

JOURNAL OF APPLIED SCIENCES AND DEVELOPMENT [JASD]

(An international academic research journal)

Volume 3, Number 1-2, October, 2012 ISSN: 4121-8241

Editorial

**Water pollution and sustainable development in Nigeria –
A review *Isife, Chima Theresa***

**Documentation quality appraisal of private and public
projects in Nigeria *Ajator, Uche O. (Ph.D)***

**An efficacy appraisal of communication strategies for
malarial eradication among antenatal women in Enugu
metropolis, Nigeria *Eze, Charles C.***

**Economic evaluation principles for sustainable
management of environmental projects in Nigeria
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**Road traffic accidents in Waari and environs: A trend
analysis *Atubi, Augustus O. (Ph.D)***

**The role of chemist in healthcare delivery and sustainable
development in Nigeria *Isife, Chima Theresa***

**An analysis of deaths from road traffic accidents in Lagos
State *Atubi, Augustus O. (Ph.D)***

**A comparative analysis of the effects of private and public
housing investments on environmental quality in Enugu
metropolis *Emodi, Edmund Emeka (Ph.D)***

Call for Articles

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The aim of the *Technscience Review (TR)* derives from the mission and objective of the Publishers, *Welfare & Industrial Promotions (WIPRO) International*, as follows:

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ISSN 4121-8241

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ISSN
4121-8241

Cover, Design & Concept: Rowland Egolum & Felix Ezeh

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EDITORIAL

Driven by curiosity and speculation as well as quest for new facts and principles, Pure Sciences stop at the development of general laws of nature and are less concerned with the practicality of their results or finds. Applied sciences take over from there, seeking the practical use of scientific knowledge and, therefore, forming the bridge between sciences and development. With the growth of the chemical and electrical power industries in the 19th century, scientific knowledge became of direct use in solving problems and the development of products.

The *Journal of Applied Sciences and Development* was born to publish materials on the areas bordering in the output of Applied Sciences as they relate to development of the society. It is a biannual published April and October beginning from 2010. However, due to high rate of rejection of low-standard papers, we could not publish Volume 1 Number 2 of October 2010. Rather, we rolled the qualified articles to form part of the Volume 2 Number 1-2 of October 2011. As usual, the current Issue, Volume 3 Number 1-2 of October 2012, is loaded with a variety of sound articles covering contemporary issues in Applied Sciences (including Environment, Transport Management, and Health) and Development.

In the first paper, Chima Theresa Isife (Mrs.), a Research Fellow/Lecturer with the Institute for Development Studies, Enugu Campus, University of Nigeria, Nsukka, reviews water pollution and sustainable development in Nigeria. The author noted that water pollution has continued to impact adversely on health and sustainable development in developing countries. In Nigeria, patronage of hospitals and other health care facilities is on the increase due to water-borne diseases arising from contamination of water sources, which defy public policy and majorly unco-ordinated and poorly monitored interventions. It is recommended that mechanism be put in place to sensitise policy-makers on the challenge of water pollution to health and sustainable development in Nigeria.

In the second paper, Dr. Uche Ajator, former Head, Department of Quantity Surveying and Cost Analysis, Enugu State University of Science and Technology (ESUT), visited the increasing rate of project failure, cost and time overruns, which is raising a wave of public concern in Nigeria. The author took a comparative evaluation of documentation practices in private and public projects in Nigeria in order to unravel the quality of the documentation for infrastructural development projects. Ten (10) private and ten (10) public capital projects were surveyed. Fifteen (15) documentation quality variables (DQVs) that are key to project actors were used to measure the documentation implementation levels (DILs) and the index of project success (PSFS). The results showed a general low quality documentation and dismal level of project

success, without any significant difference in achievement between public and private sector projects. The study recommended, among others, proper procurement documentation, balanced and collaborative professional design and construction team, which must admit inputs from work operatives, and the application of information communications technology (ICT) in construction documentation to generate and manage quality construction databases at all stages.

In the third paper, Charles C. Eze, Research Fellow with the Institute for Development Studies, Enugu Campus, University of Nigeria, Nsukka, evaluated the effectiveness of communication strategies for eradicating malaria among antenatal women in Enugu metropolis, Nigeria. Results showed that the media messages on malaria eradication were not only clearly understood by the studied segment of the target audience, antenatal women, but the messages also addressed the critical questions on the minds of the target audience. What is more, the messages are educative, informative and illuminative. Again, the messages employ the participatory approach. Ironically, the messages do not produce behaviour change in the audience, nor do they prompt the audience to take the recommended actions. This paradox was attributed to poverty, which is not only linked to endemic malaria challenge, but also to influenced audience response to campaigns.

The study recommended increased frequency and exposure time to improve bombardment, more participatory and integrated communication rather than awareness and increased knowledge, and policy to compel women and children to sleep under insecticide-treated nets (ITNs).

In the fourth paper, Dr. Uche Ajator, former Head, Department of Quantity Surveying and Cost Analysis, Enugu State University of Science and Technology (ESUT), reviewed the basic economic principles employed in evaluating environmental projects. The author viewed economic evaluation as a crucial component of capital budgeting used for allocating the financial resources of private and public organizations of a nation in order to achieve sustainable development, and cost/benefit analysis (CBA) as a versatile evaluation technique suited for public and major private projects. Project development/management strategies must embody full dose of greenness/sustainability strategies whose private/social costs and benefit cash-flows are estimated, strategically projected and discounted to enable projects with highest net social benefits to be implemented. It recommended the bridging of private and social rates of return to serve as a catalyst for a private-

Editorial

sector-led social and economic development activities that would ensure sustainability of development.

In the fifth paper, Associate Professor Augustus O. Atubi (Ph.D) of the Department of Geography and Regional Planning, Delta State University, Abraka, Nigeria noted that road traffic accidents (RTAs) rank 9th as the leading cause of death globally. Nigeria is among the worst cases. This study examined road traffic accidents in Warri and environs from 1990-2009. The data generated were analysed using time-series and one-way analysis of variance (ANOVA). Findings showed that the road traffic accident cases totalled 3,475 within the period of study, had a fluctuating pattern and increased in 2009. There was an upward trend in the study area as evidenced by a calculated value of 3.728, which is greater than the critical table value of 1.734 at $p < 0.05$. The model forecasted a 66.68 % increase by 2015, if the current trend is unabated. With a calculated F value of 13, which is greater than the critical table value of 3.16 at $p < 0.05$, there was spatial variability in road traffic accident trends in different parts of Warri and environs. Based on the findings recommendations were proffered.

In the sixth paper, Chima Theresa Isife (Mrs.) reviewed the role of chemist in healthcare delivery and sustainable development in Nigeria. They included vaccines production; drugs isolation and extraction; phytochemical screening, separation, purification and analysis; chemotherapy; incubation and other life-saving techniques, and medical devices, such as pacemakers. Fertilizers and pesticides as well as sports materials for healthy living are also formulated by the chemist. The study recommended encouragement for chemists and chemical researches, as well as recognition of chemical research outputs by policymakers and the regulatory bodies. It also recommended enhancement of enabling environment for improved teaching and practice of chemistry.

In the seventh paper, Associate Professor Augustus O. Atubi (Ph.D) of the Department of Geography and Regional Planning, Delta State University, Abraka, Nigeria, analyzed the reported deaths from road traffic accidents in Lagos State, Nigeria. Data were obtained for a period of thirty-two years (32) from 1970-2001 from relevant agencies. The 16 harmonics for the selected Local Government Areas considered contribute above 90% of the total variance in the time series. This means that more than 90% of deaths from road traffic accidents in Lagos State could be attributed to recklessness on the part of drivers, ignorance of high way codes, over speeding etc. Also, the dominant cycles of deaths from road traffic accidents observed in the study area have

periodicities of 32.00, 10.67 and 4.0 years with the most dominant being 32 years. Based on the findings, recommendations were proffered.

In the eighth paper, Emeka E. Emodi of the Centre for Environmental Management and Control (CEMAC), Enugu Campus, University of Nigeria, Nsukka, Nigeria associated various challenges to environmental quality with dearth of public and private housing investments, which mounts pressures on facilities, amenities and neighbourhoods on available housing units in most developing countries. The study compared the effects of public and private housing investments on environmental quality in Enugu metropolis in south-east Nigeria. It stratified the study area into low, medium and high density neighbourhoods and used questionnaires to collect primary data. Factor analysis was used to reduce the environmental quality variables to a singular factor. Multiple linear regression analysis was used to establish the nature of relationship between the environmental quality and public and private housing investments in the study area. Private housing investments impacted more on the environmental quality of the area than public housing investments. It was recommended that the State and Federal Governments should rise up to the challenge of public housing investments that will effectively complement the efforts of the private sector.

We thank all our esteemed contributors and enjoin them not to flag in their zeal for research and publishing. We must all not relent in our determination to use research and publishing to confront abounding development challenges in developing countries for the development of the total man. We welcome contributions from across the globe in all cognate disciplines (see *Call for Articles*), as we reiterate our commitment to delay-free and efficient processing of all submissions and their subsequent professional and competitive publishing in hard copy and online.

Best regards.

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WATER POLLUTION AND SUSTAINABLE DEVELOPMENT IN NIGERIA - A REVIEW

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Abstract

Water pollution has continued to impact adversely on health and sustainable development in developing countries of the World. Patronage of hospitals and other health care facilities in Nigeria is on the increase due to water-borne diseases arising from contamination of water sources. The review, which relied on secondary information, is an attempt to capture water pollution as it affects sustainable development in Nigeria. Public policy has not improved the situation in Nigeria. Interventions against water pollution remain majorly unco-ordinated and poorly monitored. It is recommended that mechanism be put in place to sensitise policy makers on the challenge of water pollution to health and sustainable development in Nigeria.

Introduction

Water is a colourless transparent liquid compound of hydrogen and oxygen. It has neither taste nor smell. It turns to steam when boiled

and to ice when frozen. Water is undoubtedly the most precious natural resource that exists on our planet and it is vital to all forms of life. It comprises over 70% of the earth's surface. Since water is needed by both plants and animals, there is need for it to be supplied at the least contaminated form. This will enable plants and animals to assess water naturally and to minimize the negative effects of water pollution.

Access to and usage of unpolluted water is very important for health, sanitation and sustainable development in every nation. Water pollution occurs when the quality of water in a body of water is adversely affected due to addition of large amount of contaminants to the water body. It has continued to impinge on the health of citizens and sustainable development in Nigeria. Massive pollution of the biosphere must be controlled in order to survive the crisis of environmental degradation and maintain the earth as a place for human habitation.

The awareness of water pollution by wastes is very low in Nigeria. Collecting groundwater through shallow wells, sometimes very close to excreta dump, is a common practice. Also, extensive use of water downstream of effluent discharge points is not uncommon. The pollution of natural and artificial waters by waste matters resulting from human activities constitute one of the most important, difficult and complex problems confronting public health authorities in Nigeria. Pollution-linked illnesses result in loss of productivity, and excess levels of mortality imply substantial welfare loss as well.

Nigeria has tremendous pressure for the improvement of various aspects of living, and sustainable development is always on the highest priority of any government. The large increase in

industries has brought about huge increase in the quantity of discharge and a wide diversity of types of pollutants reaching water bodies. Increased industrial activity has also led to migration of people from the rural to the urban centres. Population explosion has resulted in huge generation and discharge of municipal waste. The combined discharge of industrial and municipal waste in highly populated concentration points has undesirable effects on human and other life forms.

Water pollution has caused loss of sources of livelihood to some individuals. Health hazards emanating from the use of polluted water has equally caused more harm to most people in Nigeria. It has affected governments, locally and internationally. This review relies on secondary information to capture water pollution as it affects sustainable development in Nigeria.

The study will enable the concerned groups know how to tackle these problems in order to have less contaminated aquatic environment. The study will enable the policy makers and implementation agencies, project proponents, environmental authorities and other stakeholders to fully appreciate water pollution and the negative effects it has on sustainable development and give it due weight.

Water quality, health and sustainable development in Nigeria

A number of studies (World Bank, 1993; Brockehoff, 1995; Hoddinott, 1997) have examined water quality, water pollution and the impact of water pollution on health status of household members and sustainable development. Most of the studies hypothesized that

an improvement in water quality has a direct effect on people's health via reduced exposure to water-associated diseases.

Water quality is the physical, chemical and biological characteristics of water (Ajayi and Oshibanjo, 1981). It is most frequently used by reference to set a set of standards against which compliance can be checked. The most common standard used to assess water quality relate to drinking water, safety of human contact and for the healthy ecosystems (Nwafor, 2006).

Water quality is a complex subject because water is a complex medium intrinsically tied to the ecology of the earth. Different parameters for water quality are determined by the intended use. There are guidelines for drinking water quality which are the international reference point for standard setting and drinking water safety set by the World Health Organization (WHO). The guideline was set up in 1993 and revised in 2006. Nigeria also has her standard for drinking water quality.

Environmental pollution can be categorized into three groups. These are air or atmospheric pollution, aquatic or water pollution and land or surface area pollution. The World Health Organization (WHO, 1990) submits that air pollution is "limited to situation in which the outer ambient atmosphere contains materials in concentrations which are harmful to man and his environment".

Water pollution can be defined in many ways. Usually, it means one or more substances have built up in water to such an extent that they cause problems for animals or people. Water pollution occurs when a body of water is adversely affected due to the addition of large amount of materials to the water. When it is unfit for its intended use, water is considered polluted. When chemical, pathogens or contaminants are detected, water could be

said to be polluted. Water pollution is all about quantities, how much of a polluting substance is released and how big a volume of water it is released into. A small quantity of a toxic chemical may have little or no impact if it is spilled into the ocean from a ship. Hence, the same amount of the same chemical can have a bigger impact if it is pumped into a lake or river, where there is less clean water to disperse it.

There are two different ways in which pollution can occur. They are point source and non-point source pollutions. Point source pollution occurs when harmful substances are emitted or discharged directly into a body of water. If pollution comes from a single location, such as discharged pipe attached to a factory, it is point source pollution. Other examples of point source pollution include an oil spill from a tanker or someone pouring oil from car down the drain.

The World Commission on Environment and Development (Brundtland Commission) defined sustainable development as meeting the needs of current generations without compromising the ability of the future generations to meet theirs (UN, 1987). The debates of the Millennium Summit upheld this definition (UNDP, 2001). Hughes and Johnston (2005) recognize that sustainable development is now as much about efficient resources for present generation as for future ones.

Sustainable development is a mainstream recognition of relationship between development and environment. This is interested in meeting the economic, political, cultural social and other health needs of generations of today without compromising the ability of the future generations to meet their own needs (Eneh & Owo, 2008).

Sustainable development stands on three pillars in terms of its definition for the 2002 World Summit on Sustainable Development (WSSD). These are social development, economic development and environmental protection. In 1972, the first World United Nations Conference on Human Environment took place in Stockholm, Sweden, consequent upon the recognition of environmental problems as global issues.

MDG 7 seeks to ensure environmental sustainability; implement national strategies for sustainable development by 2005 so as to reverse the loss of environmental resources by 2015; halve by 2015 the proportion of people without sustainable access to safe drinking water; and achieve by 2020 a significant improvement in the lives of at least 100 million slum dwellers (Eneh, 2009).

Hence, water pollution is not in favour of sustainable environment for the future generation. Water pollution have continued to generate unpleasant implications for health and economic development in Nigeria and the Third World in general, the consequences of which include 4.6 million deaths from diarrhoeal disease and a sizeable number of casualties from ascariasis (Esrey et al., 1991). In the West African sub-region (with significant contribution from Western Nigeria), there are estimated 4 million cases of guinea worm, while about 500 million cases of trachoma leads to blindness of about 8 million people each year (Hoddinott, 1997). However, despite the public and international agencies' policy focus on this problem, the situation in Nigeria seems degenerating and, therefore, demands increased attention.

Patronage of hospitals and other health care facilities in Nigeria is on the increase because of water-borne diseases. The rapidly increasing populations coupled with the deteriorating

environment are some of the factors responsible for this trend (Sangodoyin, 1995). Hospital records have confirmed high incidence of typhoid, cholera, dysentery, infectious hepatitis and guinea worm in urban settlements of Nigeria.

Amongst all the costs of urban environmental degradation, damage to human health is by far the highest. There is a direct link between urban environmental degradation and public health in terms of water-related diseases, such as diarrhoea, dysentery, cholera and typhoid. The rapid growth of urban centres in Nigeria, coupled with the development of unstructured infrastructural and social services have created an environmental situation in many parts of the country, which is becoming inimical to healthy living.

Studies have shown that zoonotic diseases (diseases of animals transmitted to humans) are yet to be eliminated or fully controlled in above 80 percent of the public abattoirs in Nigeria (Olugasa et al., 2000). Thus, they pose serious environmental health risk. Some of the infectious diseases are tuberculosis, colibacillosis, salmonellosis, brucellosis and helminthoses. These are common examples of zoonoses prevalent in slaughters cattle population in Nigeria. Kajogbola (1998) revealed the prominence of malaria, dysentery, chicken pox, measles and pneumonia as the greatest causes of morbidity within the Ibadan region in Nigeria. The study also revealed that the leading killer diseases in the region are solid waste management related and are precipitated by ignorance, poverty and low standard of living.

The concern for increases in the level pollutants in surface and underground water is justified, since a large proportion of rural, and recently urban, dwellers in Nigeria obtain domestic water, and sometimes drinking water from ponds, streams and shallow wells

(Sangodoyin, 1990). The use of dump as a mode of waste disposal, is seen as a means of reclaiming natural gullies and excavations in Nigeria. More so, leachates from such waste dumps may contain organic and inorganic toxic pollutants which may flow laterally or percolate through permeable soil strata and pollute surface or ground water (Benka-Coker and Bafor, 1999). These leachates may contain high concentration of sulphates and other chemicals harmful to both aquatic plants and animals.

In their study of the pollution potential of the Teboga waste tip in Benin City, Nigeria on the physical and chemical characteristics of the adjacent Ikpoba River, Benka-Coker and Bafor (1999) suggested that the leachates have the potential to pollute both surface and underground waters, as could be inferred from the generally acidic nature of the waters of the Ikpoba river, when compared to the values for previous years.

However, Sangodoyin (1989) examined the quality levels of both river water and adjacent dug wells along the Ogunpa stream in Ibadan, Nigeria and infers that the quality of the water, as determined by several quality parameters, fall far below established standards (FEPA, 1991).

Interests shown in the contamination of groundwater by pollutants are not much. This may not be unconnected with the slow movement of groundwater, as well as the slow degradation of many pollutants, the latter sometimes remain for years (Cohen et al., 1984).

Types of water pollution

The most obvious type of water pollution affects surface water (oceans, lakes, rivers and streams). For example, a spill from an oil

tanker creates an oil slick that affects a vast area of ocean. Water stored underground in aquifers is known as groundwater. Aquifers feed rivers and supply much of drinking water. They too can be polluted, for instance, when weed killers used in the gardens drain into the ground. Groundwater pollution is much less obvious than surface water pollution, but is no less of a problem. Both surface and groundwater are the two types of water resources that are affected by pollution.

A non-point source delivers pollution indirectly through environmental changes. A great deal of water pollution happens from many different scattered sources which are non-point sources. This could happen if chemicals from farms are carried into the stream by rain in the form of run-off, which in turn affects aquatic life. The pollution from non-point sources accounts for a major source of the contaminants in streams and lakes. Most of the times, pollution that enters the environment in one place has an effect hundreds or even thousands of miles away. This is known as trans-boundary pollution (DANIDA, 2000).

Pollution control is all about having a cleaner environment. Sometimes, this involves costly measures and controversial political decisions. As a result, developing countries, poor communities and financially constrained enterprises have often argued that the environment is an expensive luxury that diverts resources from more productive uses. This perspective is giving way to a new paradigm stating that neglecting the environment can impose high economic and even financial and health challenges on the people. Excessive water pollution levels damage not only economic assets but human health as well.

Causes of water pollution

The causes of water pollution are endless. Water pollution has many different causes and most of the water pollution does not begin in the water itself. Take the oceans for instance, about 80% of the ocean pollution enters the seas from the lands.

Some of the causes include:

i. Industrial discharge of chemical wastes and by-products

Dumping and discharging of industrial wastes containing heavy metals, harmful chemicals, by-products, organic toxins and oils into any source of water is one of the visible causes of water pollution. Chemical wastes in water bodies include dissolved metals and their salts, acids and bases, organic and inorganic compounds, solvents, solutions and others. Some industrial effluents contain dyes and colourants, fluorine, heavy metals, waste water and other chemicals that may be toxic to human and aquatic lives. These pollutants are discharged either directly or indirectly to the water sources. Attimes, they are leached through the deposited sites into ground water system.

Crankcase oils discharged by mechanical workshops, industries, power stations and commercial houses estimated at about 20 million gallons per year are discharged carelessly into drains and surface waters, thereby contaminating surface and underground waters.

ii. Nutrients

Sewage and fertilizer contain nutrients, such as nitrates and phosphates. Sewage can be a fertilizer, if suitably treated and used in moderate quantities, by returning important nutrients

to the environment which plants and animals need for growth. The trouble is that sewage is often released in greater quantity than the natural environment can cope with (Adelegan, 2004). Some of the nutrients drain into the water bodies. The fertilizers used in the farms add nutrients to the soil which drains into rivers and seas adding to the fertility effect of the sewage (Benka-Coker, and Ojior, 1995). All these give rise to increase in the growth of algae that overwhelms huge areas of oceans, lakes or rivers. This is referred to as harmful alga boom (or red tide because it can turn the water red) (Gruber and Galloway, 2008). This harmful effect removes oxygen from the water and kills other forms of life leading to what is known as dead zone.

iii. Solid Waste

Most people, who are not conscious of the environment, dump solid waste, especially household waste, into rivers, streams and flood without a thought about where they eventually end up. These wastes are subsequently transported from one place to the other downstream, contaminating larger water bodies. The solid waste could include textiles, plastics, wood, rubber, paper, debris, metal scraps, clothes, and many other household wastes.

iv. Oil Spill

Globally, over 70% of oil pollution at sea comes from routine shipping and from the oil people pour down the drains on land. About 12% of the oil comes from tanker accident (World Bank, 1994). This is destructive because it delivers large quantity of oil at once into a localized area of the water. In Nigeria, oil spills occur due to a number of reasons,

including corrosion of pipelines and tankers (about 50%), sabotage (28%), oil production operations (21%), with 1% of the spills being accounted for by inadequate or non-functional production equipment (Oghogho and Adejeko, 2007). The largest contributor to the oil spill total corrosion of pipes and tankers is the rupturing or leaking of production infrastructures that are described as “very old” and lack regular maintenance.

The pipelines with life span of about 15 years are old and susceptible to corrosion (World Bank, 1998). Many of the pipelines are as old as twenty five years. Sabotage through what we know as “bunkering” in which the saboteurs attempt to tap the pipeline, in the process of extraction, most of the times damage the pipeline. This has become a major issue in Niger Delta region of Nigeria, and contributes further to the environmental degradation.

v. ***Increase in Temperature***

Rise in water temperature can result in the death of many aquatic organisms and disrupt many aquatic habitats. This is caused by heated water discharged by factories and power plants. By raising the temperature, it reduces the amount of oxygen dissolved in the water. Global warming, which is a process whereby the average global temperature increases due to the greenhouse effect, equally causes a rise in the earth’s water temperature.

- vi. ***Other causes of water pollution*** include the waste from construction firms, such as cement, lubricants, plastics, and metals.

Effects of water pollution

The effects of water pollution are far-reaching and affect not only the environment, but human beings and animals as well. Some effects show up immediately, while others take some months or years to manifest. It affects the food chain. When toxins are in water, they migrate from the water to animals through drinking and to man through meat and fish consumed. Acid rain contains sulphate particles, which can harm fish or plant life in lakes and rivers. Pollutants in water alter the overall chemistry of the water, causing changes in acidity, temperature and conductivity. These changes have adverse effect on the marine life and are not favourable for sustainable development in Nigeria.

The effect of uncontrolled disposal system renders surface water and underground water system unsafe for human, agricultural and recreational use, destroys biotic life, poisons the natural ecosystems, poses a threat to human life and is, therefore, against the principles of sustainable development. Since the drive for increased control of the environment gathers momentum, the financial expenditures for pollution control also increases (Bulama, 2005). This becomes necessary to prevent deterioration in the quality of life arising from rapid economic development.

Nigeria, like other developing countries suffer from a number of primary environmental problems mainly attributable to under-development and attendant poor living conditions. Also, numerous industries are fast springing up in different parts of the country. Consequently, failure to begin waging an early war against environmental degradation today is likely to affect output adversely and increase costs in the future. However, if the adverse effects of river pollution and spread of water-borne diseases are to be

mitigated in Nigeria, it would appear that current planning laws and waste disposal practices should be reassessed (Sangodoyin, 1989).

Diseases can spread through polluted water. Infectious diseases such as typhoid and cholera can be contracted from drinking contaminated water (microbial water pollution). The human heart and kidney can be adversely affected if polluted water is consumed regularly. Other health problems associated with polluted water are poor blood circulation, skin lesions, vomiting, and damage to nervous and skeletal system and so on. In fact, effects of water pollution are said to be the leading cause of death for humans across the globe.

Marine food sources are eliminated or contaminated by the water pollutants. If oil spill occurs, the oil can wash up on nearby beaches devastating the ecosystem and affecting tourism severely. The oil clings to the gills of fish and prevents oxygen extraction from the water by the fishes, leading to oxygen starvation and consequent death.

Oil spill, especially in the Niger Delta region of Nigeria, dispossesses fishermen of their sources of livelihood, thereby encouraging militancy and unrest. Many of the pollutants are carcinogenic. Some of these can affect generations to come by changing the body's chromosomal makeup.

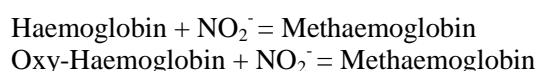
Heavy metals washed into the water causes serious injury to the aquatic lives. This means that entire animal communities can be badly affected by this type of pollutants. It however, disrupts the community structure of an aquatic environment. Microbial pollutants from sewage often results in infectious diseases that infect aquatic life and terrestrial life through drinking water

(Akpata, and Ekundayo, 1978). This often increases the number of mortalities seen within an environment.

Organic matter and nutrients causes an increase in aerobic algae and depletes oxygen from water column. This is called eutrophication and causes the suffocation of fish and other aquatic organisms. Suspended particles can often reduce the amount of sunlight penetrating the water, thereby disrupting the growth of photosynthetic plants and micro-organisms. This has subsequent effects on the rest of the aquatic community that depend on these organisms to survive. This also adversely affects biodiversity.

Sulphate particles from acid rain changes the pH of water, making it more acidic. This damages the health of marine life in the rivers and lakes it contaminates, and often increases the number of mortalities within an environment.

According to Eneh (2011a), nitrate in water is particularly dangerous to babies and children. In proportion to their body weights, babies and children consume much more water than adults. The digestive system of an under-6-month infant secretes lower amounts of gastric acid, leading to low acid concentration or higher pH level and attendant proliferation of acid-inhibited bacteria, which transform nitrate to nitrite. Thus, when water with excessive nitrate concentration is used for preparing baby food or as baby drinking water, the baby's immature digestive system, with its lower concentration of gastric acid and the attendant higher concentration of bacteria, facilitates the reduction of the nitrate to nitrite. The nitrite ions (NO_2^-) react with haemoglobin and oxy-haemoglobin to form methaemoglobin, which cannot carry oxygen, and thereby, making oxygen transfer difficult.



This leads to asphyxia (difficulty in breathing), which may result to death. This blood disorder is called methaemoglobinemia (blue baby syndrome). It occurs mostly in babies, pregnant women and people with weak immune system.

Pollution loads by domestic and industrial effluents in Nigeria

Several researchers (Aka, et al., 2009; Atubi, 2009; Ugwu, 2010; Eneh, 2011 b, c) report that water pollution remains a major problem in the Nigerian environment. Both urbanization and industrialization have contributed to the scale of pollution. Presently, there are no incentives for the adoption of pollution abatement measures and very few disincentives, if any, for polluting the environment. Wastes are disposed of indiscriminately, especially for small and medium scale industries, but excluding major establishments like the refinery industry, which is encouraged to adopt adequate waste disposal and good refining practices under the Petroleum Refining Regulation Act of 1974.

The discharge of wastewater into surface water and the resultant changes in its ecology have been reported by several researchers (Law, 1980; Okoronkwo & Odeyemi, 1985; Odokuma and Okpokwasili, 1993), who also express concern over human health and the possible accumulation of human enteric pathogenic microorganisms by aquatic organisms. Incidences of water-borne diseases in rural areas of developing countries leading to millions of deaths have been reported (UNU, 1983). Some of these deaths have

been traced to the use of waters grossly polluted by untreated waste (UNEP, 1991). Researches show that coliforms and *E. coli* in particular increased in streams and lagoons where faecal matters were released (Apkata and Ekundayo, 1978; Egborge and Benka-Coker, 1986). The discharge of wastewater from bathroom, laundry, slaughterhouses, among others, have been used to explain the deterioration of most tropical rivers as they pass through inhabited places (Oluwande *et al*, 1983). This condition, pollution load and effluent effects on water sources in Nigeria have impacted negatively on the health of the people.

Table 1.1 shows the morbidity patterns.

Table 1.1: General morbidity pattern in Nigeria

S.No.	Morbidity rank	Percentage
1.	Infectious and parasitic diseases	38.2
2.	Respiratory disease	12.7
3.	Diseases of nervous systems and organs	9.9
4.	Ill-defined conditions	9.2
5.	Skin diseases	8.4
6.	Digestive system	4.7
7.	Accidents	3.1
8.	Muscle and skeletal diseases	2.9
9.	Genito-urinary diseases	2.9
10.	Blood diseases – anaemia	2.5
11.	Nutritional and metabolic diseases	1.8
12.	Others	3.7
	Total	100

Source: Federal Ministry of Health (FMH, 1986)

Infectious and parasitic diseases constitute 38.2% of water-related diseases. Respiratory disease accounts for 12.7%. Diseases of nervous systems and organs are responsible for 9.9%. Ill-defined

conditions account for 9.2%. Skin diseases were 8.4%. Digestive system diseases were 4.7%. Accidents accounted for 3.1%. Muscle and skeletal diseases were 2.9%. Genito-urinary diseases accounted for 2.9%. Blood diseases (anaemia) were 2.5%. Nutritional and metabolic diseases were responsible for 1.8%. Others constitute 3.7%. These point to the fact that the MDG disease reduction target by 2015 is still a far cry with water pollution.

Environmental Regulation in Nigeria and the Challenges of Sustainable Development

Sustainable development poses important question as to how economic growth is conceived and managed through incentives and regulation. The examination of environmental regulation and sustainable development principles in Nigeria shows that the nation needs to integrate the principles of sustainable development into the country policies and programmes in order to reverse the loss of environmental resources. In spite of the fact that the country has embraced the concepts of sustainable development, Nigeria is far from pursuing the goals and objectives (Adelegan, 2004).

The evidences and impediments are as follows:

- There is the absence of appropriate national guidelines and standards on environmental pollution and natural resources conservation, although some progress was made in this direction by FEPA. This implies that pollution problems and the damage to the environment cannot be adequately monitored and enforced especially in the industrial sector.
- There is the general absence of effective resource pricing instruments for resource conservation and nature protection.

The major implication is that resources are still being wantonly exploited by individuals, groups, communities and corporate bodies without any concern for environmental damage.

- Techniques and appropriate instruments for environmental costing, especially one that takes into consideration, damage to the value of natural ecosystems is yet to be fully developed in Nigeria. It will be difficult to speak of attaining both a balance and compatibility between resource conservation and economic growth.
- Absence of economic incentives and disincentives for natural resources conservation and environmental management abound.
- Absence of a system of national resources accounting and auditing, especially one that takes reversible and irreversible damage to the environment into account.

Recommendations

There is equally the need to create an environmental monitoring network with an environmental data bank. There is need to improve on the current conservative policy option with regard to public education. The abject level of environmental deterioration noticeable in Nigeria gives a strong impression that the current level of knowledge of the public regarding public health matters is very low.

There is also the need for supported active research into waste minimization strategies, waste avoidance technologies, cleaner production processes and zero emission concepts in Nigeria.

Wastes that are pushed into waters could be turned to wealth with some research on recycling.

Water pollution is not easy to solve. It is necessary that all hands must be on deck to fight it. This means that both government and citizen's co-operation are needed to reduce water pollution to the barest minimum. Since water contamination comes from many different sources and has many numerous effects, every aspect of water pollution needs to be addressed.

Strategies for tackling the problems include:

Education

Public awareness of this problem is the first step to solving this problem. Massive public education can make a positive difference. Farmers should be enlightened to understand that the use of pesticides and other chemicals around or near streams, rivers, lakes and even small springs can have an effect on the ecology of the water ways. The consumers should be educated on the causes and types of water contamination, the symptoms of water-borne diseases and home methods of preventing and controlling drinking water hazards. Some toxic chemicals can be avoided by taking some precautions.

Laws and regulations

The major problem with water pollution is its trans-boundary nature. Many rivers cross countries, while seas span whole continent. Pollutants discharged by factories in one country with poor environmental standards can cause problems in neighbouring nations, even when they have tougher laws and higher standards. Environmental laws can make it tougher for people to pollute, but to

really be effective. They have to operate across national and international borders. Hence, there are international laws governing the oceans, such as 1982 UN Convention on the Law of the Sea (signed by over 120 nations), the 1972 London Dumping Convention and other laws. Most countries also have their own water pollution laws. Problems lie strictly on implementation, not in the making of laws, especially in Nigeria.

Polluter pays principle

Some environmental experts agree that the best option to solving the water pollution is by what is known as polluter pays principle. This means that whosoever causes pollution should have to pay to clean it up in one way or the other. It could mean that tankers owners should have to take on insurance that covers the cost of oil spill clean ups. Also, it could mean that the factories that use rivers must have their water inlet pipes downstream of their effluent outflow pipes, such that if they cause pollution, they will be the first to suffer it. The polluter pays principle is designed to deter people from polluting by making it less expensive for them to behave in an environmentally responsible way.

Denitrification

This is an ecological approach that can be employed to prevent the leaching of nitrates in soil. Fertilizers contain nitrogen and bacteria in the soil convert it to nitrates making it easier for plants to absorb. During low oxygen levels, another form of bacteria then turns the nitrites into gases, such as nitrogen, nitrogen dioxide and nitrous oxide. The conversion of these nitrates into gas is referred to as

denitrification. This stops any ground water from being contaminated with nutrients, which lead to algal boom.

With these recommendations, our government and more environmentally responsible corporate industries can lower the water pollution that also affects food supplies, since they have the resources to prevent or remove these contaminants. It is worth noting that water pollution cannot be entirely stopped as long as there are industries, but can be reduced to a minimum level with less threat to aquatic lives and human health. This will lead to sustainable development in Nigeria.

Conclusion

The problems associated with water pollution have the capabilities to disrupt life on earth to a great extent. It is ultimately for all to be informed, responsible and involved when it comes to problems we face with water in order to achieve sustainable development. We must learn about methods of disposing harmful household wastes so that they do not end up in our water ways. Farmers should use alternatives to chemicals to prevent washing chemicals into the water. Working together, we can reduce water pollution both locally and internationally.

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DOCUMENTATION QUALITY APPRAISAL IN PUBLIC/PRIVATE PROJECT DELIVERY IN NIGERIA

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Abstract

The increasing rate of project failure, cost and time overruns is raising a wave of public concern in Nigeria. This study was aimed at comparative evaluation of documentation practices in private and public projects in Nigeria in order to unravel the quality of the documentation for infrastructural development projects. Ten (10) private and ten (10) public capital projects were surveyed. Fifteen (15) documentation quality variables (DQVs) that are key to project actors were used to measure the documentation implementation levels (DILs) and the index of project success (PSFS). The results showed a general low quality documentation and dismal level of project success, without any significant difference in achievement between public and private sector projects. The study recommended, among others, proper procurement documentation, balanced and collaborative professional design and construction team, which must admit inputs from work operatives, and the application of information

communications technology (ICT) in construction documentation to generate and manage quality construction databases at all stages.

Introduction

Construction projects depend on quality documentation to be effective because they require complex interactions of the multiple stakeholders and participants. All parties involved in ownership, use, design, estimation, construction, operation and maintenance have contributions to make in effective documentation of projects. Working as a team in a structured, organized and collaborative manner, the supply chain needs to provide authoritative project documentation as a sine-qua-non for project success.

Quality is defined in terms of zero defects and getting things right first time. The conceptual questions in documenting for project success are: (1) What level of quality is exercised in structuring project briefs/requirements by the client and user? (2) What level of quality is exercised in producing geotechnical, architectural, civil, structural, mechanical/electrical designs transformed into physical structures by contractors? (3) What level of quality is applied in documenting for contractors' and consultants' procurement?

How accurate and comprehensive are the project cost estimate / bills of quantities? Does planning for execution provide specific, accurate, real-time details on scope, work breakdown structure (WBS), schedule, networks, milestones, budgets, cash-flow analysis, labour and equipment requirements and safety/risk standards? Are there control/reporting system that provide for monitoring and feedback at all stages and which enables comparison of schedules, budgets and standard performance with actual

achievements and project goals? The level of implementation of these critical project documentation issues in public and private projects is what this study attempted to investigate.

Literature Review

Most projects require the use of basic contract documents. These include (IBRD, 1999; Langdon, 2007) articles of agreement, conditions of contract with all necessary deletions/amendments if standard form is used, drawings and/or specifications of work to be done, Cost estimates/priced Bills of quantities including, post-tender negotiation documentation, and contract programmes/progress charts. Other basic documentations required in projects include pre-tender documentation, early warning charts, quality performance charts, minutes of site meeting, instructions, valuations/certifications, among others.

There has been an increasing concern over declining quality of documentations and disregard of due processes that have contributed to decline in construction efficiency, resulting in increased project cost, time, risk, delay and dispute (Ajator, 2007, 2000 a, b; Project Documentation Certification Taskforce, 1997). Many researchers (Gallo, et al 2002; Tilley et al, 2000; 2002; Love et al, 2000, 1996) have identified the following issues associated with documentation failings and its manifestations: Design quality; inappropriate design and design checking, inexperienced design personnel, buildability problems, conservative design, legally/statutorily non-compliant design, quick-fix/rushed design. Documentation quality, inaccurate/unclear and untimely document, insufficient details, confusing and conflicting/voluminous documentation, low quality documentation, general co-ordination problems, insufficient

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information, erroneous information, and conflicting information. Client-related problems include inadequate definition of brief and susceptibility to changes issues, expectation that designers can absorb the effects of changes to project requirements, design and documentation coordination/review often squeezed toward the end of the design process, documents issued with the knowledge that they may have deficiencies, a preference for designers to cease involvement at the conclusion of the design development stage with detailed design being undertaken by construction contractors, inequitable terms of engagement of professional design team / consultants and unwillingness to negotiate fair conditions and a perception by designers (that inadequate allowance is made for the time necessary for design processes, clients believe that tight project time frames can be overcome merely by adding staff to the design team, and clients are not prepared to pay design fees commensurate with the professional services required for quality outcomes).

Designer-related problems have been noted in earlier reports to include (Ajator, 1996; 2000b) disregard of standard fee structure, designer firms bidding at fee levels too low to fully accommodate client expectations, cost estimating services not provided by professional quantity surveyor / cost engineer, selection of designers on the basis of lowest price, reluctance by clients to compensate for most costs of changes or variations arising from design and documentation failings of the consultants, environmental impact mitigations not reflected in the designs, role of designers limited to part of the project design function only (e.g. the concept design or the detail design stage), design coordination function not adequately recognized and not allocated as a responsibility of a particular party, drawings issued for tenders that are often incomplete/uncoordinated, restrictions on time and budget

precluding opportunity for the designer to propose innovative or other practical alternatives, construction constraints not identified in design and / or not adequately represented in project documentation, inadequate and untimely issue of documentation changes, discrepancy errors in drawings and divergent errors with other documents (e.g. inconsistencies between design concept drawings and shop drawings), multiple requests for information (RFIs) together with cumbersome and tardy process for their resolutions, lack of recognition of the need for an overall project manager role and for definition of the relationship of that role with all stakeholders, and inability to promote whole-life considerations, including total project cost aspects because of lowest initial capital cost approach.

Workshop detailing-related problems are tight time frame, excessive numbers of RFIs, and long response times to RFIs. Contractor-related problems are tendering practices which inhibit disclosure of innovation and other technical advantages; ambiguities, errors and shortcomings in project documentation creating time and budget difficulties; defensive and blame cultures; sub-optimal programming changes and sequencing of works; time and budget over-runs; and other adversarial behaviours leading to deterioration in project relationship.

Some of the causes of these declining documentation quality manifests are consequential on others, while some involve more than one stakeholder. A list of causes attributable to the various stakeholder groups reported by many researchers (Tilley et al 2002; Gallo et al, 2002; Love et al, 2000, 1996) include client-related causes, such as inadequate knowledge of the implications of their expectations, demands and directions; inadequate recognition of whole – life implications at briefing and design phases;

lowest price mentality in engagement of designers; unrealistic expectations about time and cost constraints; defensive approach to variations and claims for additional costs or time; failure to appoint an overall project manager; and reluctance to formally commit to a design at appropriate stages of a project. Designer-related causes are perceptions of constraints imposed by client expectations; focus on risk shedding rather than on targeting quality of documentation; short design times result in inadequate checking of details and insufficient reviews with relevant parties; inadequate design coordination between engineering, architectural and mechanical design disciplines; an apparent “design by crisis” operating mentality by designers, leaving design issues to be sorted out in the construction process; inadequate consideration of whole-life cycle and constructability issues including poor coordination between services and suboptimal sequencing of project activities; cumbersome (and even defensive) approaches to RFIs; incomplete documentation including inadequate detail; design documentation issued with known deficiencies; designs developed by many parts of the organization – lack of coordination; “Cut and paste” syndrome and ambiguities due to lack of integration and quest for economy of design time; erosion of expertise with design draftsmen being replaced with CAD operators; fewer “green field” and more retrofit projects lead to tighter tolerances and more interfaces – increased costs without corresponding recompense in fees; reluctance to allocate experienced staff to projects because of their high cost in an environment of inadequate fees; optimum design solution not adequately researched; and emphasis on minimum effort rather than on doing the job right first time.

Other causes related to tendering procedures are multiple “notices to tenderers” and question/answer steps erode document accuracy due to short time for amendments,

reluctance by tenderers to ask questions that might reveal competitive edge, extended and unduly complicated award processes, and reduced tender times. Contractor-related causes are seeking to re-apportion risks to other stakeholders, lowest price mentality in engagement of subcontractors, adversarial approach to RFIs, reluctance to seek clarification (especially during the tender phase) to protect competitive advantage, spurious claims submissions to recover losses arising from initial low bids, introduction of legal and insurance advice in order to cover perceived risks, and difficulties in maintaining skill levels. The general causes involving all parties are inadequate time for project planning; relevant parties not involved in project planning early enough, especially at concept and decision times; responses by clients and their agents to questions/queries from bidders, worsen rather than improve documentation quality; and adversarial attitude embedded in the procurement culture.

Cost estimate documentation problems/sources

Accuracy of cost estimates largely depends on the level and quality of project definitions and the use of bottom-up approach involving relevant executory personnel to analyse costs at the lowest possible work units. Cost estimate documentation for power plant projects appears to be the most critical of project documentation failings.

The accuracy of cost estimate of a power project is largely dependent on the quantity surveyor / cost engineer's understanding and experience of the terrain, the technologies, the various currencies/conversion rates, the duties, ports' charges, transport systems (both local and international) available and costs of finance and funding system. Apart from the problems of integrity of the analysed benchmark costs and factoring errors, there is the problem of improper planning/

non-inclusion of work items for which costs/prices must be allocated (Ajator, 1989, 1999; Aliyu, 2006).

The quantity surveyor / cost engineering efforts must go beyond rudimentary work measurement currently provided by robust design softwares to full financial engineering. The services must embrace arranging the financial relations between parties in a contract, arranging finances for projects, monitoring and costing delays, and projecting/modeling cost estimates. In estimating costs of power plants, consideration must be extended to funding of letter of credit (LC), to various manufacturers through one off-shore or multiple off-shore financial institutions representing the various component manufacturers located in parts of the world using various currencies and rates. For an investor, the conditions of LC will have an effect on the total cost of the project. Some manufacturers will insist that the LC be fully funded before they commence the manufacture especially for a plant meant for developing country like Nigeria. What this means is that the investor would have to pay fully, or raise a loan from a financial institution in full settlement, months ahead of shipping the basic plants (IBRD, 1999; Ajator, 1989; Aliyu, 2006). The varying currency exchange rates during the period of the contract would also have an effect on the total project cost. The quantity surveyor is, therefore, expected to consider these issues in preparing estimates for a power plant and other infrastructural projects.

Other important cost considerations include cost of shipping, stacking in the factory (demurrage charges by manufacturers), marine insurance, clearing costs at ports, duties, insurance, warehousing, local transport, among others. These are real costs which if omitted can cause failure. For instance, shipping costs are obviously the cost of transport from manufacturers' port or airport to the entry port of the

power-plant location. Should the project not be synchronized whereby preparatory works on the site are delayed and the manufacturer had to keep a fully manufactured machinery, then occupation of the factory may be charged. Sometimes, the charge results from non-payment of shipping costs component of the contract, which delays the machinery leaving the factory. Marine insurance is a premium for possible damages or lose on the sea which is calculated as a percentage of the cost of the machinery. There is no option of refusal, the insurance must be paid. Clearing costs are payments for off-loading and movement within the destination port. In Nigeria, a percentage of the cost of the plant is charged instead of weight and bulk (volume) of the equipment/machinery. Duty is usually government tax on the machinery which is adjusted for the various machinery/equipment from time to time as the Government deems fit. Insurance could cover manufacturing accident, local transport even initial tests on site. Premium could be charged appropriately for these. Ware-housing, could be a temporary accommodation for the machinery before final installation on site and can be located anywhere between the destination port and final installed position of the machinery. It could be rented or built for the project. And could serve as part of maintenance workshop where final coupling could take place before positioning of the machinery. Local transportation could be a nightmare especially in a third world country on two counts. Proper vehicle for transporting the machinery/equipment may not exist necessitating a reconfiguration of the plant before transporting to site or an expensive provision of proper vehicle by outright importation into the country. The transportation route, roads, rivers, bridges may need to be reinforced, overhead powerlines/overhead bridges removed, roads constructed

before transportation of the machinery or plant can be undertaken.

This is particularly important, as it constitutes a major difference in comparing plant installation cost in various locations in the world. Existence or non-existence of source of energy must be considered in terms of power evacuation facilities, terrain maps, and accurate geotechnical reports. To avert considerable adverse effect on the cost of a large power plant, some very important information are necessary. Source of energy, such as gas source and cooling water source must be considered. Gas pipeline cost can be in the region of \$500,000.00 to \$2,000,000.00 per km, including pumping/flowstations along the route. The cost ultimately is dependent on the terrain it is to be laid and environmental issues which must be properly/accurately documented. If water for cooling is to be sourced from a river, piping and flow stations can cost over \$2,000,000.00 per km. Where water for an hydro electric power station are to be collected from various sources (rivers), extensive civil and pipe laying can be undertaken including mechanical pumping of part of the water. These additions can run into millions of dollars. For power generated to be useful, it must be linked to consumers. The distance of the power plant to consumers and the transmission system available all have effect on cost of plant. The voltage level the power must be transmitted (11 KV, 33 KV, 132 KV, or 330 KV) will directly affect the cost of the equipment, largely the electromechanical installation on site. Electricity generated by large power plants is expected to be evacuated at 132 KV or 330 KV voltage levels being the transmission voltage in Nigeria. The generators usually generate at 15 KV which must be boosted to the required transmission voltage by a series of power transformers and other electromechanical arrangement known as switchyard.

These can cost about a quarter of the cost of power plant for a typical gas turbine system. The cost of boosting to 330 KV is naturally higher than that of 132 KV.

Contrary to the above which deals with installation of electromechanical within the site premises of the power plant, transmitting electricity through some distance is typically done on pylons spaced at 300 m to 500 m apart. These pylons have insulators mounted on them. These insulators in-turn support the conductors which actually carry the current from the generating plants. Typical double circuit (D/C) transmission line, with 2 x 350 mm² biscom conductors per circuit with optic fibre wire for control can cost in the region of \$180,000 to \$300,000 per km, depending on the locations. Along the transmission lines, transmission substations have to be built which can cost as much as three billion naira (₦3 bn) for a 150 MVA 330/132/33 KV and occurs within distances of 50 to 100 km of transmission lines. The transmission substations facilitate the conversion from one voltage level to another and also serve as an inter-phase for linking/combining electricity from various power plant sources. For hydropower plants, all sorts of costs that do not form part of the physical plant, in addition to the general ones outlined above, occurs right from the moment a decision to build is made.

Such costs include terrain mapping costs (activity usually carried out by specialist/experts using special tools/equipment) to determine the volume of water and hence the capacity of the plant, geotechnical studies to determine the subsoil conditions and other such work that determines the dam type to be designed and the position of facilities on the site, and relocation and compensation costs payable. Expert feasibility and viability studies/reports must expose these cost considerations and provide guide for appropriate selection of plants and cost of facilities, among others. The practice is for

investors in the third world to refuse to recognize costs of these important first step actions especially when the studies are packaged abroad. This results in project abandonment midstream with colossal waste of resources. Like the power plant costing issues exposed above, costing of other infrastructural development projects require detail planning and investigation to identify and document all activities to which accurate costs must be allocated.

Methodology

In 2009/2010, ongoing ten (10) public and 10 private infrastructural development projects were surveyed in Nigeria by the researcher and his team. The projects were physically observed and their documents were reviewed with the co-operation of the managing consultants, in order to ascertain the quality of the project documentation and its outcome in successful discharge of the contracts. Through incisive literature search various documentation quality issues were unveiled, reviewed and collapsed into 15 documentation quality variables DQVs, which were assumed to be relevant to the study. These were issued to fifty professionals of the construction industry to elicit their opinions as to the relevance or importance index (II) of the implementation of each documentation quality variable on the overall success of a project (see Table 2.1). Also, key project actors/stakeholders of each project were issued questions and interviewed to obtain data on the extent of implementation of the DQVs in their projects. The data are recorded as documentation implementation index (DII) in Table 2.2.

The project success factor (PSF) for each variable was ascertained (as the multiplicative value of importance index and document implementation index (II x DII) and recorded for both public and private projects in Tables 1.2 and 1.3

respectively. The PSFs are illustrated pictorially in bar charts for both public/private projects as Figure 2.1. Chi-square test was applied on the analysed data to establish whether there was any significant difference in documentation practice exercised by project actors in public and private projects, using the highest ranking/impacting variables for public and private projects (see Table 2.4).

Analysis, Findings and Discussion

Thirty six professionals of the construction industry rated cost estimating and bills of quantities documentation most sensitive in impacting project success, with highest score of 89 % and importance index of 32 (see Table 2.1). This was closely followed by design quality documentation, to which 33 consultants ascribed 80 % with relevance index of 26.

This result appears to contradict normal expectation, which adjudges estimate quality as a function of design quality and level of project definition. Design quality documentation paired with construction plan impacting index of 26, while change orders documentation ranked third with importance index of 23 (Table 2.1).

Tables 2.2 and 2.3 shows a general low level of documentation practice quality, going by implementation index scores or ratings of the surveyed public and private sector projects. Only very few projects achieved 50 % documentation implementation score line and in consequence the project success factors (PSFS) were generally below admissible threshold of 86 %. For public projects (Table 2.2) the highest scoring variable was cost estimate documentation with project success factor (index) of 74.2. This was closely followed by change order and design documentations with 65.5 and 64.4. project success indices respectively. Similar

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results were obtained for private projects (Table 2.3) with PSFS of 69.1, 66.7 and 63.7, for cost estimating, change order and design documentations respectively.

Table 2.1: Importance Index (II) of Documentation Quantity Variables

	Documentation Quality Variable (DQVS)	Weighted Rating		
		No of Resp. W	Score % S	Imp. Index WXS
1	Project Brief/Requirements Documentation	32	70	22
2	Project Design	33	80	26
3	Cost Estimating/BOQ Preparation	36	89	32
4	Construction Plan Documentation	35	75	26
5	Implementation Sequence Documentation	33	60	20
6	Budgeting/Cashflow Documentation	31	65	20
7	Earned Value Management Documentation	25	61	15
8	Labour/Plant/Equipment Statements	33	60	20
9	Control/Report System Documentation	25	56	14
10	Project Inspections/Site Meetings/ Minutes Documentation	26	58	15
11	Valuation/Certificates Documentation	30	62	19
12	Change Orders (variations) / Other Instructions Documentation	29	78	23
13	Price Fluctuation Documentation	26	50	13
14	Day Works Claims Documentation	18	50	9
15	Accidents/Force Majure/Weather Change/Dispute Documentation	16	45	7

Source: Field survey 2009/2010

Generally, the private projects show slight documentation practice edge, possibly because of the investment consciousness of private investors vis-à-vis social concern of government/stakeholders in public projects. What these results implicitly communicate is that inadequacies in the project design and costing documentations created high incident of change order / variation instruction practices at projects execution. This issue has remained one of the most

recurring sources of disputes and delays in the studied projects. It is also evident from Table 2.2 and 2.3 and Figure 2.1, that the projects exhibited poor budgeting/cash-flow documentations which resulted in dismal earned value success factors of 20.4 and 20.2 respectively for public and private projects. This is buttressed by the fact that earned value management process is yet to gain the desired popularity in Nigeria construction practice.

The foregoing analysis shows that there is no marked difference in documentation practices exhibited by project actors in the public and private projects, judging from their projects success factors depicted in Figure 2.1. Also the Chi-square comparison test (see Table 2.4) adjudged the observed differences as statistically insignificant.

Conclusion and Recommendations

Overall, the projects performed below the National Industrial Standards' documentation achievement benchmark for construction business of 86%. There is conspicuous failing in monitoring and control of construction activities. This was reflected in unacceptable level of budgeting and virtual absence of earned value system documentation that would anticipate, monitor and report performance failings for prompt corrective actions. In consequence the management of the projects were reactive with increased risks, time and cost overruns, reduced margins and performance quality. This presents great loss of expectations to the stakeholders and the economy at large.

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Table 2.2: Degree of Application of Documentation Quality Variables (DQVS)/Analysis of Project Success factors (PSFS) (Public Projects)

DQVS/Importance Index	Projects Doc. Implementation Index/Rating (%)											
	A	B	C	D	E	F	G	H	I	J	Total (PSFS)	
1	22	11	5	12	14	15	15	10	11	20	19	27.3
2	26	20	15	30	31	20	22	27	32	30	21	64.4
3	32	23	10	35	30	30	15	21	20	26	22	74.2
4	26	15	12	30	24	27	16	20	24	20	21	55.6
5	20	0	5	10	15	15	5	10	14	12	10	19.2
6	20	14	10	12	17	15	10	11	18	15	11	26.6
7	15	05	15	10	11	16	19	10	20	16	14	20.4
8	20	18	35	11	34	15	29	14	33	29	12	46.0
9	14	10	25	12	30	11	26	12	30	31	15	30.3
10	15	20	40	28	38	20	35	15	37	42	20	44.2
11	19	21	39	32	40	22	40	26	29	28	22	56.8
12	23	27	40	20	35	18	37	20	35	29	24	65.5
13	13	28	50	30	35	31	40	28	30	33	28	43.2
14	9	18	41	35	40	21	43	26	39	40	30	29.9
15	7	40	25	27	39	40	42	31	43	41	37	25.5

Source: Field Survey 2009/2010

Key

Public Project Types:

- A Univ. Campus facilities Dev. Project
 - B State Gas turbine power project
 - D Bridge Construction project
 - F Urban water treatment and Reticulation Project
 - H Federal High way
 - I State Road project
- Other Mass housing projects.

The paper recommends for a procurement practice that would ensure thorough assessment and equitable allocation of project risks to all stakeholders. Full project definitions (where possible) by responsible, balanced, experienced professional design team who must partner overtly to achieve project success. And the allocation of accurate time and budgets to all phases of project development. The projects packaging should

involve work operatives at the lowest activity levels to ensure that all relevant costs are identified and included in the cost estimate. This will ensure the documentation of accurate project baselines for effective monitoring and evaluation of achievements at the projects' process phase.

Table 2.3: Degree of Application of Doc. Quality Variable (DQVs) / Analysis of Project Success factors (PSFS) (Private projects)

DQVS/Importance Index	Projects Doc. Implementation Index/Rating (%)										Total PSFS	
	A	B	C	D	E	F	G	H	I	J		
1	22	15	9	10	16	14	20	11	18	21	10	31.6
2	26	22	31	17	21	45	40	9	20	19	21	63.7
3	32	17	13	40	50	10	20	14	30	12	10	69.1
4	26	20	28	14	22	31	34	10	14	31	11	43.0
5	20	28	22	9	20	12	38	14	30	32	14	43.0
6	20	10	16	20	8	27	11	12	14	20	10	29.6
7	15	11	14	7	13	20	12	13	15	19	11	20.2
8	20	22	31	18	39	10	40	10	35	32	14	50.2
9	14	14	21	15	40	8	18	16	34	21	12	27.8
10	15	18	45	33	34	31	29	20	31	38	27	42.8
11	19	26	30	48	46	18	45	19	24	24	17	56.4
12	23	18	25	42	48	18	31	15	21	34	38	66.7
13	13	30	41	35	28	47	20	35	27	30	32	42.2
14	9	20	29	47	36	32	58	20	47	42	30	32.4
15	7	34	42	30	54	35	51	25	50	45	31	27.7

Source: Field Survey 2009/2010

Key

Private Project Types:

- A Private Univ. Campus Project
- B Private Gas turbine plan project
- D Massive Box Culvert Projects
- F Water Intake Works for Industrial Plant Project
- H Private Estate Road Project
- I Factory arterial Road project
- Other Private Complex Housing projects.

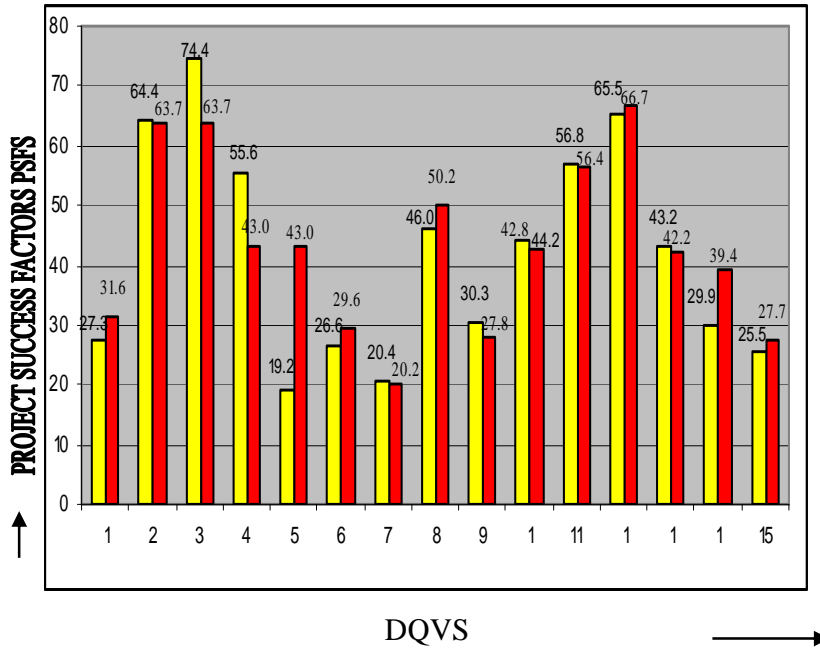


Figure 2.1: Bar Chart of Project Success Factors for Public/Private Projects.

Source: Authors’ Documentation, Quality Surveys 2009/2010

Key: ■ PSF public projects; ■ PSF private projects.

The goal should be to aim at digitizing the entire spectrum of the construction process of; planning, design, costing, construction and management. This will facilitate the speedy generation and management of quality data-bases at all phases for effective monitoring and control of capital projects. Full application of ICT has become imperative for Nigeria to achieve the desired quality of documentation of her construction business.

Table 2.4: Chi-square comparison Test of Significant Difference in Documentation Practice in public/private projects

Fo	Fe	Fo-Fe	$(Fo - Fe)^2$	$\frac{(Fo - Fe)^2}{Fe}$
74	72.20	1.80	3.24	.044
66	67.15	- 1.15	1.32	.019
64	64.63	- 0.63	0.39	.006
69	70.79	- 1.79	3.20	.045
67	65.84	1.16	1.35	.020
64	63.36	0.64	0.41	.006

Source: Documentation Quality Survey 2009/2010

X^2 cal = 0.545 < X^2 .05 crit 5.99, Accept Null Hypothesis

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AN EFFICACY APPRAISAL OF COMMUNICATION STRATEGIES FOR MALARIA ERADICATION AMONG ANTENATAL WOMEN IN ENUGU METROPOLIS, NIGERIA

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Abstract

An evaluation of the effectiveness of communication strategies for eradicating malaria among antenatal women in Enugu metropolis, Nigeria was undertaken. Using the survey method, a sample of antenatal women in Enugu metropolis was studied. Results showed the media messages on malaria eradication were not only clearly understood by a segment of the target audience, antenatal women, but also addressed the critical questions on their minds. The messages were also educative, informative and illuminative to the target audience.

The messages employ the participatory method. Nonetheless, the messages do not produce behaviour change in the audience, nor do they prompt the audience to take the recommended actions. This paradox was attributed to poverty, which is not only linked to endemic malaria challenge, but also influenced audience response to campaigns. The study recommended increased exposure time to improve bombardment, more participatory and integrated communication rather than awareness and increased knowledge, and policy to compel women and children to sleep under insecticide-treated bed-nets.

Introduction

In Africa and other less developed parts of the world, over a million people, mostly children and women, still die of malaria each year. The global drive and investment to combat malaria include the Millennium Development Goals (MDGs) No. 5, which seeks to eradicate malaria by 2015. There is also the Roll Back Malaria Programme.

Malaria is poverty-related diseases (PRDs) in Nigeria and other less developed countries (LDCs) of Africa. Kinoti (1994: 19) remarked that:

Poverty means disease, disease means pain, inability to work and death. Africa's economy has been plagued by malaria and other numerous diseases. Most important

are infectious diseases, which are both curable and preventable, but have greatly depleted the continent. Malaria has caused untold suffering in Africa and claims something like a million African lives a year. It was once an important disease in the warmer parts of Europe and USA, but improvement in living conditions led to its disappearance.

According to the National Malaria Control Programme (NMCP, 2005), malaria constitutes a serious health challenge in Nigeria. It is responsible for 60% outpatient visit to health facilities, 30% childhood deaths, 25% of death in children and under one year, and 11% of maternal deaths (4,500 die annually). A Nigerian child is sick of malaria between 2 and 4 times in one year. About 70 % of pregnant women suffer from malaria. This contributes to cases of maternal anaemia, low birth weight, still birth, abortion and other pregnancy-related complications. The financial loss due to malaria annually is estimated at about =N=132 billion in treatment and prevention costs, loss of man-hours, among others. In 2005 a comparison of malaria with other common causes of morbidity per 10,000 cases showed that malaria alone accounted for 1,858 cases, while diarrhoea, pneumonia and measles together accounted for 1,245 cases. This underscores the need for concerted efforts by all stakeholders towards its eradication.

Sleeping under insecticide-treated bednets (ITNs) can greatly reduce deaths from malaria, especially among children and women (WHO, 2009). Yet, a reasonable number of people in Enugu have not adopted this preventive strategy of malarial reduction. This calls for effective communication strategies to drive behavior change among the target. Eneh (2009) emphasized the need for sensitization of African countries on the challenges in making health projects work. It requires effective communication strategies to reach the target audience and stakeholders. In line with this, Partnership for Transforming Health System (PATHS) designed the a model programme communication package for malaria eradication in Enugu State (Egbo, 2010).

This study was aimed at appraising the effectiveness of the communication strategies for eradicating malaria among antenatal women in Enugu metropolis. This will help in developing newer and sharper strategies that will enhance Africa's chances of meeting the health targets.

Theoretical framework

The Top-to-Bottom Approach

Nwosu (2008) conduit metaphor, "top-to-bottom" or the "hypodermic needle" approaches are the oldest communication models. They have long given way to prevalent audience interest and circumstances. According to Egbo (2010), the new communication pattern should be a departure from the usual information or enlightenment approaches to more democratic,

participatory, bottom-to-top approach. And, participatory communication is now advocated for integration into all stages of a development project/programme.

The Agenda Setting Theory

This theory describes the powerful influence of the media and its ability to state and define what issues are important in society for the masses. McCombs and Shaw (1970) observed that “the mass media force attention on certain issues. “The mass media controls what the society should think about, know about and have feelings about. An issue is important as long as it is continuously reported in the media, and ceases to be relevant the moment media attention is removed. Audiences not only learn about public issues and other matters through the media, they also learn how much importance to attach to an issue or topic through the media. The potential of the topic to affect many or few in the audience is called “issue threshold” and has a bearing on “agenda building” for people. Today, issues that constitute public matters are driven by the content of the media message. It is what the media houses choose to emphasize that becomes the topic of discussion everywhere. Hence a successful campaign on malaria eradication will depend on a sustained exposure to the media.

The Two-step Flow and the Multi-Step Flow

Okenwa (2002) wrote on the powerful “Effect Model”, also referred to as “Power theory”, which emphasize and reflects the strength of the media and the people’s perception of the strength of the media. The earliest thinking on media effects were products largely from the prevailing theoretical development in the field of sociology and

psychology. From the sociological perspectives, which emerged toward the end of the 19th century and the beginning of the 20th century, the society is perceived as highly individualistic or atomized with social ties among individuals almost completely absent. The individual members of the society were left vulnerable to powerful influences from without and had little or no tie with others in the society. There were, therefore, no mediating influences in his social system. It was the later recognition of these mediating influences that led to the modification of the all powerful media theory.

Uses and Gratification Theory

The gratification theory was developed in the 1940s, when researchers became interested in the way people engaged in various forms of media behaviours. It is a theory that is audience-centered, asking what people do with the media. It states that audience derives level of satisfaction/reward from using the media. As Lazarsfeld and Stanton (1949) noted, several typologies of mass media motives and functions have been formulated to conceptualize the seeking of gratifications as a variable that intervenes before media effects. Recent studies have revealed that a variety of audience gratifications are related to a wide range of media effects. The uses and gratification theory reveals that people seek out and use the media to gain several gratifications. Differences exist in the way individuals and group reacts to media messages.

Methodology

Study area

Enugu State was created on 27th August, 1991, with the capital city as Enugu. It belongs to the Southeast geo-political zone of Nigeria – one of the 6 zones in the country. The various campaigns on malaria eradication in the State have not resulted in expected behaviour change. Enugu metropolis was chosen for the study because of the cosmopolitan status, which harboured most of the media outfits in the State.

Instrument for data collection

Structured questionnaire was designed on a five-point Likert scale (strongly disagree 1, disagree 2, don't know 3, agree 4, strongly agree 5) and 200 copies administered to women that came for antenatal care at ESUT Teaching Hospital, Park Lane, Enug. The study captured the communication component of current malaria eradication strategies in Enugu State. Preliminary survey was carried out to ascertain the suitability of the instrument before it finalising.

Data analysis

Data obtained were arranged in percentages and frequency tables. Analysis of the data employed the calculated value (CV) and decision value (DV) technique. The DV is the neutrality point (3), while the formulae for CV is (Osuala, 2007):

$$C.V. = \frac{\sum Fx}{\sum F}$$

Where F is frequency
x is scale-point

A comparison of CV with DV showed if respondent set of opinions fell on the affirmative or negative side, thereby assisting to also test the hypotheses. Calculated values that are greater than the decision values confirmed affirmative answers, while those that fell below confirmed negative answers. CV greater than DV leads to rejection of null hypothesis, while CV less than DV meant that null hypothesis should be accepted.

Results and Discussion

Demographic data showed that 80 respondents or 40% were aged 20-30, while 120 of them or 60% were aged 31-40. There was no teenage pregnancy or child marriage. All respondents were married – no divorcee, single parent or widow. Therefore, vulnerability among them was minimal.

Twenty respondents or 10% had First School Leaving Certificate or FSLC, another 20 of them or 10% had West African School Certificate or WAEC, 80 of them or 40% had Ordinary National Diploma or OND or Nigerian Certificate in Education or NCE, and the rest 60 or 30% had Bachelor degree or Higher National Diploma. Therefore, respondents were educated enough to face the experience of pregnancy and child bearing.

Forty respondents or 20% were students, 20 of them or 10% were traders, and the rest 140 or 70% were civil servants. These were common occupations for female adults in Southeast Nigeria. The respondents hailed from all parts of Enugu metropolis: Coal camp, Iva Valley, GRA, Ogui, Asata, Maryland, New Haven, Independence Layout, Garki, Awkunanaw, Achara Layout, Abakpa-Nike, Thinkers' Corner Layout, and Emene.

However, they were not evenly distributed among these parts of the metropolis.

Respondents understand current media messages on malaria eradication, which also addresses the critical questions on their minds. The media messages on malaria provide education and the needed illumination to the target audience on the malaria eradication campaign. Also, the media messages on malaria employ the participatory method. The media messages do not produce behaviour change in the audience. The media messages on malaria eradication do not prompt the audience to take the recommended actions. To tackle this irony, more exposure time may be necessary for heavier bombardment. Also, participatory and integrated communication, rather than awareness and increased knowledge, may prove effective in bringing about behavior change.

Test of Hypotheses

A number of null hypotheses that guided the study were tested, as follows:

H₀₁: Media messages on malaria eradication are not clearly understood by the target audience.

Question 1 addressed this issue. The CV was 4.4, which $> DV$ or 3, hence, the null hypothesis is rejected, and the alternative hypothesis accepted as 'Media messages on malaria eradication are clearly understood by the target audience.'

H₀₂: The media messages address the critical questions on the mind of the target audience. Therefore, the null hypothesis is rejected.

Question 2 on the questionnaire addressed this thrust. The CV of 3.1 > 3 , showing that the answer was in the affirmative. Therefore, the null hypothesis was rejected in favour of the acceptance of the alternative

hypothesis, i.e. 'The media messages address the critical questions on the mind of the target audience.'

H₀₃: The media message on malaria eradication are not participatory in approach.

Question 3 addressed the matter. The CV was 3.1, which was > 3 , hence, the null hypothesis was rejected. The alternative hypothesis was accepted as 'The media message on malaria eradication are participatory in approach.'

H₀₄: The media messages on malria eradication do not provide education and illumination.

Question 4 of the questionnaire addressed this factor. The CV was 3.2, which is higher than DV of 3.0. Therefore, the null hypothesis was rejected. The accepted alternative hypothesis was 'The media messages on malria eradication do not provide education and illumination.'

H₀₅: The media messages do not produce behaviour change in the audience.

Question 5 addressed this matter. The CV was 2.8, which is lower than DV of 3.0. Therefore, the null hypothesis was accepted.

H₀₆: The media messages on malaria eradication do not prompt the audience to take the recommended actions.

Question 6 addressed this issue. The CV 2.7, which is lower than 3.0 - the DV. Hence, the null hypothesis accepted.

Conclusion

This survey study found that the media messages on malaria eradication were not only clearly understood by a segment of the target audience, antenatal women, but also addressed the critical questions on their minds. The messages are also educative, informative and illuminative to the target audience on the malaria eradication. Also, the media messages on malaria employ the participatory method. Yet, the media messages do not produce behaviour change in the audience, nor do they prompt the audience to take the recommended actions. This paradox may be explained by biting poverty, which appears to determine audience response to campaigns.

Recommendations

Since, the media messages on malaria eradication is right, but do not produce behaviour change in the audience, nor prompt the audience to take the recommended actions, it is ineffective. To combat this paradox, more exposure time may be tried to produce heavy bombardment effects. Participation and integrated communication, rather than awareness and increased knowledge, might prove effective in behavior change. There should be increased interactive programmes in communicating target audience of various health programmes, as this will enhance their success chances and sustainability. Policy may be made to compel pregnant women to sleep under insecticide treated nets each night.

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ECONOMIC EVALUATION PRINCIPLES FOR SUSTAINABLE MANAGEMENT OF ENVIRONMENTAL PROJECTS

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Abstract

This paper x-rays the basic economic principles employed in evaluating environmental projects. It viewed economic evaluation as a crucial component of capital budgeting used for allocating the financial resources of private and public organizations of a nation in order to achieve sustainable development. It opined that projects development/management strategies must embody full dose of green/sustainability strategies whose private/social costs and benefits cashflows are estimated, strategically projected and discounted to enable projects with highest net social benefits to be implemented. It identifies CBA as a versatile evaluation technique suited for public and major private projects and recommended the bridging of private and social rates of return to serve as a catalyst for private-sector-led social and economic development activities that would ensure sustainability of development.

Introduction

The proper budgeting of available resources of a nation is crucial to its socio-economic and political existence. Economic evaluation is the key element of capital budgeting, which is a process of allocating the financial resources of private and public organizations in a nation in the manner that best achieves the nation's overall goal of sustainable development (Ajator, 1994).

The need for capital budgeting arises when an organization (private or public) has to select the best potentially profitable (social, economic, environmental) investment project strategies from a range of available project strategies for a given set of budget constraints. The selection of the optimal combination of projects from a set of available options and budgeting the available capital is thus critical (Ajator, 1999, 1996).

Misjudged ventures can significantly impair the profitability/sustainability of the organizations and the society development programmes, and the credibility of the agencies in charge of the programmes. The basic approach is to evaluate and rank the projects using any acceptable appraisal techniques and select the best-ranking projects that fit into the capital budget (Ajator, 1996).

Evaluation goes beyond the investment capital, and private costs and benefits of proposed projects to include all externalities, the social costs and benefits to the society at large throughout the project life cycle. The cycle begins with the initial conception of the project and continues through planning, design, procurement, construction start-up, operation and maintenance to final demise/disposal of the facility. For sustainability of the environmental projects the basic

procedural considerations would include the following (Hill and Bowen, 1996; Ajator and Onyeador, 2007):

- Undertake prior assessments of proposed activities;
- Involve people potentially affected by proposed activities in decision-making process in a timely way;
- Promote interdisciplinary collaborations and multi-stakeholders partnerships;
- Recognize the necessity of comparing alternative, courses of action;
- Utilize a lifecycle framework;
- Utilize a system approach (optimality concept);
- Exercise prudence;
- Comply with relevant legislation and regulations;
- Establish a voluntary commitment to continued improvement of performance;
- Manage activities through the setting of targets, monitoring evaluation, feedback and self-regulation of progress;
- Identify synergies between the environment and development;

With these sustainability factors built into the projects proposal, the selection of a balanced set of projects that would meet the goals, resources and constraints of the private/public organizations would follow.

Methods of economic evaluation of facilities

Various criteria for cash flow analysis exist to evaluate the viability of projects and capital expense proposals. The three formulae commonly used by medium to large-sized private/public companies are (Ajator, 1996; Al-Tabtabai and

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Alex, 1998; Hendrickson, 2003; Henshaw, 2006) net present value (NPV) and its affiliate models: profitability index (PI) and discounted payback (DPB); internal rate of return (IRR); and Cost-Benefit-Analysis (CBA).

Economic evaluation of facilities refers to the evaluation of the economic/operating cash flows representing the benefits and costs associated with the acquisition and operation of the facility over the planning horizon. We must distinguish between economic evaluation of alternative physical facilities and the evaluation of alternative financing plans for a project, which refers to the evaluation of the cash-flows, representing the incomes and expenditures arising from adopting a specific financing plan for funding the project. In general, economic evaluation and financial evaluation are carried out by different groups in an organization since economic evaluation is related to design, construction, operations and maintenance of the facility while financial evaluations require knowledge of financial assets such as equities, bonds, notes and mortgages available for financing the facilities. Both economic and financial evaluation should be integrated because wrong choice of financing option might affect the profitability and sustainability of the environmental projects.

Basic Steps in Economic Evaluation

A systematic approach for economic evaluation of facilities consist of the following major steps:

- Generate a set of projects or purchases for investment consideration;
- Establish the planning horizon for economic analysis;
- Estimate the cash flow profile for each project;
- Specify the minimum rediscount rate (cost of capital);

- Establish the criterion for accepting or rejecting a proposal, or for selecting the best among a group of mutually exclusive proposals, on the basis of the objective of the investment;
- Perform sensitivity or uncertainty analysis;
- Accept or reject a proposal on the basis of the established criterion.

Often many assumptions and policies, some implicit and some explicit, are introduced in economic evaluation by the decision maker. The decision making process will be influenced by the subjective judgement of the management as much as by the result of systematic analysis.

Cost of capital (interest rate)

The interest rate or cost of capital for appraising projects specified by top management in a private firm reflects the opportunity cost of capital of the firm, the market interest rates for lending and borrowing and the risks associated with investment opportunities. For public projects, the interest rate is specified by a government agency, such as the office of management and budget, the Central Bank and the National Assembly. The public cost of capital (interest rate) specified, reflects social and economic welfare considerations and is referred to as the social rate of discount (SROD).

The SROD is generally lower than the interest rate set by private firms as it is often regarded as a risk-free rate. The cost of capital for economic evaluation of investment proposals is critically important in determining whether any investment proposal is worthwhile. Hence lowering the SROD for public projects while maintaining higher cost of capital for private projects creates the risk of approving more public projects, which have lower social benefits than private

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sector projects, which is forced to use the higher commercial discount rate on its future revenue stream. The implication is that more and less beneficial public projects than government budget can handle are approved with high risk of abandonment, while rejecting viable private projects. This might go against the rational policy of catalyzing national development through private sector-driven social/economic development activities.

Costs and benefits of a constructed facility

The basic principle in assessing the economic costs and benefits of new facility investments is to find the aggregate individual changes in welfare of all parties affected by the proposed projects (Hendrickson, 2003). The changes in welfare are generally measured in monetary terms, but there are exceptions, since some effects cannot be measured directly by cash receipts and disbursements. Examples include the value of human lives saved through safety improvements or the cost of environmental degradation. The difficulties in estimating future costs and benefits lie not only in uncertainties and reliability of measurement but also on the estimation of social costs and benefits generated as side effects. Furthermore, proceeds and expenditures related to financial transactions, such as interest and subsidies, must also be considered by private firms and by public agencies.

To obtain an accurate estimate of costs in the cash-flow profile for the acquisition and, operation of a project (Hendrickson, 2003; Chandra, 2002; Patel, 2000), it is necessary to specify the resources required to construct and operate the proposed physical facility, given the available technology and operating policy. Typically, each of the labour and material resources required by the facility is multiplied by its price, and the products are then summed to obtain the total

costs. Private corporations generally ignore external social costs unless required by law to do so. In the public sector, externalities often must be properly accounted for. An example is the cost of property damage caused by air pollution from a new plant. In any case, the measurement of external costs is extremely difficult and somewhat subjective for lack of a market mechanism to provide even approximate answers to the appropriate value.

In the private sector, the benefits derived from a facility investment are often measured by the revenues generated from the operation of the facility. Revenues are estimated by the total of price times quantity sold. The investment cost/depreciation, investment credit allowances, interest and taxes on revenues must be deducted according to the prevailing tax laws. In the public sector, income may also accrue to a public agency from the operation of the facility. However, several other categories of benefits may also be included in the evaluation of public projects. First, private benefits can be received by users of a facility or service in excess of costs such as user charges or price charged. After all, individuals only use a service or facility if their private benefit exceeds their cost. These private benefits or consumer surplus represent a direct benefit to members of the public. In many public projects, it is difficult, impossible or impractical to charge for services provided, so direct revenues equal zero and all users' benefits appear as consumers' surplus. Examples are a park or roadways for which entrance is free. As a second special category of public benefit, there may be external or secondary beneficiaries of public projects, such as new jobs created and profits to private suppliers. Estimating these secondary benefits is extremely difficult. It demands caution since resources devoted to public projects might simply be

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displaced from private employment and thus represent no net benefit.

Investment evaluation criterion

Basic characteristics of sound investment evaluation criterion are:

- ❖ It should consider all cash-flow to determine the true profitability of the project
- ❖ It should provide for an objective and unambiguous way of separating good investment projects from bad ones
- ❖ It should help in ranking the projects according to their true profitability.
- ❖ It should recognize the fact that bigger cash-flows are preferable to smaller ones and early cash-flows are preferable to later ones.
- ❖ It should help to choose among mutually exclusive projects, the project which maximizes the shareholders' wealth.
- ❖ It should be a criterion, which is applicable to any conceivable investment project independent of others.

Net present value method: The objective of facility investment in the private sector is generally understood to be profit maximization within a specific time frame. Similarly, the objective in the public sector is the maximization of net social benefit, which is analogous to profit maximization in private organizations. Given this objective a method of economic analysis will be judged by reliability and ease with which a correct conclusion may be reached in project selection. The NPV method discounts back the net inflows over the life of the investment to determine whether they equal

or exceed the investment outlay. The project is accepted if the NPV is greater than zero and profitability index (PI) is greater than 1.

The basic principle underlying the decision for accepting and selecting investment projects is that if an organization can lend or borrow as much money as it wishes at given cost of capital, the goal of profit maximization is best served by accepting all independent projects whose NPVs at the cost of capital are nonnegative, or by selecting the project with maximum nonnegative NPV among a set of mutually exclusive proposals. The NPV makes the conservative assumption that over the years, inflows can be reinvested at the original cost of capital or discount rate. This reinvestment assumption of NPV method allows for consistency (Al-Tabtabai et al, 1998). Inflows from each proposal are assumed to have the same investment opportunity, and it is for this reason that NPV is generally the preferred method (Prall, 1990). The following steps are involved in the calculation of NPV:

- ❖ Cash flows of the investment project should be forecasted based on realistic assumptions.
- ❖ Appropriate discount rate should be applied to discount the forecasted cash flows. The appropriate discount rate is project's opportunity cost of capital which is equal to the required rate of return expected by investors on investments of equivalent risk
- ❖ Present value is calculated as the aggregate of the discounted net cash inflows.
- ❖ The net present value (NPV) is then the difference between present value of discounted inflow (benefits) and present value of discounted outflows (costs)

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$$NPV = \sum_{t=0}^n B_t - C_t (1 + r)^{-t} > 0$$

where B is benefit and C is cost and t is time.

The project is accepted if NPV is positive (NPV>0) and rejected if NPV is negative (NPV<0). Where the NPV of a project is positive, it means that by undertaking that project the organization immediately increases its present wealth by the value of the NPV and the rate of return on the project exceeds the cost of capital. The proceeds of the project will yield sufficient funds to repay the initial capital sum plus any additional borrowing to the value of the NPV.

The Internal Rate of Return (IRR): The internal rate of return (IRR) method calculates the interest rate(s) at which the net cash inflows of an investment can be discounted to equal the discounted outflows or capital cost of the project. It is the rate, when used in discounting that makes the NPV equal to zero (NPV = 0). It is obtained through trial and error and use of interpolation model. Like the NPV, it takes into account the magnitude and timing of cash flows. In contrast to the NPV method the IRR method assumes that all inflows can be reinvested at the marginal yield from a given investment. For proposals with a very high IRR, it may be unrealistic to assume that reinvestment will occur at these high rates. Besides the IRR method is rigorous to calculate and may give multiple rate if some cash flows of the project are negative. The decision rule is to accept the project if the IRR is greater than the cost of capital. And, for mutually exclusive projects, to select one with the highest IRR.

IRR Interpolation Model:

$$\text{IRR} = \frac{R_1\% + \frac{\text{NPV}_{R_1}}{\text{NPV}_{R_1} + \text{NPV}_{R_2}} (R_2 - R_1)\%}{1}$$

where

R_1 = interest rate at which NPV is + Ve

R_2 = interest rate at which NPV is immediately negative.

Cost-Benefit-Analysis (CBA): CBA is essentially an investment appraisal technique, which takes into account not merely the private costs and benefits of an investment project but also the social costs and benefits. CBA is a technique used in either investment appraisal or the review of the operation of a service for analyzing and measuring the cost/benefit to the community of adopting special courses of action and for examining the incidence of these costs and benefits between different sections of the community.

Brown & Howard (1982) defined CBA as an analytical tool in decision making which enables a systematic comparison to be made between the estimated cost of undertaking a project and the estimated value/benefit which may arise from the operation of such a project. CBA is used widely in the areas of public finance and in private sector when large projects are being considered. CBA has the basic objective of identifying and measuring the costs and benefits, which stem from either the investment of monies or the operation of service.

It is concerned with not only examining those costs and benefit which have a direct impact on the providing authority, but also those which are of an external nature and accrue to other persons. Also, the cost and benefits to be measured are those, which accrue throughout the life of the

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project. Hence, CBA provides the decision maker with useful guidelines to enable him make decisions based on rigorous appraisal of all the factors involved in the undertaking of a project. He is made aware of the probable range of costs and benefits, which would be experienced to help him consider the complete scenario before making his decision.

Nationally, CBA can be used in allocating scarce resources between such public services as education, environment and health, but its effective use is marred by high level of politics attending such crucial decision of allocation of public resources. CBA is not a new technique, as earlier writers including Foster & Beesley (1963) had indicated. The popularity of use of CBA in decision making originate from its application in U.K. in the study for a third London Airport and Victoria underground line of London transport in the 1960s. And in USA the Tennessee Valley Scheme for the provision of water, Cole (1976 in Brown and Howard, 1982).

The rationalization of the application of CBA to public expenditure derives from its use by welfare states to provide free services in the areas of medical care, school, environmental control, etc. This was to ensure equal opportunities for all regardless of income level, with clear disinclination to apply commercial techniques in investment appraisal. Its narrow application rendered it difficult to evaluate the efficiency of resource allocation in these areas. CBA aims at setting out the factors, which need to be taken into account in making economic choices. Most of the choices to which it has been applied involve investment projects and decisions whether or not a particular project is viable financially, which is the best of several alternative projects, or even when to undertake a particular project. The aim is generally to maximize the present values of all benefits less that of all costs, subject to specified constraints.

CBA incorporates a number of techniques. It draws on the concepts of capital budgeting such as investment criteria, forecasting and risk/ uncertainty. In addition it involves wider issues such as environmental problems, opportunity costs and transfer prices with considerable amount of inputs being subjective. Notwithstanding the subjective nature of data/decisions involved, careful preparation and analysis of such data as an aid to decision-making is superior to decisions made on a “hunch” or intuition. CBA attempts to consider all the consequences, which may arise from undertaking a project. For example a company may be considering the building of a new plant, which, because of its manufacturing process will discharge a considerable amount of effluent into a local river. The normal capital budgeting techniques may show that it will be profitable for the company to operate the plant, but CBA examines all consequences including of course, the effects the effluent discharge may have on the health of the population, on the fishing, swimming, local/scenic beauty, etc. This type of environmental problem is regarded as a social cost and should be an important item in considering a major project. CBA is therefore a precursor to the current Environmental Impact Assessment EIA, that has received wide acclaim as an important tool for sustainability of projects.

Principal Criteria to be Determined: The principal issues to be determined are:

- Which costs and benefits are to be included?
- How are they to be valued?
- At what interest rate are they to be discounted?
- What are the relevant constraints?

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Methodology to be Used in Cost Benefit Study: The suitable steps to be used in a cost benefit study are:

- ✓ Define the problems to be studied
- ✓ Identify the alternative courses of action
- ✓ Identify the costs and benefits both to the investor and the external parties
- ✓ Evaluate the costs and benefits and
- ✓ Draw conclusions as to the alternative to be adopted.

Differences Between Costs-Benefits-Analysis and Conventional Investment Appraisal Techniques

The following have been identified as some differences between CBA and conventional investment appraisal techniques:

- CBA include not merely private costs and benefits, but also social costs and benefits in the calculation of annual cash flow of a project.
- The valuation of these costs and benefits is also significantly different. Conventional techniques use, market value, while CBA often use shadow prices.
- The discount rate used to discount these costs and benefits may also be different. Conventional techniques use the cost of capital, while CBA generally uses some sort of social discount rate.

Valuation of Social Costs and Benefits

The problems of forecasting future costs and benefits especially of long-term projects are considerable even with the existence of refined mathematical techniques and computer applications. In CBA the problem is compounded by the need to estimate social costs and benefits, which have no market

price. These costs must be quantified no matter how subjective or relative. For example in road projects, estimates of time/costs saved through decongested traffic and reduced exhaust gas emissions, speedy evacuation of farm product and thriving, small businesses and enhanced property values incident on the road project are measured. Where this is not possible social costs may be ranked in order of preference or indexed to show the category of desirability as a guide to the decision maker.

Alternatively contingency method may be used whereby monetary benefits are subtracted from monetary costs and the decision maker then decides whether the value of the intangibles is worth the difference. In forecasting, three point probabilities estimates of costs and benefits to show the possible worst, most probable and possible best estimates are preferable as they present the probability of cost and revenue being within acceptable limits.

These estimates of project investment cost, life span, running costs, possible scrap values, cost of capital, capital allowances etc provide guide costs (Benchmarks) on which sensitivity or simulation of the impact of changes in these standard costs will have on the overall profitability/sustainability of the environmental project. For example, the effect on project if revenue were increased by say 30% or if the asset life were reduced by 20%. This helps to highlight the assumptions, which are considered to be critical to the project.

This synthesized and projected costs and benefits can then be presented in a simple tabular model of social NPV analysis. The social NPV analysis 1996 – 2000 of oil production projection in Nigeria is illustrated in Table 4.1.

Table 4.1: Oil production projection in Nigeria - Social NPV analysis (1996-2000)

Year	Social disc. Rate 10%	Social costs (\$b)	Discounted social costs (\$b)	Social benefits (\$ b)	Discounted social benefits (\$ b)
1996	1	10576	10576	11199	11199
1997	.92	10327	9500	11448	10532
1998	.85	10078	8566	11572	9836
1999	.79	9829	7764	11821	9338
2000	.73	9581	6994	12443	9083
			\$43,400b		\$49,988b

Sources: Oil Production and Shadow Price Survey, 1996; Nwankwo and Ifeadi (1992)

Social NPV = \$ (49988 – 43400) b = \$6.588 billion

Conclusion and Recommendation

For sustainability of environmental project management strategies, full range of sustainability factors have to be inbuilt into environmental project planning, development, financing, evaluation and control. The environmental impact mitigating options for major capital private/public projects have to be evaluated using CBA with its multiple evaluation technique derived from capital budgeting such as investment criteria, forecasting, risk and uncertainty simulation and environmental factoring. Appropriate bridging of private cost of capital and the social rate of discount is to be considered, to create impetus for a private – sector – led social and economic activities that will ensure sustainability of national development.

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ROAD TRAFFIC ACCIDENTS IN WARRI AND ENVIRONS: A TREND ANALYSIS

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Abstract

Road traffic accidents (RTAs) rank 9th as the leading cause of death globally. Nigeria is among the worst cases. This study examined road traffic accidents in Warri and environs from 1990-2009. The data generated were analysed using time-series and one-way analysis of variance (ANOVA). Findings showed that the road traffic accident cases totalled 3,475 within the period of study, had a fluctuating pattern and increased in 2009. There was an upward trend in the study area as evidenced by a calculated value of 3.728, which is greater than the critical table value of 1.734 at $p < 0.05$. The model forecasted a 66.68 % increase by 2015, if the current trend is unabated. With a calculated F value of 13, which is greater than the critical table value of 3.16 at $p < 0.05$, there was spatial variability in road traffic accident trends in different parts of Warri and environs. Based on the findings recommendations were proffered.

Introduction

With 1.17 million deaths, road traffic accidents (RTAs) have been ranked the 9th leading cause of mortality globally. They account for about 70% of deaths in developing countries, including Nigeria (World Health Organisation, 1998).

Population explosion and increasing motorization are responsible for increasing rate of fatal road traffic accidents worldwide (Atubi, 2008). Increased motorization may be characterised briefly as the “automotive revolution”, that is, the motorizing of urban population, especially in the developing countries.

The reported cases of fatal road traffic accidents (FRTAs) in Nigeria increased from 12,212 cases in 1995 to 13,913 in 1996 and to 15,418 in 2004. This shows an increase of 13.9% from 1995 to 1996 (Central Bank of Nigeria, CBN, 1997). FRTA figures across Nigeria rose sharply in 1992, resulting in 22,992 deaths (CBN, 1994). According to the National Bureau of Statistics (NBS, 2008), between 2003 and 2007, a total of 225,891 RTA cases were reported by the Nigeria Police Force, out of which 29,490 were fatal, 39,065 were serious cases, 23,380 were minor cases.

Dramatic increases in the proportion and absolute number of traffic fatalities have been witnessed in a number of developing countries, while they decreased by more than 20% in industrialised nations (Ross et al, 1991). Over the past 30 years, a fivefold increase in traffic-related fatalities was observed in both Nigeria (Atubi, 2010a, 2009; Oluwasanmi, 1993; Ezenwa, 1986) and Kenya (National Road safety Council of Kenya, 1992). African and Asian countries, with relatively low vehicle densities, are experiencing substantially higher fatality rates per 10,000 vehicles than the industrialised

European and North American States (WHO, 1984; Jacobs and Sayer, 1983).

Traffic crashes also impact on the economy of developing countries at an estimated cost of 1.2% of a country's GNP per annum, as a result of morbidity, mortality and property-related costs (Downing et al, 1991; Jadan, 1989a and 1990; WHO, 1989; Jacobs and Sayer, 1983; Fouracre and Jacobs, 1976). Causes of motor vehicle crashes are multifactorial and involve the interaction of a number of pre-crash factors that include people, vehicles and the road environment (Stansfield et al, 1992; Robertson, 1992; AMA, 1983; Haddon, 1980).

Human error is estimated to account for between 64 % and 95 % of all causes of traffic crashes in developing countries. A high prevalence of old vehicles, overload of persons and luggages, lack of safety belts and helmet use, poor road design and maintenance and the traffic mix on roads are other factors that contribute to the high rate of fatalities in less developed countries (Atubi, 2009). Ajedi (1980) and Atubi (2010b) reported that the poor interconnections of existing Nigerian roads and poor maintenance of these roads were responsible for the chaotic urban transportation, which in turn, leads to accidents and irreparable losses in human lives and physical resources. Other researchers concentrated on other factors of road safety (Golias et al, 1997; Agunloye, 1989; Perrow, 1984).

In Nigeria, the RTA situation over the last three decades has been particularly disturbing. In 1976, there were 53,897 road traffic accidents resulting in 7,717 deaths. Although in 1981, the number reduced to 5,114 accidents, the

fatality increased to 10,236, giving an average of 96 accidents and 28 deaths for every day of that year (Ogunsanya, 1990). The situation in subsequent years has not been any better. The number of people killed in road accidents between 1990 and 2005 rose from 28,253 to 37,873 and the fatality rate remains consistently high (Atubi, 2009).

Study area

Warri is located between latitude 5°30' and 5°35'N and longitude 5°29'E and 5°48'E. Warri is situated within the Niger Delta region of Nigeria. It is bounded to the north by Okpe and Sapele Local Government Areas (LGAs), to the South by Warri South West LGA and the Atlantic ocean, to the east by Ughelli South and to the west by the Warri North LGA (Figure 1). Warri metropolis is made up of Warri south, Udu and Uvwie LGAs.

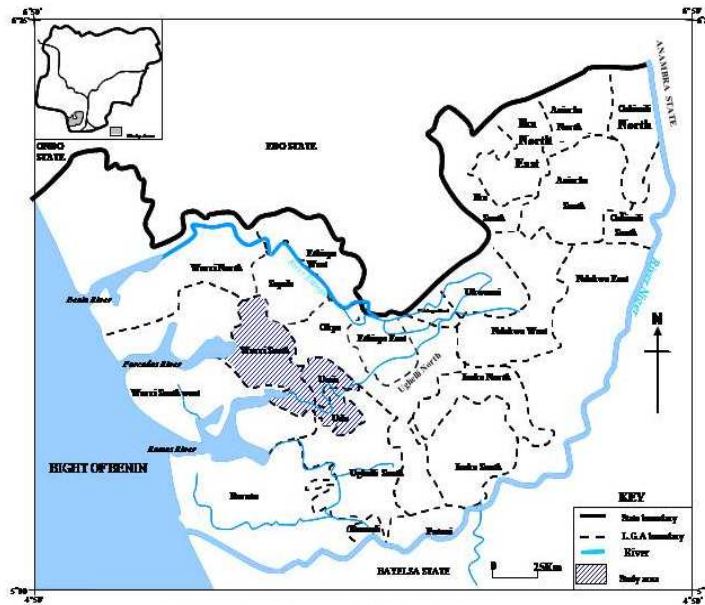


Figure 1: Map of Delta State Showing Study Area

Methodology

The data used in this study were derived from secondary source. The secondary data include records on RTAs in Warri and environs for a period of twenty (20) years (1990-2009) from the Delta State Office of the Federal Road Safety Commission (FRSC) and the Nigeria Police Force, Warri and complemented with information from research reports and articles and national statistical abstracts and newspapers. The data were presented in tables and analysed with the aid of percentages, time-series and one-way ANOVA. Simple descriptive analysis of the distributions and cross tabulation of

variables were carried out. The data on accident cases were analysed with time-series by using auto-regressive integrated moving averages (ARIMA) models. The moving averages were specifically applied in this study because of the basic assumption that trend must be linear or approximately linear (Atubi, 2009; Okeke, 1996; Hammond and McCullagh, 1974).

Results/Findings and Discussion

Table 5.1 shows the distribution of major black spots in Warri and environs. There were a lot of pot holes and a few black spots on almost all the roads in the study area, despite the billions of naira that the government of Delta State has reportedly spent on road repairs and maintenance. This casts a slur on the sincerity of the government on the one part and on the road construction contractors on the other part. This insincerity has contributed in no small measure to the peculiar nature and rate of RTA in Warri and environs.

Table 5.1: *Distribution of major black spots in Warri and environs*

Roads	No. of black spots	Major black spots areas
NPA	1	Before NPA gate
Ajaminmogha	Nil	Nil
Ugboro	Nil	Nil
Okere	1	By Robert road junction
Eboh	Nil	Nil
Deco	1	Before Gbagi's plaza
Enerhen	Nil	Nil
Airport road	1	U-turn by old airport
Ugborikoko	Nil	Nil
Udu	1	Around Udu bridge
Mcdermott	Nil	Nil

Source: Fieldwork, 2010

Table 5.2: Road traffic accident distribution

Zones	Place of occurrence	Daily traffic	Accident cases	% of RTA
Warri	Ogunu road to Okere road	1276	3	4.8
	Okumagba avenue road	1168	7	11.1
	Edjeba road to Apala road	1054	2	3.2
	NPA road	1071	5	7.9
	Makiava road to Warri main market road	1014	9	14.3
Uvwie	Airport road to Enerhen road	1854	13	20.6
	Refinery road	1730	6	9.5
	Ekpan to Jakpa road	1124	3	4.8
	PTI road	1601	8	12.7
Udu	Udu road	1152	5	7.9
	DSC road	1011	2	3.2

Source: Nigeria Police (A and B division) Road Traffic Accident Statistics, Warri (2010)

** adapted from Atubi and Onokala (2005d).

From Table 5.2, daily traffic pass along Uvwie area was 6,307, while the daily traffic pass along Warri and Udu were 5,583 and 2,163 respectively. About 20.6 % of accidents occurred in the Enerhen road axis of Airport road, while 3.2 % of accidents occurred in the Apala road and DSC road axis of Edjeba road. The accident rate in Warri and environs increased correspondingly with the daily volume of traffic within Warri and environs (Figure 3). These findings are in line with the work of Atubi and Onokala (2005), which stated that the increased rate of fatal road traffic accident in Warri and environs had been attributed to population explosion and increased daily traffic.

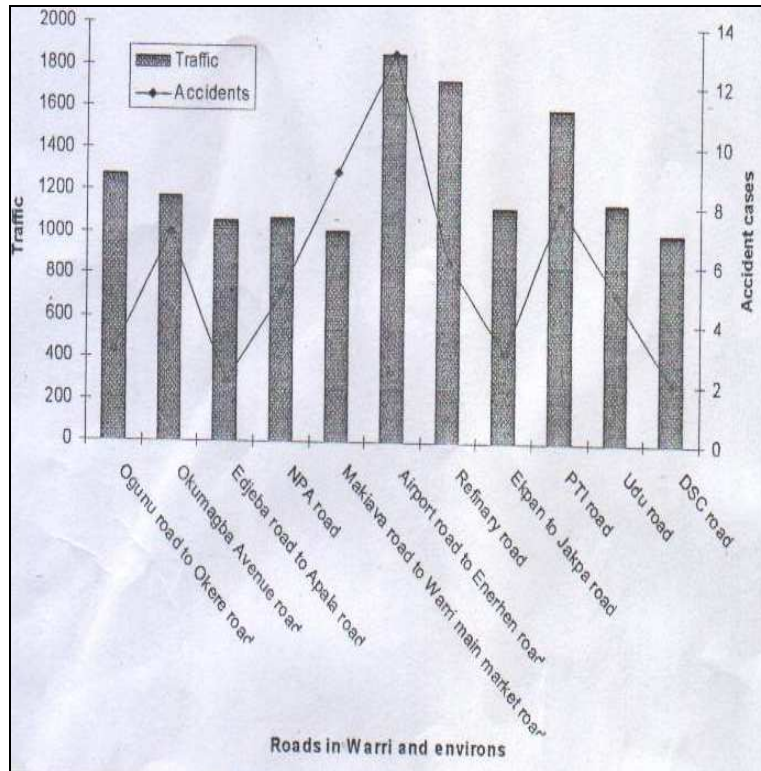


Figure .3: Accident distribution in Warri and environs

Table 5.3: Total number of reported RTA in the study area from 1990-2009

Years	Months												Total
	J	F	M	A	M	J	J	A	S	O	N	D	
1990	9	15	25	39	21	17	21	14	23	22	18	15	239
1991	10	21	11	14	14	21	28	17	13	15	12	27	203
1992	20	15	17	29	10	17	18	9	21	14	15	14	199
1993	16	17	15	17	21	23	15	19	23	25	15	25	231
1994	18	20	22	12	9	13	6	11	48	25	16	18	218
1995	24	21	33	15	0	11	7	7	19	6	9	23	175
1996	40	39	39	31	31	31	22	22	27	18	16	16	332
1997	22	29	33	36	34	25	25	29	36	34	26	30	359
1998	45	29	10	15	16	15	13	4	17	32	8	17	221
1999	12	17	28	21	17	17	14	14	24	23	18	22	227
2000	16	11	12	27	16	25	17	22	21	9	5	14	195
2001	9	10	9	13	10	11	8	14	11	8	15	6	124
2002	9	10	13	10	7	6	10	11	14	14	10	16	130
2003	8	12	7	5	4	6	6	5	5	5	1	7	71
2004	5	3	6	4	6	4	0	5	6	4	1	6	50
2005	6	8	12	7	6	0	15	4	10	21	9	8	106
2006	28	10	6	12	15	8	10	21	5	6	4	17	142
2007	15	7	4	7	9	6	8	5	11	12	13	13	110
2008	10	5	9	0	5	6	4	9	10	6	8	9	81
2009	5	11	4	5	4	8	3	5	5	4	5	4	63
	327	310	315	319	255	270	250	247	349	303	224	307	3476

Source: Nigeria Police Force (A and B Division) Road Traffic Accident Statistics, Warri

Table 5.3 indicates that the actual number of traffic accidents for the period under review was 3,475. The highest number of

road traffic accident cases was in 1997 with a total of 359 cases, while the lowest number of cases, which is 50, was recorded in the year 2004. The year 2000, 2001, 2002, 2003, 2005, 2006, 2007, 2008 and 2009 had annual total RTA cases of 195, 124, 130, 71, 106, 142, 110, 81 and 63, while the years 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1998 and 1999 had annual total of 239, 203, 1999, 231, 218, 175, 332, 221 and 227 RTA cases respectively. These first ten years of the period under review accounted for 2,404 (69.2%) of the traffic accident cases within the period, while the last ten years accounted for 1,071 (30.8%) of the road traffic accident cases during the period.

The monthly traffic accident data of Warri and environs for the period under review is the basic information upon which analysis of trends and patterns were based and the frequency of reported road traffic accidents were also considered (Table 5.4). There were a total of 3,475 reported road traffic accidents within the period with annual mean traffic accident value of 174 cases and a mean monthly RTA value of 15 cases. The deviations of the accident figures from the mean (\bar{x}) are presented in Table 5.4 and Figure 4.

Table 5.4: Deviations of reported cases of RTA figures from the mean

Year	Annual total (x)	Annual mean (x)	Deviation from the means (x-x)
1990	239	174	65
1991	203	174	29
1992	199	174	25
1993	231	174	57
1994	218	174	44
1995	175	174	1
1996	332	174	158
1997	359	174	185
1998	221	174	47
1999	227	174	53
2000	195	174	21
2001	124	174	-50
2002	130	174	-44
2003	71	174	-103
2004	50	174	-124
2005	106	174	-68
2006	142	174	-32
2007	110	174	-64
2008	81	174	-93
2009	63	174	-111

Source: Fieldwork, 2010

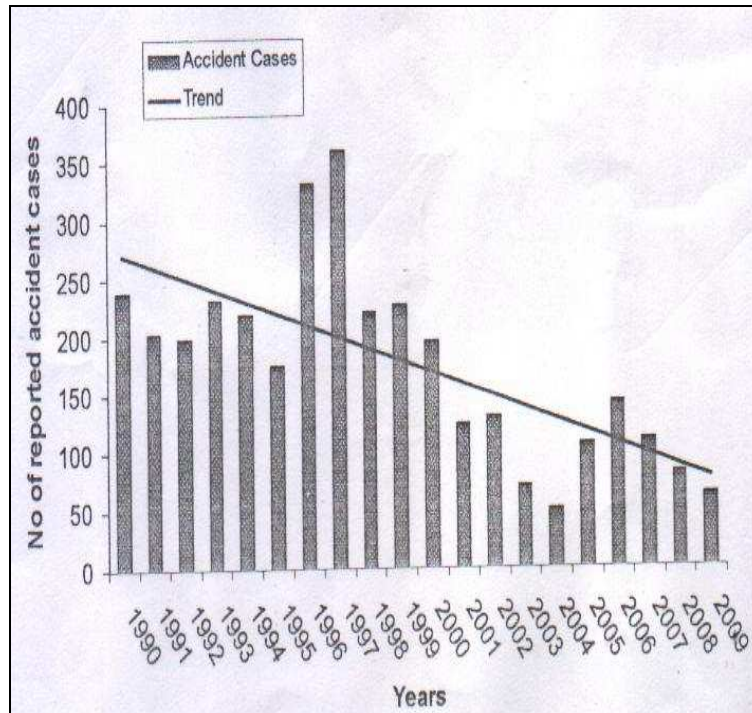


Figure 5.4: Trend in road traffic accidents in Warri and environs from 1999-2009

Road traffic accident cases were more in 1997, during which 359 road traffic accidents cases were reported. Since 1999, when 227 traffic accidents were reported, there was more of intermittent decrease up to 2009, during which only 63 traffic accident cases were reported. From the year 2001, the RTA cases were below the mean (\bar{x}) (less than 174). Figure 5.4 shows a progressive decrease from the mean (\bar{x}) up to the year

2009. This implies that from 1997 there has been an unstable decrease in RTA in Warri and environs. This could have arisen from improvement in road rehabilitation effort of the government, road safety practice of drivers and increased monitoring of speed by Federal Road Safety Corps marshals. When the Third Republic took effect in 1999, the civilian administration embarked on massive road rehabilitation through the agency called Federal Road Maintenance Agency (FERMA). The observed decrease in RTA cases, which were below the mean (\bar{x}) from 2001-2009 may also be attributed to the increased use of information and communication technology (ICT) facilities by the population. The available ICT services, such as e-mail, e-banking and the use of mobile phones had reduced travels on the major roads. RTA rarely occurs when the population travels less frequently.

Table 5.5: Exponential smoothing model parameters

Model	Estimate	SE	t	Sign.
RTA-Model-1 No Alpha (level) transformation	.842	.226	3.728	.001

From Table 5.5, the calculated t (3.728) was greater than the critical table (1.734) at $p < 0.05$. Thus, the model was significant. Therefore, there is an upward trend in road traffic accident in Warri and environs. This result implies that RTA in Warri and environs needs to be checked seriously by all relevant stakeholders, using a holistic approach in order to step down the carnage and eventual loss of lives and properties.

Table 5.6: Forecast

Model	2010	2011	2012	2013	2014	2015
RTA-Model-1 Forecast	66.68	66.68	66.68	66.68	66.68	66.68
UCL	188.99	226.55	256.83	282.91	306.17	327.36
LCL	-55.64	-93.20	-123.48	-149.56	-172.82	-194.01

For each model, forecasts start after the last non-missing in the range of the requested estimated period, and end at the last period for which non-missing values of all the predictors are available or at the end date of the requested forecast period, which ever is earlier. From Table 5.6, the model further forecasted that road traffic accident trend is on the increase and will certainly increase to about 66.68% cases in 2015, if the trend of accident remains unabated. This means that there will be more loss of lives and properties, which will affect the socio-economic status of the study area.

Table 5.7: ANOVA on variability of road traffic accidents

Square of variation	Sum of squares	Df	Mean sum of square	F	P
Between group	27913.8	2	13956.9	13	0.00
Within group	60707.3	57	1065		

From Table 5.7, the calculated F value of 13 is greater than the critical table value of 3.16 at $p < 0.05$. Thus, the model is significant. Therefore, there is a significant variability in the trends of road traffic accidents in the different areas of Warri and environs. The implication of this is that the areas marked in Figure 2 as accident black spots in the study area should be monitored and proactive steps should be taken to reduce drastically the current trend of RTA.

Policy implications and Recommendations

The high RTA rates and high forecasted increase by 2015 by over 66 % in Warri and its environs in Delta State have far-reaching implications on road traffic planning and management sector of the economy, as well as traffic monitoring and road rehabilitation in the country. When similar studies are conducted in other parts of Nigeria, it can form the basis for generating regional or national empirical models based on the peculiar RTA factors identified in the study area. In a similar vein, there will be room for comparative RTA analysis and studies between different states of Nigeria. In this regard, the influence of nature of road and months of the year can be determined for various parts of the country with a view to understanding the variations their individual and collective influences have on RTA occurrence.

Further studies are necessary in Delta State to ascertain the categories of vehicles that are frequently involved in RTA more than the other vehicle types. The development of other modes of transportation, such as the railway, is necessary to reduce pressure and over dependence on the roads. In developed countries, such as U.S.A., UK, France and Canada, road is not the only principal mode available for inter-urban transportation. Railway, inland water way and air ways are equally available at reduced cost. The contrast is the case in developing countries, like Nigeria, Ghana and Liberia, where there is over-dependence on road transport resulting to increased congestion and traffic accident. This measure if adopted will significantly reduce road traffic accident cases not only in Warri and its environs, but also in Nigeria generally.

Conclusion

This study is one of the current attempts at placing transportation safety in the realm of burning national issues. This is to enable transportation geographers make more definitive and deterministic statements about processes and trends in the discipline. Despite the incomprehensiveness and non-availability of similar studies, particularly in the south-south geopolitical zone of Nigeria this study represents a huge success in analysis of general trend, spatial pattern and effects of fatal road traffic accident occurrences over a period of time. However, a lot remains to be done even in this respect.

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THE CHEMIST IN HEALTHCARE DELIVERY AND SUSTAINABLE DEVELOPMENT IN NIGERIA

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Abstract

Healthcare delivery requires some roles of the chemist to achieve. These roles, which also enhance sustainable development, are hardly captured in literature in harmonized form. This review paper captures these roles, including vaccines production; drugs isolation and extraction; phytochemical screening, separation, purification and analysis; chemotherapy; incubation and other live-saving techniques, and medical devices, such as pacemakers. Fertilizers and pesticides as well as sports materials for healthy living are also formulated by the chemist. It recommends encouragement for chemists and chemical researches, as well as recognition of chemical research outputs by policymakers and the regulatory bodies. It also recommends enhancement of enabling environment for improved teaching and practice of chemistry.

Introduction

Chemistry plays key roles in helping to keep and improve the healthcare delivery in Nigeria. The future holds new breakthroughs, through the advancement of chemistry in health.

The Brundtland Commission of 1987 introduced the concept of sustainable development to replace the economic development paradigm, which is based on the conquest and wrecking of the world for increased economic productivity. Depleting the planet for economic production, only to deny the future generations the resources bequeathed to the present generation as well as the future generations of the earth's inhabitants, is unacceptable (Nigel, 2002). Sustainable development is a mainstream recognition of a link between development and environment. It advocates meeting the health, economic, environmental, political, social and cultural needs of the present generation without compromising the ability of the future generations to meet their own needs (Eneh and Owoh, 2008). It seeks to minimize the incidence of ill health by provision of high quality healthcare delivery system which makes use of the chemist.

All people have certain basic needs without which life would be impossible. These lives- sustaining basic human needs include food, shelter, health, and protection (World Bank, 2007). When any of these is absent or in critical short supply, a condition of "absolute underdevelopment" exists. A basic function of all economic activity, therefore, is to provide as many people as possible with the means of overcoming the helplessness and misery arising from a lack of food, shelter, health, and protection. To this extent, economic development

is a necessary condition for the improvement in the quality of life, i.e. development. Without sustained and continuous economic progress at the individual as well as the societal levels, the realization of human potential would not be possible.

This paper reviews the relevance of the chemists in healthcare delivery and sustainable development. Healthcare delivery cannot be properly harnessed without the input of chemist. The vaccines, drugs, medical devices, pacemakers, chemotherapy and other life-saving techniques need the role of chemist.

The health status of a people in any geographical setting is so important that if the leaders of that nation fold their arms and do nothing to improve citizens' health conditions, it will only be a matter of time before plagues or diseases will ravage such people. It is for this reason that health care delivery forms a very important aspect of any nation's policy. When individuals are in good health, they can engage fully in their daily social, economic and religious activities. For this reason, countries place great premium on health to enjoy the fruit of their labour.

In realization of the importance of health, all tiers of Government in Nigeria devote large sums of money in their annual budgets to health care. For instance, in 2009, a total sum of ₦103.46 billion was earmarked for the health sectors (Nigerian Village Square, 2008). For the 2011 budget, the Federal Government of Nigeria proposed to spend a total amount of ₦235,866,438,244 for the health sector. Out of this amount, the total personnel cost was put at

=N=192,885,136,258; total overhead cost =N=9,453,716,258; total recurrent =N=202,338,852,916; total capital cost =N=33,527,630,328 (Federal Ministry of Finance, 2011). These yearly expenditures show that enormous budgetary resources were allocated to the health sector due to its importance to the nation.

The World Health Organization (WHO), the key United Nations agency concerned with global health matters, defines health as “a state of complete physical, mental, and social well-being and not merely the absence of disease and infirmity” (World Health Organization, 1999). In September 2000, the 189 member countries of the United Nations adopted eight Millennium Development Goals (MDGs), committing themselves to making substantial progress towards the eradication of poverty and achieving other human development goals by 2015. The MDGs are the strongest statement of the international commitment to ending global poverty. They acknowledge the multidimensional nature of development and poverty alleviation, and that an end to poverty requires more than just increasing incomes of the poor.

The eight goals are ambitious: to eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child mortality; improve maternal health; combat HIV/AIDS, malaria, and other diseases; ensure environmental sustainability and development of a global partnership for development. The goals are then assigned specific targets deemed achievable by 2015 based on the pace of past international development achievements (Eneh, 2009; Todora

and Smith, 2011). The 4th, 5th and 6th MDGs are all about health (reduce child mortality; improve maternal health; combat HIV/AIDS, malaria, and other diseases). The chemist is indispensable in combating health problems ravaging the world today.

The creator has been recognized as the great Chemist. He performed the first chemical reaction in the creation of light. He then created man and empowered chemists with skills and knowledge for the production of new substances. Chemistry has been defined as a branch of science that studies the properties, composition and structure of matter, which comprises all things that have mass and occupy space, along with the associated chemical and/or physical changes, as well as how such changes impact on the welfare of man and the society. Chemistry is the centre of sciences. It is with it that technology is built for national and international development. Remove science and technology, mankind will revert to the Stone Age (Okieimen, 2007).

Basic scientific research and technological development have played a crucial role in the modern economic growth and experience of contemporary developed countries, including the area of health care delivery. A chemist is a graduate of chemistry or chemistry-related discipline from a recognized university or polytechnic. He was trained to be able to handle chemicals, use and manage them. He can practice in industries, government ministries, agencies, schools and other areas (Okolo, 2007).

The chemist is actively involved at every stage of the search for drugs - biologically active substances of known or unknown

structure, compounds which affect life processes. Both pharmacokinetics (absorption, distribution, biological transformation and excretion) and pharmacodynamics (biochemical and physiological effects and their mechanism of action) of drugs are directly related to the chemistry of the drugs. Chemistry is deployed in isolation (extraction, phytochemical screening, separation, purification and analysis) of drugs.

In the agricultural sector, chemist plays important role to produce and preserve food for a healthy living. He determines the soil nutrients and formulates appropriate fertilizers to suit the soil for effective production and high yield, pesticides and other chemicals to prevent weeds and other farmer's enemies. Chemical compounds are used to eradicate a plethora of disease-carrying pests that compete for food supply (Eneh, 2010).

Chemotherapy and other drugs are delivered more accurately on plastic patches and dissolving disc. Nanotechnology can deliver drugs to specific cells. Premature babies are kept safe and warm in plastic incubators. Vaccines have eradicated crippling diseases. Medical devices, such as pacemakers and blood bags, save lives every day. Life-saving medicines help to combat diseases, thereby enlongating lives. Diabetics readily test their blood sugar levels by a simple chemical test. These biomedical tests and techniques are prepared by chemist.

The World Health Organization (1999) estimates that diseases associated with dirty water kill at least 6,000 people every day. Chlorine chemistry is the most effective weapon against water-borne bacteria and viruses. Water treatment facilities across the world rely on chlorine treatment.

The gear and equipment used in gym, playing field and on the trail are predominantly products of chemistry. Football, baseball, hockey, lacrosse, skateboarding and nearly every popular sport, relies on plastic pads, helmets and other protection equipment made by chemist. Plastic fibers make wornout clothing breathe and

wick away sweat. Modern swimsuits help athletes glide through the water. Cyclists, skiers, hikers, mountain climbers and other outdoor enthusiasts all rely on carbon fiber-reinforced plastic gear, safety equipment and clothing, from skis to helmets to goggles to ropes to insulating fibers that are made by chemist.

Policies implications and Recommendations

The promotion of safe use of the essential products of chemistry is a shared responsibility of manufacturers, the government and those who use or sell chemical products. Manufacturers and government must work together to:

- Develop, implement and comply with sound regulations on safe use of chemicals;
- Enhance scientific understanding of chemical safety applications; and
- Produce publicly accessible safety information.

National primary chemicals management law must be updated to adapt to scientific advancements and to promote safe chemical product use. Incentive packages and encouragement for chemists and chemical researches, as well as recognition of chemical research outputs by policymakers and the regulatory bodies are areas calling for urgent policy attention. Enabling environment for improved teaching and practice of chemistry has become imperative.

Conclusion

The roles of chemist in healthcare delivery and sustainable development are as crucial as they are diverse. This paper has attempted to review them. It is worth noting that new areas are being exploited day by day.

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AN ANALYSIS OF DEATHS FROM ROAD TRAFFIC ACCIDENTS IN LAGOS STATE, NIGERIA

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Abstract

The major objective of this paper is to analyze the reported deaths from road traffic accidents in Lagos State, Nigeria. The study used mostly secondary data. The data were obtained for a period of thirty-two years (32) from 1970-2001. The 16 harmonics for the selected Local Government Areas considered contribute above 90% of the total variance in the time series. This means that more than 90% of deaths from road traffic accidents in Lagos State could be attributed to recklessness on the part of drivers, ignorance of high way codes, over speeding etc. Also, the dominant cycles of deaths from road traffic accidents observed in the study area have periodicities of 32.00, 10.67 and 4.0 years with the most dominant being 32 years. Based on the findings, recommendations were proffered.

Introduction

There are some accident characteristics which are common to a number of developing countries and yet are some what

different from those in developed countries. For instance, in the third world, a relatively high proportion of fatalities are pedestrians and children aged under 16 years and many fatal accidents involve trucks, buses and other public service vehicles (Downing, 1991).

Roads are often built through areas where economic activity already exists, thus creating conflict over space between road users and the local population. People also tend to settle near roads because of the increased economic activity. This is a dynamic process involving changing populations, changing settlements, changing migration patterns and changing needs, yet these changeable conditions are generally not considered in the design and construction of roads. Nantulya and Rich (2003) call for a paradigm shift in road safety and transportation planning so that the needs of all road users both in the rural and in the urban areas are taken into account.

One area of focus in road traffic research in developed countries in the 21st century is on road safety impact of highway projects. The interest of research in this area was triggered by the classification model adopted by the U.S. National Committee on injury prevention and control from road traffic accidents in 2001 aimed at enhancing safety on the highways and reducing road traffic accidents (Al-Masaeid et al, 2001; Hauer et al, 2003; Tarko et al, 2004). Also, experience from other countries showed that small roundabouts were an effective speed reducing measure (Simon, 1991). He also concluded that small roundabouts increased safety. Minnen (1992) reported that new roundabouts reduced the total number of accidents by 50% and the number of casualties by 80%.

Nigeria, like other developing countries, is experiencing a rapid increase in motorization without having

adequate road traffic safety mechanisms in place to control the growing number of road traffic crashes and injuries. As reported for other low-and-middle income countries, the main victims are pedestrians, cyclists and public transport passengers (Filani and Gbadamosi, 2007).

In Nigeria, the road traffic accident situation over the last three decades has been particularly disturbing. In 1976, there were 53,897 road traffic accidents resulting in 7,717 deaths. Although, in 1981, the magnitude reduced to 5,114 accidents, but the fatality increased to 10,236, which means that there was an average of 96 accidents and 28 deaths for everyday of that year (Ogunsanya, 1990). The situation in subsequent year has not been any better. The number of people killed in road accidents between 1990 and 2005 rose from 28,253 to 37,873 and the fatality rate remains consistently high (Atubi, 2009b).

Road traffic accident rates all over the world show great disparity, most especially between the developed and developing countries. It has been shown by research that the degree of severity of accidents and the frequency with which they occur in the developed continents such as North America and Europe are decreasing, while in the developing continents of Africa and Asia, the rates are increasing (Ghee et al, 1997; Yang et al, 2003; Afukaar et al, 2003; Odero, et al 2003; Atubi, 2010a, 2010c).

Based on data that are at best conservative estimates, Nigeria is a country with a serious and growing road accident problem that is among the worst in the world (Asogwa, 2002). Analysis of global statistics indicates that fatality rates (per licensed vehicle) in developing countries are high in comparison with those of developed countries (Adeniji, 2002). African countries in particular have rates often 30 to 50 times greater than those in the countries of Western Europe.

Nigeria has the highest rate of deaths from motor accidents in the world, according to statistics compiled by the Federal Road Safety Commission (FRSC). The country leads 37 other nations with 240 deaths in 10,000 vehicles crashes. Ethiopia ranked second with 200 deaths per 10,000 vehicles, Malawi took the third position with 180 deaths (The Guardian Newspaper, Lagos, 19 December, 1989, P. 12, Atubi, 2010b).

Various road safety strategies and counter measures have been used at different stages of network development. This method of seeking to prevent road accident mainly involves conscious planning, design and operations of roads. One of the most important factors in this method is the systematic identification and treatment of hazardous locations. The main objective of the study is to develop a model necessary to identify these hazardous locations on roads commonly termed as black spots. In general, the various factors that cause accidents can be broadly categorized into road related, vehicle related and driver related (Atubi, 2012).

Study area

Lagos State is a suitable case study because it hosts metropolitan Lagos, Nigeria's major traffic centre, fastest growing city, and most heavily motorized urban area in the country. Consequently, the state has one of the highest accident and casualty rates in the country (Federal Republic of Nigeria, 1997, p. 6). Moreover, the traffic situation in Lagos State is bad because of the absence of effective planning, vehicle-misuse, poor management, inadequate street parking, traffic congestion, delays and accidents among other contributory factors.

Lagos State is situated in the South Western corner of Nigeria. This elongated state spans the Guinea Atlantic coast for over 180km, from the Republic of Benin on the west to its

boundary with Ogun State in the east (Figure 1), while Lagos State is the smallest in Nigeria, it has over 5 percent (i.e. 9,013,534) of the country's estimated 140 million people (National Population Census, 2006). Its rate of population growth has been in excess of 9 percent per annum, or 25,000 per month or 833 per day or 34 per hours in the last decade (Lagos urban Transport Project, 2002). This population increase has been accompanied by a corresponding increase in motor vehicles and traffic accidents. However, accident rates in Lagos State are still very much on the high side compared to other states in the federation. But, fatalities and non-survival indices for the state are on the decline. This is attributable to its high level of traffic congestion (which reduces the probability of the high fatality accidents resulting from over speeding) and accessibility to good post – crash medical care in the Lagos metropolitan area.

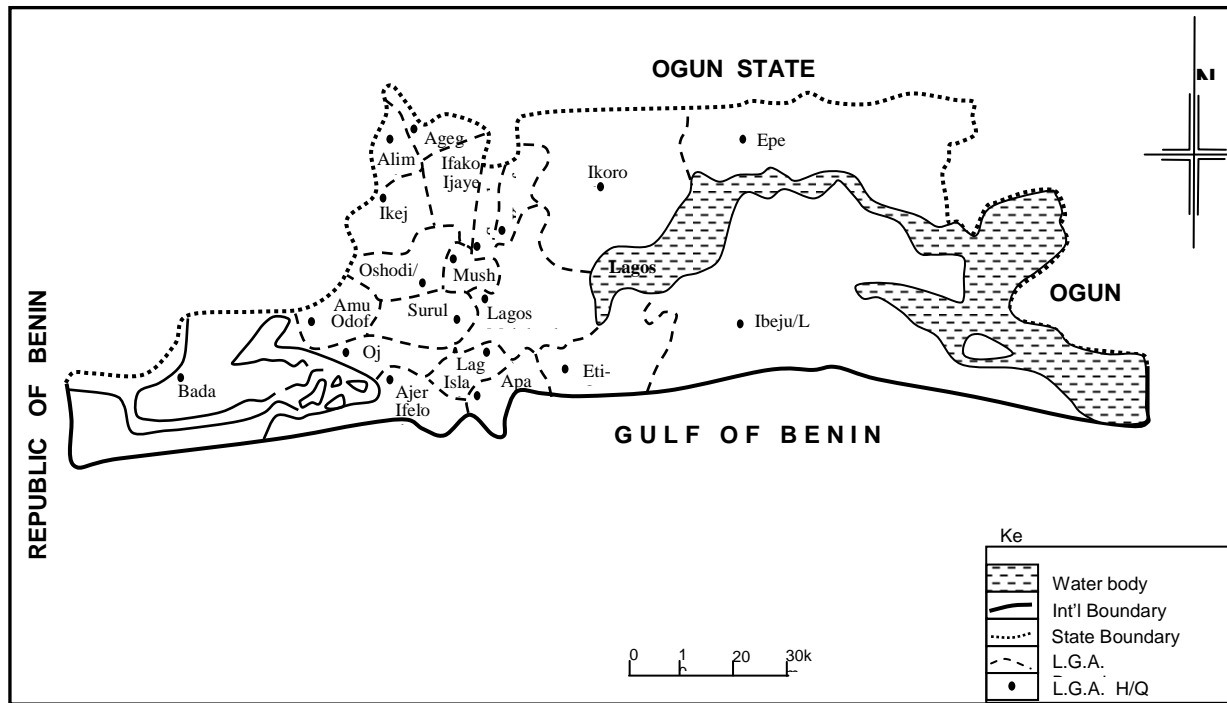


Fig. 7.1: Map of Lagos State showing the 20 Local Government Areas.

Source: Lagos State Ministry of Environment and Physical Planning (1999)

Materials and Methods

Data for the study were mainly obtained from the Nigeria Police Force accident records, the Federal Road Safety Commission (FRSC) and were complemented with data from research reports and articles and national statistical abstracts and newspapers. The author reviewed the statistics of deaths for the year 1970 to 2001, disaggregated by administrative councils.

The harmonic analysis was used to estimate the contributions of particular bands of frequencies to the overall variance in terms of a fluctuating time series. However, the justification for choosing Ikeja, Lagos Island, Lagos Mainland and Ajeromi/Ifelodun Local Government Areas for this study lies in the fact that they carry more than fifty (50%) percent of the vehicular traffic in Lagos State (Atubi, 2007).

Results/Findings and Discussion

Table 7.1 and Figure 2 and 3 revealed the reported number of deaths from road traffic accidents in Lagos State from 1970 – 2001. It is observed from the table that the highest number of deaths from road traffic accident was recorded in Ikeja Local Government Area with a total of 1825 representing 15.78% of the total death from motor traffic accidents. This is followed by Lagos Island Local Government Area with 1693 deaths representing 14.64%. Ajeromi/Ifelodun Local Government Area recorded 1148 deaths representing 9.93% of the total deaths.

Table 7.1: Reported number of deaths from RTAs in Lagos State, 1970-2001

Year	Lagos Island	Ajeromi/Ifelodun	Ikeja	Lagos Mainland
1970	22	20	26	16
1971	20	19	22	18
1972	25	22	28	20
1973	70	60	78	60
1974	50	30	60	28
1975	73	45	78	40
1976	80	50	80	40
1977	66	42	69	42
1978	100	58	98	50
1979	85	67	89	60
1980	100	72	102	70
1981	92	60	94	50
1982	50	35	53	52
1983	60	30	62	27
1984	63	38	62	36
1985	105	96	104	91
1986	74	52	73	50
1987	64	40	68	41
1988	91	51	90	49
1989	60	35	63	33
1990	56	30	60	28
1991	29	15	32	13
1992	26	15	28	12
1993	20	17	22	16
1994	20	16	22	14
1995	16	16	18	14
1996	22	18	24	19
1997	30	21	32	18
1998	32	20	38	21
1999	30	19	40	20
2000	30	20	50	18
2001	32	19	60	29
Total	1693	1148	1825	1095
%	14.64	9.93	15.78	9.47

Source: Lagos State Police Command, Ikeja 2004

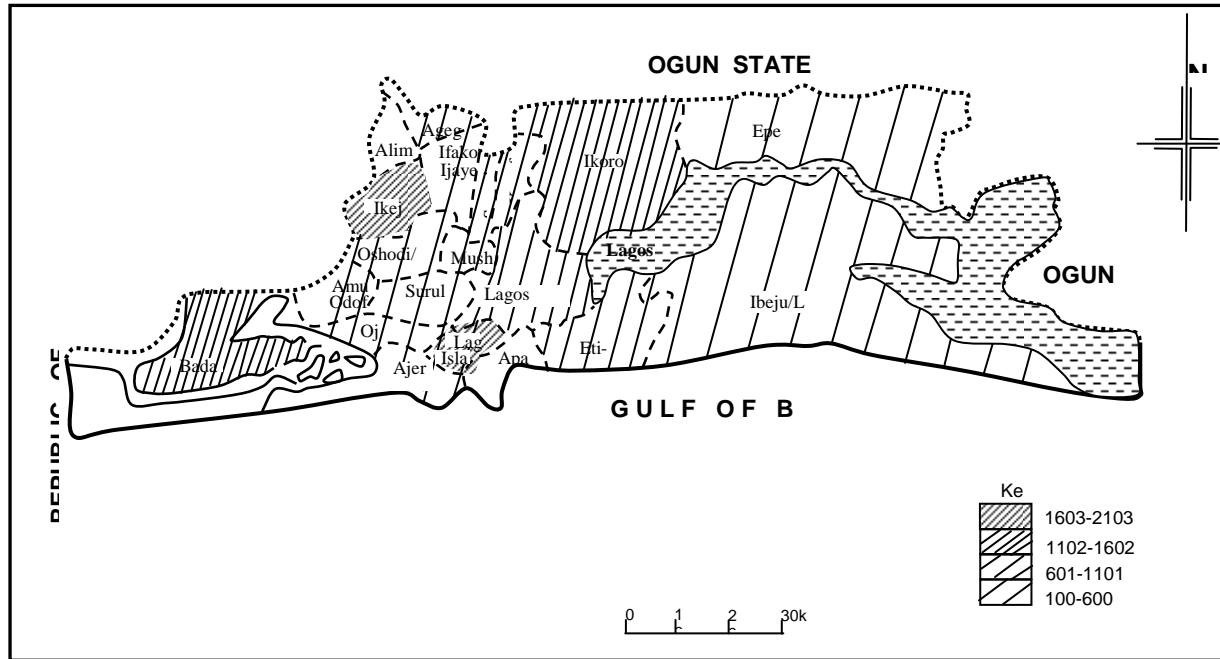


Fig. 7.2: Chloropleth Map Showing the Reported Number of deaths from Road Traffic Accident in Lagos State (1970-2001)

Source: Lagos State Ministry of Environment and Physical Planning (1999)

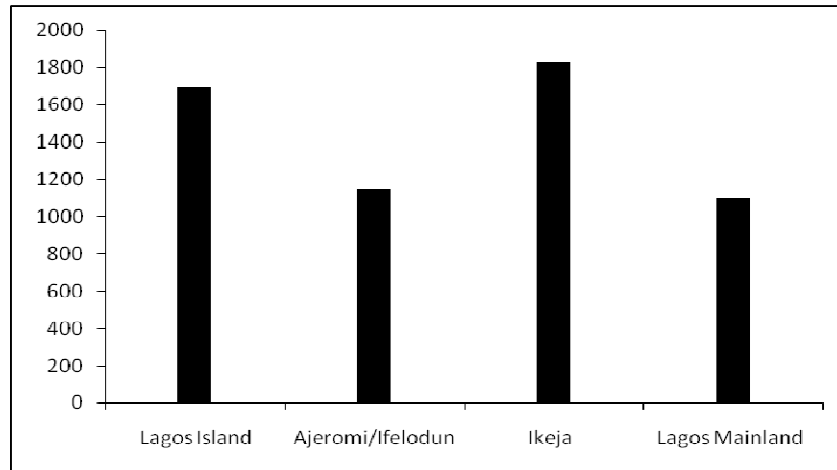


Fig 7.3: Reported deaths from RTAs in Lagos State (Adapted from Table 7.1)

Table 7.1 shows that Ikeja, Lagos Island and Ajeromi/Ifelodun Local Governments Areas are the three Local Governments with the highest number of deaths from road traffic accidents in the study area. These three Local Governments emerged as the ones with highest road traffic accident records. Ikeja Local Government Area in particular also appear among the Local Governments with highest number of deaths from road traffic accidents. All these then show that Ikeja, Ajeromi/Ifelodun, Lagos Mainland and Lagos Island Local Government Areas are very notorious for road traffic accidents and associated consequences such as deaths and injuries.

In an attempt to examine the temporal patterns of deaths from road traffic accidents in Lagos State, the time series and trend analysis of the accident statistics leading to deaths in respect to each of the selected Local Government Areas were undertaken. The results of these analyses are shown in (Figure

4 and Table 7.2). This figure revealed the time series as well as trend of death from road traffic accidents for Lagos State. The year 1988 recorded the highest figure of 478 while the least was in 1972 with 209 deaths from road traffic accidents. The trend of deaths from road traffic accidents as shown in figure 4 reveals that the phenomenon is on the increase; in other words, the trend of deaths occurrence from road traffic accidents is on the increase in Lagos State between 1970 and 2001 as revealed by the trend analysis.

On the arithmetic mean of reported number of deaths from road traffic accidents in Lagos State, generally the 1st harmonic contributes the highest percentage variance of 27.81%, closely followed by the 3rd and 8th harmonics contributing 22.15% and 9.57% of the total variance respectively (See Table 3). The lowest percentage variance of 0.20% is contributed by the 7th harmonic. The 16 harmonics contribute 98.56% of the total variance in the time series.

Table 7.2: 5 Year Moving Averages of Reported Number of Deaths from Road Traffic Accidents in Selected Local Government Areas in Lagos State (1970-2001)

S/N	Lagos State	Lagos Island	Ikorodu	Ajeromi/ Ifelodun	Badagry	Epe	Ikeja	Mushin	Lagos Mainland
1	208.60	37.40	15.40	30.20	15.60	11.40	42.80	32.00	33.20
2	250.00	47.60	19.40	35.20	17.20	12.20	53.20	37.20	37.60
3	299.60	59.60	25.40	41.40	20.60	13.00	64.80	41.20	42.00
4	333.00	67.80	25.40	45.40	24.20	14.00	73.00	38.80	40.00
5	340.80	73.80	25.20	45.00	25.80	15.20	77.00	43.00	46.40
6	379.40	80.60	27.20	52.40	30.80	16.00	82.80	47.00	52.40
7	407.80	86.20	26.60	57.60	32.60	17.40	87.60	49.60	54.40
8	415.00	88.60	22.60	59.60	30.60	19.00	90.40	49.60	56.40
9	410.00	85.40	23.40	58.40	28.60	21.00	87.20	47.20	51.80
10	379.80	77.40	24.00	52.80	25.00	19.60	80.00	42.60	47.00
11	351.20	73.00	23.00	47.00	22.80	19.20	74.60	42.60	51.20
13	359.20	74.00	21.00	51.80	22.80	18.80	75.00	40.60	51.20
13	367.80	70.40	23.00	50.20	22.80	17.40	70.80	39.60	49.00
14	393.60	73.20	24.40	51.20	22.80	16.20	73.80	42.00	53.40
15	441.00	79.40	24.00	55.40	24.60	18.20	79.40	43.00	52.80
16	478.20	78.80	21.80	54.80	24.00	19.40	79.60	36.60	40.20
17	460.00	69.00	22.20	41.60	23.80	19.60	79.30	29.40	32.80
16	437.60	60.00	21.60	34.20	23.80	19.60	70.80	24.80	27.00
19	417.40	52.40	18.40	29.20	21.40	17.60	62.60	19.80	20.40
20	391.40	38.20	16.80	22.40	20.40	16.40	54.60	15.80	16.60
21	372.80	30.20	15.80	18.60	18.40	14.40	41.00	13.00	13.30
22	360.60	22.20	13.40	15.80	14.80	12.60	32.80	13.40	15.00
23	370.40	20.80	10.20	16.40	14.00	11.60	24.40	14.80	16.20
24	383.20	21.60	10.00	17.60	14.00	11.40	22.80	15.40	17.20
25	377.80	24.00	9.60	18.20	12.20	10.80	23.60	16.20	18.40
25	368.20	26.00	9.60	18.80	12.20	11.00	26.80	16.40	19.20
27	360.20	28.80	9.40	19.60	12.40	10.80	30.40	17.00	21.28
28	371.80	114.80	10.40	19.80	12.00	11.00	36.30	25.20	29.60

Source: Analysis of Data Collected

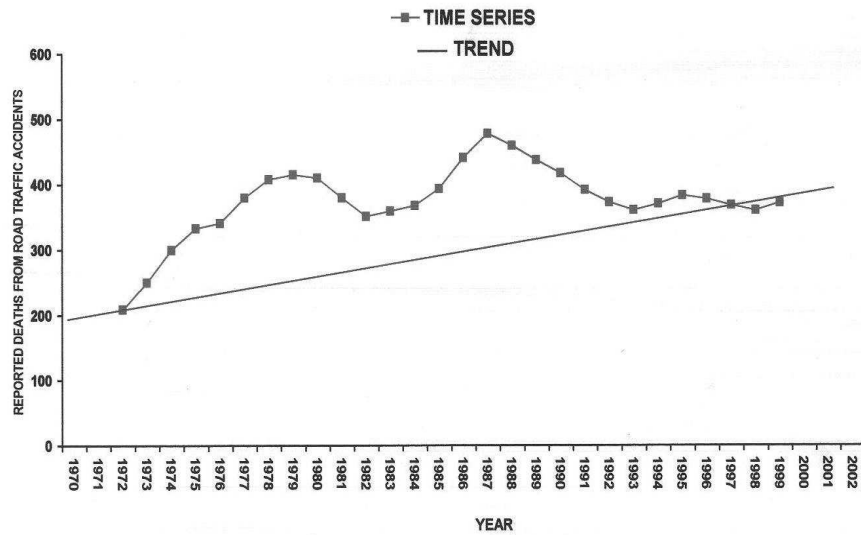


Fig. 7.4: *Time series and trend of the reported deaths from road traffic accidents in Lagos State (1970-2001)*

Table 7.3: Variance spectra of reported number of deaths from RTAs for selected LGAs in Lagos State

Harmonics	Lagos		Lagos Island		Ikorodu		Ajeromi		Badagrey		Epe		Ikeja		Mushin		Lagos Mainland	
	%V	Amp	%V	Amp	%V	Amp	%V	Amp	%V	Amp	%V	Amp	%V	Amp	%V	Amp	%V	Amp
1	27.81	73.50	4.36	22.37	50.27	8.20	57.26	21.78	50.21	8.10	59.03	5.00	58.75	29.98	33.21	16.92	47.14	19.10
2	3.77	27.05	5.59	25.32	6.42	2.93	0.11	0.95	7.51	3.13	0.45	0.44	0.25	1.97	1.55	2.39	4.12	5.65
3	22.15	65.59	7.48	29.31	3.49	2.16	4.87	6.35	9.41	3.51	7.30	1.76	12.39	13.77	1.23	2.58	4.43	3.33
4	1.63	17.75	5.05	24.08	1.35	1.34	3.30	5.23	1.78	1.52	7.27	1.75	0.15	1.53	4.83	5.1	5.28	6.39
5	7.56	38.33	5.31	24.68	0.83	1.05	6.08	7.10	2.95	1.96	3.00	1.15	3.56	7.33	1.06	2.39	1.58	3.50
6	9.35	42.62	8.71	31.62	9.15	3.50	4.59	6.16	7.53	3.13	2.20	0.96	4.28	8.09	5.71	5.54	5.92	6.30
7	0.20	6.21	4.30	23.48	0.67	0.94	2.53	7.62	1.50	1.40	0.97	0.64	0.16	1.59	2.10	3.36	1.19	3.03
6	9.57	43.12	9.17	3.44	6.09	2.86	4.92	6.38	1.15	1.25	4.15	1.33	3.55	7.33	5.81	5.59	6.44	7.06
9	1.18	15.11	5.55	2.24	10.32	3.30	0.39	1.79	0.57	0.66	150.00	0.30	0.17	1.64	1.54	2.88	1.55	3.47
10	3.40	25.63	7.77	29.37	1.25	1.25	2.42	4.48	0.21	0.52	0.80	0.58	1.04	3.98	4.65	5	5.32	6.41
11	0.40	8.36	5.23	24.02	2.57	1.85	3.14	5.10	9.53	3.53	3.67	1.25	0.30	2.15	4.91	5.14	7.6	7.67
12	0.51	9.97	5.51	25.15	0.19	0.51	0.15	1.11	0.61	0.39	2.80	1.09	0.36	2.35	1.81	3.12	6.88	2.61
13	1.95	19.44	4.21	21.08	1.89	1.55	4.74	6.27	0.27	0.59	0.23	0.32	3.65	7.47	5.09	5.23	6.32	6.99
14	3.88	27.46	8.38	31.01	0.04	0.23	1.18	3.12	1.12	1.21	1.71	0.85	1.35	5.32	0.45	1.55	6.66	2.26
15	1.84	10.92	6.55	27.42	1.72	1.52	0.49	2.01	0.71	0.96	1.57	0.83	0.57	2.97	0.75	2.06	0.23	1.35
16	3.36	25.56	6.32	26.94	0.19	0.50	1.33	3.38	0.36	0.69	0.04	0.13	0.35	2.31	0.00	0.06	0.01	0.31

% v = Percentage variance

Amp = Amplitude

Similarly, for Lagos Island Local Government Area, the 8th harmonic contributes the highest percentage variance of 9.17%, closely followed by the 6th harmonic of 8.71% and the 14th harmonic which has 8.38% variance of the total variance observed. The 13th harmonic contributes the lowest percentage variance of 4.21% to the total variance of the time series. The total percentage variance contributed by all 16 harmonics is 99.84%. This means that 99.84% of deaths from road traffic accidents in Lagos State could be attributed to recklessness on the part of drivers; ignorance of highway code, driving under the influence of alcohol, wrongful overtaking, over speeding, pot holes etc leaving 0.16% to other factors.

For Ajeromi/Ifelodun Local Government Area, the 1st harmonic accounts for the highest percentage variance of 57.26%, closely followed by the 5th and 8th harmonics with percentage variances of 6.08% and 4.92% respectively. The 2nd harmonic contributes the lowest percentage variance of 0.11%. The 16 harmonics contributes a total of 97.6% to the temporal pattern of reported death from road traffic accident occurrence over that part of Lagos State.

Similarly, for Ikeja Local Government Area, the 1st harmonic contributes the highest percentage variance of 58.75%, closely followed by the 3rd and 6th harmonics which contributes 12.39% and 4.28% of the variance respectively. The 4th harmonic contributes the lowest percentage variance of 0.15%. All 16 harmonics contribute a total of 91.38% of the variance in the temporal occurrence of reported number of deaths over the 32 years.

For Lagos Mainland Local Government Area, the 1st harmonic contributes the highest percentage (47.14%) of the total variance. Closely followed by the 11th and 8th harmonics which contributes 7.60% and 6.44% of the variance respectively. The 16th harmonic contributes the lowest percentage variance

(0.01%). All 16 harmonics contributes a total of 94.87% of the variance in the temporal occurrence of reported number of deaths from road traffic accidents over the 32 years. In other words, 94.87% of the reported deaths from road traffic accident variation in the long period of accident occurrence of Lagos State are composed of different cycles.

Table 4 shows that for Lagos State as a whole, dominant cycles of reported number of deaths from road traffic accidents observed have periodicities of 32.00, 10.67 and 4.00 years with the most dominant being 32 years. This means that the dominant and strongest number of deaths from road traffic accident pattern over Lagos State repeats itself every 32 years. This also means that if the traffic situation is not given due attention by the relevant authorities high rates of reported number of deaths from road traffic accidents will repeat itself by the year 2033 in the first instance and the year 2017. Variance spectra explaining the percentage variance explained by each harmonic have been drawn for Lagos State (see Figure 5).

Table 7.4: Dominant Deaths from Road Traffic Accidents in Lagos State

Location		Cycles (Years)	% Variance	Amplitudes
Lagos State	1 st	32.00	27.81	73.50
	2 nd	10.67	32.15	65.59
	3 rd	4.00	9.57	43.12
Lagos Island	1 st	4.00	9.17	32.44
	2 nd	5.33	8.71	31.62
	3 rd	2.29	8.38	31.01
Ikorodu	1 st	32.00	50.27	8.20
	2 nd	3.56	10.82	3.80
	3 rd	5.33	9.15	3.50
Ajeromf/Ifelodun	1 st	32.00	57.26	1.78
	2 nd	6.40	6.08	7.10
	3 rd	4.00	4.92	6.38
Badagry	1 st	32.00	50.21	8.10
	2 nd	2.91	9.55	353
	3 rd	10.67	9.41	3.51
Epe	1 st	32.00	59.03	5.00
	2 nd	10.67	7.30	1.76
	3 rd	8.00	7.27	1.75
Ikeja	1 st	32.00	58.75	29.98
	2 nd	10.67	12.39	13.77
	3 rd	5.33	4.28	8.09
Mushin	1 st	32.00	53.21	16.92
	2 nd	4.00	5.81	5.59
	3 rd	5.33	5.71	5.54
Lagos Mainland	1 st	32.00	47.14	19.10
	2 nd	2.91	7.60	7.67
	3 rd	4.00	6.44	7.06

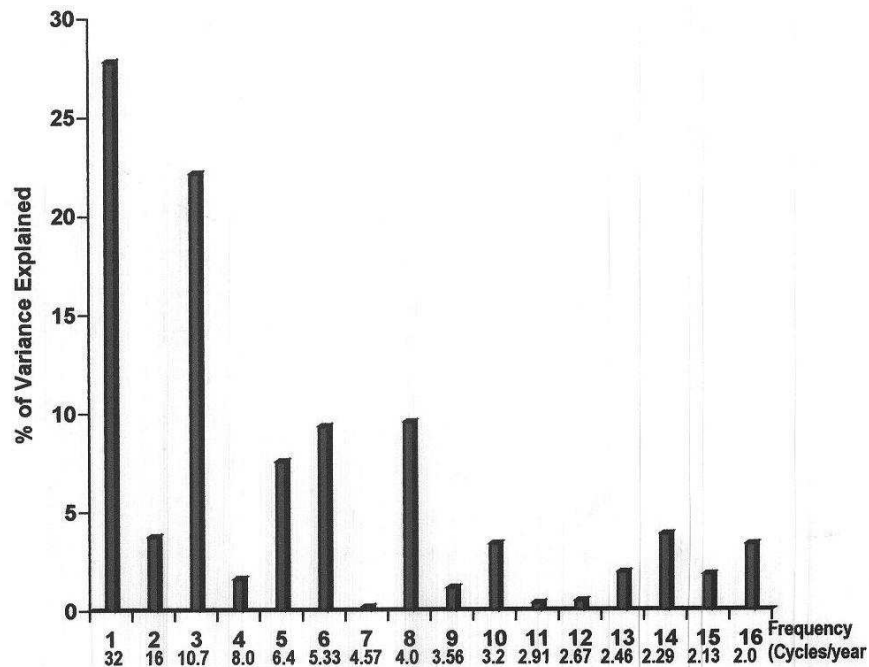


Figure 7.5: *Variance Spectrum for Lagos State on the Number of Deaths from Road Traffic Accidents*

Policy implications and Recommendations

By the serious road traffic accident situation in the study area, Local Government Areas like Lagos Island, Lagos Mainland, Ajeromi/Ifelodun and Ikeja Local Government Areas can be described as accident prone areas, because they are all associated with high accident rate, high number of deaths, high number of injuries and so on. This trend therefore, suggest that these Local Government Areas of Lagos State are associated with the menace of road traffic accidents, and these deserves urgent attention and appropriate policy intervention.

Since the driver of a vehicle is the most important determinant of the occurrence of an accident, the quality of drivers on the roads in the study area cannot be over emphasized. Consequently, training and retraining of drivers should be a basic effort towards reducing the carnage on roads. The training and retraining of drivers constitute 126 formidable means of effectively dealing with the issue of road traffic accident reduction.

In addition to the above, efforts should be made to provide parking spaces, sidewalks, road signs at appropriate places, adequate road and pavement markings and over head bridges at strategic points/places in all major roads in Lagos State.

These measures, if well executed, will contribute positively towards reducing the ugly incidence of road traffic accident in Lagos State and Nigeria in general. The current poor road safety record in Nigeria is not inevitable. As other countries like the U.S.A. and Britain have shown, population and vehicular traffic growth does not have to lead to increase in traffic crashes, deaths and permanent injuries as these undesirable outcomes can be minimized through adequate traffic accident control and injury prevention measures (Atubi, 2006).

Conclusion

Road traffic accident, a well documented consequence of motorization is the leading cause of deaths in Nigeria. While accidents occur in all modes of transport, including rail ways, no mode approaches the importance of the motor car in the scale of deaths and injuries. Living safely is a challenge that must be accepted by every one if we are to continue to move forward in an ever-changing society.

It is important to note that accident in any country and in Nigeria for that matter, cannot be found in a straight-jacket application of a package of “safety policies” without adequate understanding of the intricacies of the phenomenon. All these knowledge can be obtained through constant scientific investigation into the mechanical, social, cultural and physical characteristics of the road users, the vehicles and the road way as they all affect accidents.

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A COMPARATIVE STUDY OF THE EFFECTS OF PUBLIC AND PRIVATE HOUSING INVESTMENTS ON RESIDENTIAL ENVIRONMENTAL QUALITY OF ENUGU METROPOLIS

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Abstract

Dearth of public and private housing investments mounts pressures on facilities, amenities, neighbourhoods and available housing units in Enugu metropolis with various implications on environmental quality. This study compared the effects of public and private housing investments on residential environmental quality in Enugu metropolis. The study area was stratified into low, medium and high density neighbourhoods. Questionnaires were used to collect primary data. Factor analysis was used to reduce the environmental quality variables to a singular factor. Multiple linear regression analysis was used to establish the nature of relationship between the environmental quality and public and private housing investments in the study area. Private

housing investments impacted more on the environmental quality of the area than public housing investments. It was recommended that the State and Federal Governments should rise up to the challenge of public housing investments that will effectively complement the efforts of the private sector.

Introduction

It has been observed that the situation in some parts of Enugu metropolis like Achara Layout (built up mainly in block of flats) shows that the area which hitherto used to be mainly occupied by lower middle class individuals as medium density area is now no longer so. Some of the residents are households that vacated their accommodation in low density areas to this area so as to be able to meet with the rents demanded from the areas.

Besides, closer observation reveals that some of the flats in the area are being shared by two or more households. This, the occupants claim was as a result of non availability of enough of the dwelling units, hence, the rate of demand being greater than the rate of supply. Meanwhile, the flats were originally built to accommodate a household in each case, and the facilities/amenities provided were meant to serve as such. Hence, there has been increased rate of facilities/amenities breakdown in the metropolis and some people see it as a consequence of pressure on the existing facilities and amenities.

The implications of the situations to residential environment are numerous and pose enormous challenges. Against this background, the aim of this study was to examine the role of housing investments in the residential environmental quality of Enugu metropolis. To actualize this, the following null hypothesis was formulated: there is no

significant relationship between the residential environmental quality and housing investments in Enugu metropolis.

Literature Review

Many people invest in housing with the objective of holding it for income and profit (Richmond, 1985). The residential group of building that attract investments include, detached houses, semi detached houses, bungalows, block of flats as well as tenement buildings (Okeke, 2004). The method of conducting transactions in housing market and the lack of information generally contribute to imperfection in housing market (Johnson et al, 2005). Musa (2010) opined that the Land Use Act of Nigeria does not make investments in housing move fast, as it takes time for transfer to be effected in the events of sales and purchases.

However, certain studies have been carried out on housing investments and environmental quality worldwide. Brasington et al (2005) in the United States of America (USA) estimated the relationship between housing price and environmental disamenities using spatial statistics to confirm that nearby point-source pollutants depress house price. Six spatial hedonic regressions for Akron, Cincinnati, Cleveland, Columbus, Dayton and Toledo were determined. The highlight of the results showed that the implicit prices of environmental quality and related characteristics from the house price hedonics the estimate of a demand curve for environmental quality, a price elasticity of demand of 0.12. There was evidence of significant spatial effects in both the hedonic and demand estimations. Also, environmental quality and house size were substitutes.

Alkay (2009) studied the relationship between environmental quality level and housing sale prices in Istanbul metropolitan area. The research was carried out in two steps.

In the first step, the environmental quality index was measured, applying the principal component analysis. In the second step, relationship between the environmental quality index and housing sale prices of the districts were explored. The result showed that the weight of dwelling indicators and satisfaction from housing environment indicators were positive, while the economic, social and accessibility indicators were negative for the casual factor which explained the environmental quality at district level in the area. Hence, the result eventually showed how environmental quality of housing areas can be part of competition in a metropolitan area, because the higher the environmental quality index in the district, the higher were housing sale prices in them.

Florida, Cendrero and Fischer (1997) worked on the procedure for assessing the environmental quality of coastal areas for planning and management, based on the identification of certain characteristics. This they did, using certain indicators, including number of storms per year, and thereby proposing numerical indices which could be used to assess different qualities on the basis of the indicators. The indices could be used for mapping environmental quality and monitoring its change with time. Furthermore, they could be applied to both “natural” environmental unit and coastal jurisdiction. The method could help to determine whether existing management and policy trends move away or towards sustainability, as the indices provide a means to determine whether environmental quality in a coastal area is decreasing or increasing. Again, it could facilitate the integration of scientific assessment into the process of coastal planning and management through the application of indices which give the summary of environmental characteristics in terms that should be significant to planners and managers.

Studying the environmental quality of Brazilian Amazon, Perz (2011) emphasized that deforestation was not the only issue of importance concurring changes in environmental quality of the Amazon. Three dimensions of urban environmental quality considered were the production of environmental hazards through industrial, sewage and waste pollution; the degrees of protection from such hazards through high quality housing construction and amenities, and the capacity to defend against environmental hazards, as indicated by household, income and access to health care. Census data and health services statistics were used. The study compared enclaves of environmental quality urban population of Amazon in 1980 and 1991 quantitatively. Thirty environmental quality indicators were used in all. The results indicated that environmental quality in the region deteriorated during the 1980s as the production of and exposure to environmental hazards rose while resources to ward off hazards eroded. The findings also showed that environmental quality was particularly poor in more rapidly growing urban centres.

Using Europe and America as case studies, Cendrero et al (2003) worked on the procedure for sustainability assessment in coastal areas, based on a series of indicators and indices that reflected environmental quality. Three dimensions of environmental quality taken into consideration were functions, interaction and component. Through the procedure, sixty-seven environmental quality indicators were initially selected and stepwise procedure established for calculation of indices. The procedure offered the possibility of expressing environmental quality of the coastal areas in numerical form, through the use of indices based on clear and replicable method, using indicators that can be measured or objectively determined. The method appears to be sensitive

enough to detect changes in the environmental quality with time and therefore could be used for environmental monitoring and auditing as basis for decision making in environmental management. Hence, it could provide a useful tool for monitoring environmental quality, thus helping to assess sustainability of existing policies and practice.

Bernauer and Koubi (2004) carried out a study on the effect of various political variables such as the type of political system, the type of democratic government, civil liberties and labour union strength on environment quality. They took into account the effect of economic variables. Air pollution was used as the dependent variable. Annual observations for the years 1991-1996 from 291 observation sites located in 107 major cities in 42 countries (2,555 observations) constituted the data for air pollution. Combining the environmental, economic, political and site specific component, a statistical model was obtained. The air pollution was regressed against the explanatory variables. Results showed that higher income, higher intensity of economic activity and greater trade openness contributed to lower pollution levels. The study could be useful for environmental quality monitoring and control. However, being an issue specific in nature, it cannot be generalized to other forms of environmental quality.

Palma et al (2007), assessing the inequality in the spatial distribution of accessibility and environmental quality in Paris Metropolitan region, asserted that local amenities are generalized capitalized into housing market. Data from IAURID GIS data base and metropolitan computation were used. The empirical analysis of the study showed that considerable inequality existed in the spatial distribution of the local amenities and social indicators. Spatial representation and Lorenz curves were used to examine the degree of inequality in these amenities. These provided evidence that

some amenities were much more inequitably distributed than others, e.g. noise.

Alem and Martinsson (2011) investigated the importance of environmental quality to the poor and what the policy makers knew about it in Addis Ababa, Ethiopia. The citizen and policy makers were asked to rank the areas that they think government should focus on. The ranking areas were (a) Better health services education and housing (b) Creating environmental opportunity (c) Controlling price rise (d) Improved solid waste disposal and (e) Improved liquid waste disposal. In the findings, although standard determinants of subjective well being in Western countries seemed to explain happiness in Addis Ababa, environmental quality variables were ranked lowest by the citizens, yet they were important for the happiness of the people. On the other hand, the policy makers considered little effect on happiness and ranked quality of a higher priority area. While the government officials had more focus on long term perspectives, the citizens on their part focused more on short-term issues. However, the government of the country went as far as introducing a strict control over prices of basic commodities, adopting the views of the citizens in this regard.

In Nigeria, different people have equally worked on environmental quality as it affects different cities or towns. Olorunfemi (2009) studied the willingness to pay for improved environmental quality among the residents living in close proximity to two landfills at Olushoshun and Abule Egba in Lagos metropolis. The main instrument used in the collection of primary data was structural questionnaire. Certain socio-economic variables also collected were age, household, education, occupation, length of stay in the area and in the house, type of building occupied by household (owner occupier or rented), among others. A contingent

valuation method was used, which solicited the residents' preferences through survey techniques to state their willingness (WTP) for the benefit gains from an improvement on environmental quality or for a loss caused by degradation of quality. Results indicated that the presence of the landfills and the associated environmental impact was an important factor contributing to respondents' willingness to pay for environmental improvement in their neighbourhood. Furthermore, the proportion of respondents willing to pay decreased consistently as distance increased away from landfills in the two locations. This is probably that people may not see any reason to pay for environmental improvement since they live farther away from the landfill and may not feel much of the impacts. Again, respondents were not generally willing to pay high amount for environmental improvement. This possibly could be for economic reason, as income per capita is usually low in developing countries, like Nigeria.

Studying the housing improvement of core residential environmental quality of Ogbomosho town, Afon (1998) made use of 20 variables and identified 10 environmental quality indicators. The indicators were, water availability, economic opportunities, clean and healthy environment, availability of electricity, good condition of road, nearness to health facilities, safety, accessibility to transportation network, availability of waste disposal facility and nearness to primary school. Correlation matrix was compared to determine the relationship existing between pairs of the variables. Correlation of the ten proved positive with electricity and water being highest among them. Results showed that it was no use for planners to impose their ideas on the public because people were better planned for when they had inputs into policy and programmes that affected their present and/or future. Hence, it was asserted that it will be more effective if

core residential housing improvements were carried out through the utilization of core residents' environmental quality indicators.

Ekurekong and Jacob (1998) carried out a study on compliance that ensures high attachment of environmental quality in housing estate in Uyo, Akwa Ibom State. This study revealed that contraventions in development of the estate were mostly committed by members of the ruling government, i.e. the political class. The housing estate by all indicators was deficient in facilities and service provision. The study also showed that more than 70% of the total area of the estate had been used for residential development, leaving less than 10% for the provision of facilities and services. The analysis showed that the existing faculties were undoubtedly inadequate to support the huge population in the estate. Hence, increased demand for water and electricity, recreational space, residential accommodation space as well as increased private vehicular traffic congestion in the estate were anticipated based on increase in population. An environmental quality unit was recommended to be established to monitor and control the quality of the environmental in the estate. The unit should ensure that the land use intensity ratio specified for various sections were maintained. The unit was expected to be empowered to implement all measures to maintain quality. Such measures include evacuation of wastes, maintenance of parks, public schools and health centres.

Ede et al (2007) studied housing and neighbourhood quality for Yenegoa, Bayelsa State. The studied five neighbourhoods in the city to examine the problem using questionnaires and physical observation as instruments. The results showed that sanitary services among other independent variables have the greatest significance level of 99. Okeke

(2000) described the extensive use of temporary structure in the high density neighbourhoods of Nigeria urban centres as the forerunner of squatter settlement development, while Umeakuka and Mba (1999) observed that storm water drainage paths were totally blocked in Onitsha with solid wastes, which in turn, induced urban flood. In Enugu, the numerous and interlinked causes of urban solid waste management problems and the attendant economic, social and health costs as well as environmental and esthetic costs were the inertia factor, the demographic factor, institutional factor as well as absence of public participation (Nwafor, 2008).

The Study Area

According to the Enugu State Ministry of Information (2002), Enugu metropolis is located between, latitudes 6°27' N and 7°28' N and longitudes 7° 30'E and 8° 19E. The urban land area is roughly 72. 8 square kilometers with the rural environs covering an additional area of about 200 square kilometers. The study area comprises three local government areas (LGAs), namely, Enugu North, Enugu East and Enugu South. Enugu metropolis is bounded on the north by Isi Uzo LGA, on the south by Nkanu West LGA, on the east by Nkanu East LGA and on the west by Udi LGA.

The metropolis, which lies on an altitude of 232.6 metres above sea level, exists with natural domes in the south and undulating plains forming the foothills of Udi escarpment in the north, and widening out into the upper Ebonyi river plains. It has an annual rainfall of 1247.8 mm, and the rainfall is mostly during the months of April through October, having July as the peak period.

The temperatur variation within the season is normally less than 10 °C. The relative humidity fluctuates between 40 and 80 percent. The prevailing winds are the local monsoons -

the north east trade wind and the south west trade wind - resulting in dry and raining seasons respectively.

The metropolis has a type of soil that is predominantly reddish brown in colour, with the underlying rock having a high load-bearing capacity. This makes the soil suitable for intense building construction. The soil also supports moderate agricultural activities.

The natural vegetation in the metropolis is primarily of tall, medium and short grasses. Most of the trees are deciduous and include Isoberlina, sheer butter, locust beans, among others.

Enugu started as a photo-urban settlement near the mines, following the discovery of coal in the Udi hills about 1909. Iva Valley and Ogbete, which were the first areas to develop, functioned primarily as coal miners residences. With the discovery of deep sea harbour in Port Harcourt, construction work commenced in Enugu in 1914 (Enugu-Port Harcourt Rail line). In 1917, Enugu attained township status and was then referred to as Enugu Ngwo. As a result of its rapid expansion towards areas owned by other indigenous communities rather than towards Ngwo highland, it was renamed Enugu in 1928. By 1939, Enugu had become the headquarters of the then southern province. It became a regional capital and the most important administrative centre in the eastern region with the creation of three regions in Nigeria in 1961.

The Enugu State Housing Development Corporation (ESHDC, 2011) reported that the earliest developed residential quarters in Enugu are Coal Camp, Iva Valley, and Government Reserved Area (GRA). Other established neighbourhoods presently in the metropolis are Uwani, New Haven, Abakpa, Emene, Achara Layout, among others.

The population of the metropolis has been on the increase within the last few decades, as a result of rapid urbanization and subsequent influx of people. The population rose from 63,000 in 1953 to 482, 977 in 1991 and to 722, 664 in 2006 (NPC, 2006).

Methodology

The study adopted the survey design. Thirty neighbourhoods in Enugu metropolis - stratified into low, medium and high density neighbourhoods - were used. Samples were selected randomly from the neighbourhoods. The sample size for each stratum of neighbourhoods was determined using Bowley's proportional allocation statistical technique.

Questionnaires were used to collect primary data. They were designed using five point likert scale to address the objective of the study. The validity of the research instrument was measured using content validity. Test-retest method was used to determine the reliability of the research instrument. Also, field tests were carried out to determine the noise level, as well as the air quality of the study area.

Two major variables used in the study were the dependent and the independent variables. Environmental quality variables constituted the dependent variables, while public and private housing investment made up the independent variables. The hypothesis was tested at 0.05 level of significance, using factor analysis and multiple linear regressions. Factor analysis (principal component analysis) was first used to reduce the various environmental quality variables. Varimax rotation was introduced to get the aggregate factor score as the "y" variable. Then multiple linear regression was used to establish the nature of relationship between environmental quality of the study area and public

and private housing investments (x_1 , x_2 respectively) in the area.

Results and Discussion

Twenty-one residential environmental quality variables were used in the study, made up of 11 dwelling unit variables (condition of floor, condition of wall, condition of windows, condition of ceiling condition of roof, condition of lighting, structural condition, landscaping, nuisance, poor condition of units, neighbourhood problem), 5 parcel quality variables (condition of drives, fair condition of units, sanitary condition, drainage, noise level), and 5 basic residential quality variables (crowdedness, good condition of units, air quality, waste disposal and source of domestic water supply). The variables were used in obtaining data in all the 30 neighbourhoods of the study area.

The cost of housing investments were determined in both public and private investments in the area. Thereafter, the mean values of investments in each of the neighbourhoods were found. SPSS version 13 was then used to analyse the data. The SPSS output from regression analysis are presented in Tables 8.1-8.3 as Model Summary, ANOVA and Coefficients respectively.

Table 8.1: Model Summary

Model	R	R²	Adjusted R²	Std Error of the estimate
1	.975	.949	.915	7.02218

a. predictors (constant), privest, pubinvest

Table 8.2: ANOVA b

Model	Sum of squares	df	Mean square	f	Sig
1 Regression	6.731.305	2	1346.334	26.866	.000 a
Residual	350.243	27	50.115		
Total	7082.057	29			

a. predictors (constant) prinvest, pubinvest

b. dependent variable, aggscore

Table 8.3: Coefficients b

Model	Unstandardized coefficient		Standardized coefficient	t	Sig
	B	Std. Error	Beta		
1	24.248	13.407		3.809	.042
(constant)	-1.354	2.519	.150	5.537	.013
pubinvest	-2.247	2.551	.236	4.236	.023
prinvest					

Dependent variable: aggscore

Results showed a strong significant relationship between residential environmental quality and housing investments in the study area. $R^2 = 0.949$. This means that 94.9% of variation in the dependent variable (environmental quality) can be predicted from the independent variables (public and private investments).

However, to generalize the finding to the population beyond the sample, the adjusted R^2 is employed. Adjusted $R^2 = .915$. This means that the best coefficient of determination is 91.5%. Thus, 91.5% (explained variance) of the variables is capable of predicting the value of environmental quality in the

area. This leaves 8.5% of the variation unexplained, suggesting that the explanatory variables could be regarded as being high.

Also, P-significance = .00 and $P < 0.05$ significance level. Interestingly, the public investment has P-significance level of 0.013 and private investment has P-significance value of 0.023 which were all significant at 0.05 significance level. The standard error of the estimation = 7.02218, which is the standard deviation of the error term.

To measure the significant interactions in the model, the coefficients of the independent variables are employed. The coefficient 'b' table indicates the relative impact of each variable on the dependent variable to predict the dependent variable. It is pertinent, however, to note here that private investment variable impacts more on the environmental quality of the area than public housing investment. This suggests that housing investments in the study area are more of private investment than of public investment.

Conclusion and Recommendations

Housing investments in the metropolis is not commensurate with the teeming population of the area. Enugu metropolis is not left out of the population upsurge in Nigeria. The increased population is indeed, making great demand on the available housing stock in the area as well as the surrounding neighbourhoods. Consequently, the existing housing units are deteriorating fast, solid waste management is posing a serious problem, some amenities are depleted and certain facilities have totally broken down in the area, boiling down to degradation in the environmental quality of the area. Hence, unless urgent practical steps are taken, the current wave in the global trend of environmental quality sustainability will continue to be a vision of illusion in the area.

The government ought to regard occupation of residential housing units as a need, which should not always serve as a profit making venture. Hence, the Enugu State Government should arise and make every frantic effort towards embarking on realistic housing projects that will effectively complement the efforts of the private sector. However, the site and services scheme, part of the Enugu State Government effort to encourage private housing investment, should be seriously embarked upon to attract various categories of private investors. Besides, the Enugu State Government should reconsider the decision of privatizing some of the public housing units because they go a long way to augment the private sector provision. Where the Enugu State Government deems it necessary to go on with the programme for reasons outside the scope of this study, the civil servants, low and medium income earners, should be made to be the first beneficiaries.

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