usually emitted directly into the atmosphere, but at ground-level is created by a chemical reaction between oxides of nitrogen (NO) and volatile organic compounds (VOC) in the presence of sunlight.

Carbon monoxide is an odourless gas formed as a result of incomplete combustion of carbon-containing fuels, including petrol and diesel. Carbon monoxide is readily absorbed from the lungs into the blood stream, which then reacts with haemoglobin molecules in the blood to form carboxyhaemoglobin. Due to human activities such as the combustion of fossil fuels, deforestation, and the increased release of CO2 from the oceans due to the increase in the earth's temperature), the concentration of atmospheric carbon dioxide has increased by about 35 per cent since the era of industrialization began (Amin, 2009). The world's total annual CO2 emissions from various sources are about 24-27 billion metric tons equivalent (UNSD, 2008).

Among the OECD countries, Mexico/Chile and South Korea have the highest projected growth rates for energy-related carbon dioxide emissions, at 1.7 per cent and 1.0 per cent per year, respectively (see Fig. 1). The Intergovernmental Panel on Climate Change (IPCC), (2007) reports that "road transport currently accounts for 74 percent of the total transport CO2 emissions" (IPCC, 2007, p. 325). Twenty-three percent of world energy-related CO2 emissions originate from the transport sector. The growth rate of these emissions is highest among the end-user sectors. Such high CO2 emissions and their links with GHG, temperature rise and climate change require decarbonization of the transport energy system through the use of alternative fuels, such as electricity, hydrogen and biomass (IPCC, 2007). Despite some improvements in this direction, the trend in fossil fuel CO2 emissions continues to rise from the combined effect of population growth and more dependence on private cars.

Fig.1: Average annual growth of energy-related carbon dioxide emissions in OECD economies, 2008-2035 (per cent per year)



Source: U.S. Energy Information Administration (EIA, 2011)

Nitrogen oxides (primarily nitric oxide and lesser quantities of nitrogen dioxide) are gases formed by oxidation of nitrogen in air at high combustion temperatures. It contributes both to morbidity and mortality, especially in susceptible groups such as young children, asthmatics, and those with chronic bronchitis and related conditions (Morris & Naumova, 1998). Nitrogen dioxide appears to exert its effects directly on the lung, leading to an inflammatory reaction on the surfaces of the lung (Streeton, 1997). Motor vehicles are usually the major sources of nitrogen oxides in urban areas.

Volatile organic compounds are a range of hydrocarbons, the most important of which are benzene, toluene, and xylene, 1,3-butadiene, polycyclic aromatic hydrocarbons (PAHs), formaldehyde and acetaldehyde. The potential health impacts of these include carcinogenic and non-carcinogenic effects. Benzene and PARs are definitely carcinogenic, 1,3-butadiene and formaldehyde are probably carcinogenic, and acetaldehyde is possibly carcinogenic. Motor vehicles are the predominant sources of volatile organic compounds in urban areas. The implied cancer risks (leukaenua) corresponding to those air concentrations are, respectively, 44-75 per million population and 16-27 per million population, based on World Health Organization unit risk factors for benzene.

Sulphur oxides (primarily sulphur dioxide and lesser quantities of sulphur trioxide) are gases formed by the oxidation of sulphur contaminants in fuel on combustion. Sulphur dioxide is a potent respiratory irritant, and has been associated with increased hospital admissions for respiratory and cardiovascular disease (Bascom et al, 1996), as well as mortality (Katsouyanni et al, 1997). Asthmatics are a particularly susceptible group.

Ozone is a secondary air pollutant formed by reactions of nitrogen oxides and volatile organic compounds in the presence of sunlight. These primary emissions arise mainly from motor vehicles. Ozone is only one of a group of chemicals called photochenrical oxidants (commonly called photochemical smog), but it is the predominant one. Also present in photochemical smog are formaldehyde, other aldehydes, and peroxyacetyl nitrate. Ozone is another air pollutant that has respiratory tract impacts (Woodward et al., 1995).

Particulate matter is a secondary air pollutant which is referred to as solid and liquid particles that are dispersed into ambient air. The notation PMX refers to particulate matter comprising particles less than X m in diameter (most often, X is 10, 2.5 or 1m). Particles greater than 2.5m in diameter are generally referred to as coarse particles, and particles less than 2.5m and 100 nm in diameter as fine particles and ultrafine particles, respectively. The term total suspended particles (TSP) refer to the mass concentration of particles less than 40 to 50m in diameter (Seinfeld & Pandis, 1998). Ambient particulate mass typically has a modal size distribution, meaning that the total mass of particulate matter tends to concentrate around one or more distinguishable points on the particle size scale.

PM from specific sources typically follow short-term and long-term (seasonal) trends (Yatin et al, 2000). For example, space heating generates more combustion- related PM emissions during the cold seasons while, at the same time, snow cover can inhibit PM emissions from the soil. Seasonal peak concentrations of PM2.5 during the winter in polluted European areas have been reported (Van Dingenen et al, 2004).

Air Quality Index

Table 4 & 5 shows the USEPA standard for determining ambient air quality index which is calculated with the following formula

$$I = \left(\left(I_{high} - I_{low}\right) x \left(C - C_{low}\right) / \left(C_{high} - C_{low}\right)\right) + I_{low}$$

Where

I	=	the (air quality) index
C	=	the pollutant concentration
C_{low}	=	the concentration breakpoint that is ≤ C,
C_{high}	=	the concentration breakpoint that is ≥ C,
I_{low}	=	the index breakpoint corresponding to C_{low},
I_{high}	=	the index breakpoint corresponding to C_{high},

The ambient air pollutants are classified into categories ranging from very good to very poor. From (0-15) AQI rating is A which is very good, (16-31) AQI is B which is good, (32-49) AQI is C which is moderate, (50-99) AQI is D which is poor and (100 or above) AQI is E is very poor, showing critical values (USEPA, 2000).

Table 4: Air quality index for priority pollutants

AQI Category	AQI Rating	PM_{10}µg/m^3	CO(ppm)	NO_2(ppm)	SO_2(ppm)
Very good (0-15)	A	0-15	0-2	0-0.02	0-0.002
Good (16-31)	B	51-75	2.1-4.0	0.02-0.03	0.02-0.03
Moderate (32-49)	C	76-100	4.1-6.0	0.03-0.04	0.03-0.04
Poor (50-99)	D	101-150	6.1-9.0	0.04-0.06	0.03-0.04
Very poor (100 or over)	E	>150	>9.0	>0.06	>0.06

Source: USEPA, (2000)

Table 5: Air Quality Standard

Compound	Health effects	WHO guideline (ppm)	Nigerian ambient standard (ppm)	Averaging time
Carbon Monoxide	Headache, weakness, dizziness, fainting, confusion, and nausea	26	35	1hour
Nitrogen dioxide	Aggravation of asthma and allergies, coughing, shortness of breath, increased respiratory infections	0.10	0.04-0.06	1 hour
Sulphur dioxide	Change in lung function, difficulty breathing, aggravation of respiratory diseases, eye irritation	0.175	0.1	10 Min. 1 Hour

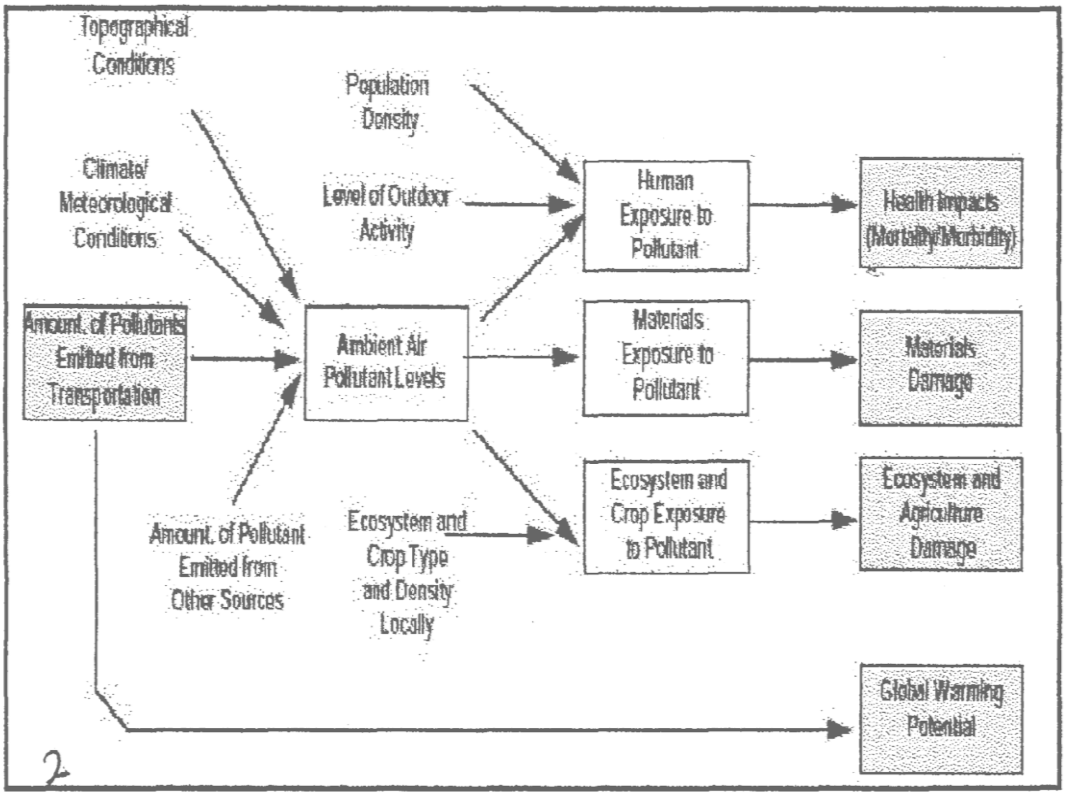
Source: WHO, (2011)

Vehicular Pollution

Vehicular emissions generally include oxides of nitrogen, sulphur, carbon hydrocarbon, mercury and leads (Ojolo et al., 2007). Vehicle emissions mainly result from fuel combustion or evaporation (Kanyoke, 2004). The most common types of transport fuels are gasoline (in leaded or unleaded form) for light-duty vehicles (such as cars) and diesel fuel for heavy-duty vehicles (such as buses and trucks). Carbon dioxide (CO_2) and water vapour (H_20), the main products of combustion, are emitted in vehicle exhaust (Onursal & Gautam, 1997).

According to USEPA (1996), factors that influence the amount of environmental damage that occurs from air pollutant emissions include: topographical conditions (hills, valleys, etc.) which affect dispersion/dilution of pollutants; climatic conditions (temperature, wind, rain, etc.) which affect the dispersion/dilution of pollutants and formation of secondary pollutants; population density which affects the number of people exposed to pollution sensitivity of local ecosystems (see Fig. 2)

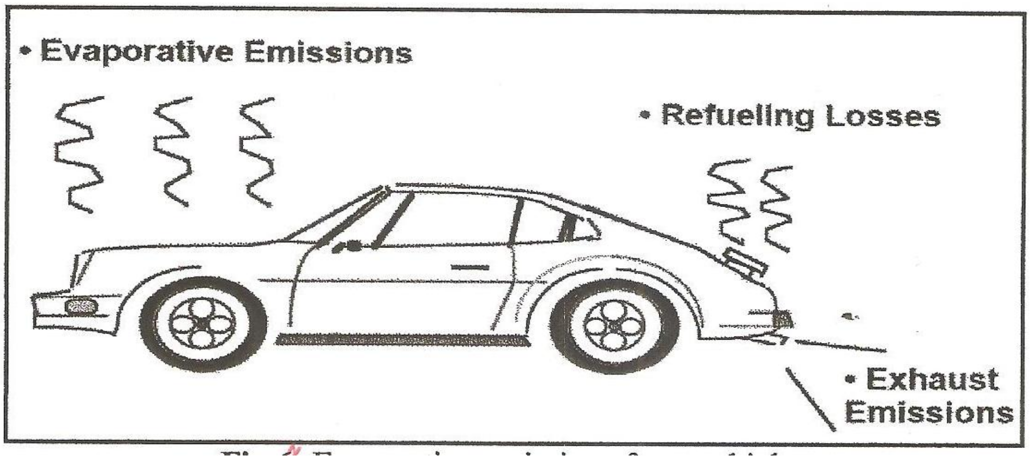
Fig. 2: Factors that influence the amount of environmental damage that occurs from air pollutant emissions



Source: **United States Environmental Protection Agency [USEPA] (1996)**

Sharma and Roychowdhury (1996), and Faiz et al. (1996) classify factors influencing motor vehicle emissions into three main groups, namely, Vehicle characteristics, Fleet characteristics and Operating characteristics. According to the United States Environmental Protection Agency (USEPA), emissions from an individual car are generally low, relative to the smokestack image many people associate with air pollution. But in numerous cities across the country, the personal automobile is the single greatest polluter, as emissions from millions of vehicles on the road add up. Driving a private car is probably a typical citizen's most "polluting" daily activity. With regards to the sources of automobile emissions it is well known that the power to move a car comes from burning fuel in an engine. Pollution from cars comes from by-products of his combustion process (exhaust) and from evaporation of the fuel itself (see Fig. 3)

Fig. 3: Evaporative emissions from vehicles



Source: (USEPA, 1994)

Despite the increase in vehicular emissions such as CO_2, the global increase in the number of motor vehicles has thus far made no significant contribution to the increase in PM_{10} air pollution. Although it is believed that the transportation sector contributes to PM_{10}, the record shows that an increase in the number of motor vehicles does not necessarily increase PM_{10} pollution (see Table 6) (Amin, 2009).

Table 6: Motor vehicle, and PM_{10} concentration in different regions

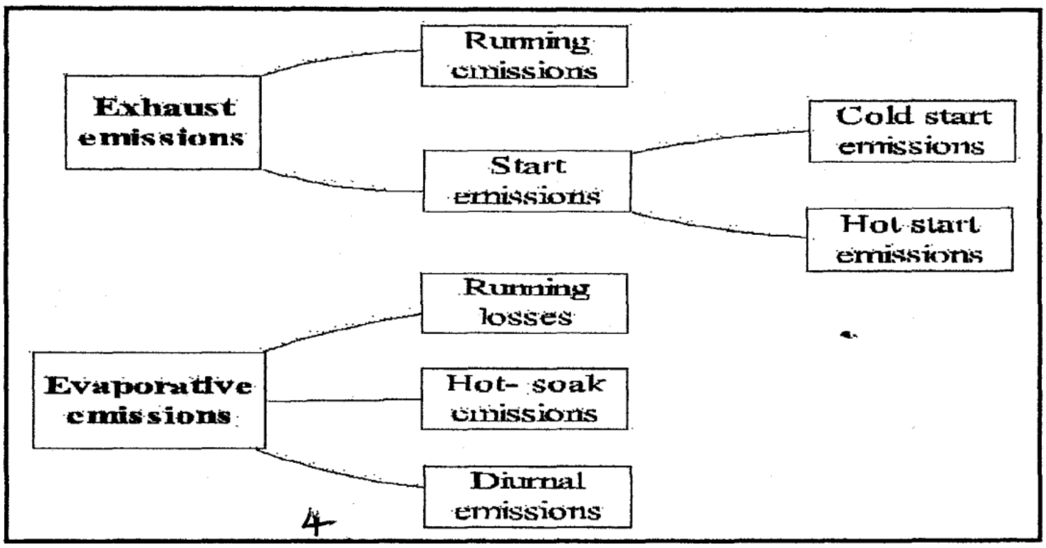
Regions	**Motor vehicles per 1000 people**		**Passenger cars per 1000 people**		**Particulate matter concentration urban population weighted PM_{10} (μg/m^3)**	
	1990	**2003**	**1990**	**2003**	**1990**	**2003**
World	118	141	91	100	77	60
East Asia & pacific	9	20	4	14	112	80
Middle east & N. Africa	36	-	24	-	126	86
South Asia	4	10	2	6	131	99
Europe & Central Asia	97	170	79	142	39	35
Latin America & Caribbean	100	153	72	108	60	43
Sub-Saharan Africa	21	-	15	-	114	73
Europe EMU	429	570	379	502	33	27

Source: World Bank (2006) and Amin (2009)

Forms of Vehicular Emission

Van des Westhuisena et al. (2004) asserted that emissions from motor vehicles are mainly divided into two categories: exhaust (tail pipe) emissions and evaporative (vapour) emissions (see Fig. 4).

Fig. 4: Forms of motor vehicle emissions



Source: Adapted from Faiz et al. (1996)

Vehicular pollution sources are not homogenous, as there is a complete range of technological mix. The mix could be in terms of fuel used — gasoline or diesel or natural gas; or engine type - 2-stroke or 4-stroke and/or a combination of these.

Traffic Emission in Nigeria Cities

In Nigeria much attention is given on general industrial pollution and pollution in oil industries, with little reference on damage of pollution caused by mobile transportation sources of air pollution (Faboye, 1997; lyoha, 2000; Magbabeola, 2001). The situation of increased pollution from mobile transportation source is on the increase in per capital vehicle ownership, thus resulting to high congestion on Nigeria city road and increase in the concentration of pollutants in the air, consequently, increasing health risk on human population. Studies conducted in Kaduna and Abuja cities show higher values of CO_2 concentration in heavily congested areas: l840ppm for Sambo Kaduna, l780ppm for Stadium round-about, Kaduna, and l530ppm for A.Y.A, Abuja, 1160ppm for Asokoro Abuja (Akpan & Ndoke, 1999). At Minna, Jimo and Ndoke (2000) observed the maximum value of

5,000ppm for CO_2 in congested areas, which was still lower than WHO stipulated maximum value of 20,000ppm.The maximum value for CO emission obtained was l5ppm still lower than the base line of 48ppm stipulated by WHO and 20ppm stipulated by Federal Environmental protection Agency of Nigeria (FLPA). The reason for this low emission concentration in Minna is due to low traffic and industrial activities in the city.

A study of the impacts of urban road transportation on the ambient air was conducted by Koku and Osuntogun, (1999) in three cities of Nigeria: Lagos, Ibadan and Ado — Ekiti all in South-west region of Nigeria. Air quality indicators namely CO. SO_2, NO, and total suspended particulates (TSP) were determined. The highest levels obtained for the air pollution indicators in Lagos were CO-233ppm at Idumota, $S0_2$-2.9ppm at Idumota, $N0_2$-1.5ppm at lyana—Ipaja and total particulates 852cpm at Oshodi bus stop. At Ibadan, the CO and SO_2 levels at 271 and 1.44ppm were highest at Mokola round about while NO_2, at 1.0ppm was highest at Bere round about.

In Ado-Ekiti the highest level obtained were CO-3l7ppm at Oke Isha, NO_2 -0.6ppm at Ijigbo Junction and $S0_2$-0.8ppm at Old Garage Junction. The obtained results of CO, SO_2, NO_2, and particulate counts per minute were found by Koku, to be higher than FEPA limits. Limits set also by FEPA are CO-l0ppm, $S0_2$-0.0lppm, NO_2-0.04-.06ppm. A comparative study of emission figures in Lagos and the Niger Delta (Oil producing region) area has been reported (Jerome, 2000). Two major cities in the Niger Delta were considered, Port-Harcourt and Warn shows that the concentrations of TSP (Total suspended particulates), NO SO_2, and CO in Lagos and Niger Delta were above FEPA recommended limit (see Table 7).

Table 7: Ambient air pollutants m Lagos and Niger Delta Area

Lagos Area pollutant	**Non-traffic urban zone**	**Traffic zone**	**Niger Delta Area Oil communities**	**Cities**	**FEPA**
TSP μ/m^3	31.4-746.5	72-950	92.2-348.5	396.8-583.3	250
NOx(ppm)	81-81.5	34-131.6	22.0-295.0	35-370	40-60
SO_2(ppm)	0.5-43	20-250	7.0-97.0	16-300	100
CO(ppm)	0.5-3.9	10-250	5.0-61.0	1.0-52	10
CO/NO_x(ppm)	0.0-6.0	50-200	20	15-130	-

Source: Jerome, 2000.

Vehicular Emission Control Technique

There are several types of emission control technologies in use now. However, not all of them are common. In developing countries especially, only catalytic converters and fuel injection systems are common.

Catalytic Converters: The catalytic converter is one of the most effective emission control devices available. It processes exhaust to remove pollutants, achieving considerably lower emissions than is possible with in-cylinder techniques. Vehicles with catalytic converters require unleaded fuel, since lead forms deposits that "poison" the catalytic converter by blocking the access of exhaust gases to the catalyst. A single tank of leaded gasoline can significantly degrade catalyst efficiency. Sulphur and phosphorous in fuel can also poison the catalytic converter.

Fuel Injection Systems: Fuel injection systems were developed and widely used from the mid-1980s', as a replacement to the use of carburettors which were found not to be efficient in maintaining air-fuel ratio control under all conditions (Faiz et a!., 1996). Fuel injection systems provide rapid and precise control of air-fuel ratio. Fuel is provided to the injectors at constant pressure by a pump and pressure regulating valve. The injectors themselves are solenoid valves, which are controlled by the engine computer. The computer controls the quantity oft fuel injected by varying the length of time the valve remains open during each revolution of the crankshaft. This reduces emissions enormously as compared with carburettors. However, majority of vehicles in developing countries have earlier developed injectors which are not as efficient as the engine computer controlled ones currently in use in developed countries.

Electronic Control Systems: Electronic control technology for stoichiometric engines using three-way catalysts has been extensively developed (Kanyoke, 2004). Nearly all engine emission control systems used in the United States since 1981 incorporate computer control of the air-fuel ratio. Similar systems have been used in Japan since 1978 and in Europe since the late 1980s. These systems measure the air-fuel ratio in the exhaust and adjust the air-fuel mixture going into the engine to maintain stoichiometry (Kanyoke, 2004). In addition to the air-fuel ratio, computer systems control features that were controlled by vacuum switches or other devices in earlier emission control systems. These include spark timing, exhaust gas recirculation, idle spend, air injection systems, and evaporative canister purging.

An often-neglected aspect of causes of traffic congestion and associated transport problems in the cities is lack of control of spatial location of activities. This particular deficiency in the overall physical planning of the cities has caused long hours of journey to work. To ensure good coordination between transport and land use, physical development policy must be designed to fully enforce land use and physical planning regulations and effective development control of various land uses (without exception of the government agencies and religious organisations). The development guidelines should ensure redistribution of human activities and provision of guidelines for emerging urban settlement that are sprawling in all direction of the cities (Atubi and Onokala, 2004a).

Conclusion

The discussion of transport and environment in development countries has given a number of conclusions and indications of conclusions which need further examination. It is also worthy to note that developed countries are attempting to reduce environmental problems caused by transport technology while Nigeria is encouraging the importation of used vehicles imported to the country and which aid the degradation of the environment.

The observed and discussed urban transport crisis is to pave way for a detailed discourse on sustainable transport development uses, with a view of ensuring a balance between modern transportation systems and achieving the objectives of mobility of the majority of the urban population viz: safety, comfort, effectiveness, efficiency moderate cost and just in time. The existing urban transport policy measures have not focused on sustainable transportation approaches that can meet the challenges of contemporary Nigeria's development and at the same time ensure minimal mobility and accessibility crisis.

Nigeria government should avid cumulative negative impacts of transport on urban environment. Therefore, environmental policy needs to be broadened and intensified. This is because, further transport development is inescapable. However, it must be done in a way that meets the needs of the present without compromising the ability of future generation to meet their own needs.

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