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CONTENTS

EDITORIAL

For many centuries, technological advances of great significance were made without benefit of knowledge from science. The iron production, printing, and hydraulic engineering, including dams, canals, irrigation systems, water wheels, canal locks, barbed wire, food preservation, fermentation and many metallurgical processes are instances where technology ran ahead of science. The steam engine was commonplace before the science of thermodynamics elucidated the physical principles underlying its operations.

With the growth of the chemical and electrical power industries in the 19th century, scientific knowledge was of direct use in solving of problems and the development of products, although it was rarely sufficient on its own. Later, the communication and electronic industries manifested the effectiveness of a close relationship between science and technology, as indeed did the experience of World War II and subsequent more local military conflicts. By the second half of the 20th century, much modern technology was intimately related to scientific knowledge, and science itself had become increasingly linked to technology through its dependence on complex instrumentation to explore the natural world.

More similarities than differences can be found between science and technology. Both terms imply a thinking process, both are concerned with causal relationships in the material world, and both employ methodology that results in empirical demonstrations that can be verified by repetition. The symbiotic and synergistic relationship between modern science and modern technology has thrown up the term "technoscience" to describe the essentially merged, even hybrid, enterprise.

So far, academic journals appear to dissect and concentrate on various aspects of technoscience, rather than merge them. Thus, there are journals of science, technology, engineering, and others. There is the need for an academic research journal of technoscience, to integrate the various aspects of technoscience, which have become hybridized, especially at the rapid rate of technoscientific development and growth. The aspiration to fill this gap has birthed *Technoscience Review*.

This issue, 4 (1&2) of November 2013, contains some very enriching papers. In the first article, titled *Relation between road distance accessibiliy and functional index of facility occurence in Lagos Island,* Atubi, Augustus O. (Ph.D.), an expert in Transport Studies and former Head, Department of Geography and Regional Planning, Delta State University (DELSU), Abraka, Nigeria sought to find out areas that have below or above average level of occurrence of facilities relative to the level of accessibility in part of a megacity, Lagos Island, Nigeria. Using both simple regression analysis and Pearson's Product Moment Correlation Coefficient, it was found that there was no strong relationship between road distance accessibility and occurrence of facilities (i.e. r = -0.14). Based on the findings, recommendations that would enhance equitable transport development in Lagos Island were proffered.

In the second article, titled *Deforestation and climate change in Nigeria,* Emodi, Edmund E. (Ph.D), Former Head, Department of Environmental Studies, Caritas University, Amorgi-Nike, Enugu, Enugu State, Nigeria, against the backdrop of very high rate of deforestation in the country as a result of primarily persistent high and ever-increasing rate of demand from wood and wood products from both domestic and external sources, argues that natural function of the forest in purifying the environment is impaired. He recommends integration of development planning and environmental management at all levels of political and economic decision making to ensure sustainable development.

In the third paper, titled *The influence of travel time on accessibility in Lagos Island,* Atubi, Augustus O. (Ph.D.), an expert in Transport Studies and former Head, Department of Geography and Regional Planning, Delta State University (DELSU), Abraka, Nigeria determined the influence of travel time on accessibility in Lagos Island, Nigeria. Average driving speed was observed to be lower over short than over long distance routes. High speeds tend to be concentrated within a distance band of over 2.7 km. But beyond 6.0 km, average driving speed was low, probably as a result of interruptions on the route. The mean driving speed for all nodes of the network was calculated to be 0.31 kmpm (approximately 19 kmph). The average driving speed was found to be

significantly related to the link distance, with a correlation value of (r = 0.76). Based on the findings, recommendations were proffered towards reducing financial and time costs and increasing accessibility

In the fourth paper, titled *An appraisal of the effectiveness of the Enugu State Waste Management Authority*, Onyenekenwa Cyprian Eneh (Ph.D), Senior Research Fellow and Anamalu, N.P. both of the Institute for Development Studies, Enugu Campus, University of Nigeria, Nsukka assessed the effectiveness of the Enugu State Waste Management Authority (ESWAMA), as perceived by consumers (the public). A multistage sampling technique was used. The first stage involved simple random sampling to select three neighbourhoods to represent high-density, medium-density and low-density neighbourhoods and to select target households. Questionnaire was administered to the households. The data were analysed by means of tables of frequency and simple percentage. Average Mean Score technique was used to test null hypotheses. Findings showed that ESWAMA was ineffective in all the 9 (out of 12) statutory responsibilities assessed. Most adverse public opinion (92.5 %) was on recycling of solid wastes, followed closely by 90 % for designing, operating and maintaining waste disposal facilities, 86.5 % for removal and disposal of abandoned vehicles, 81.7 % for approving and keeping close watch on all waste disposal systems, 80 % for monitoring, cleaning, clearing and maintaining drainage facilities, 75 % for removing and disposing carcasses of dead animals from public places, 65 % for clearing the streets of solid wastes, 64 % for collecting, removing, processing, treating and safe disposal of domestic, hospital, commercial, institutional and industrial solid wastes, and 64 % for taking requisite, advantageous and convenient actions for or in connection with the carrying out of its functions or incidental to their proper discharge. Like most state-owned enterprises, ESWAMA was found wanting by consumer opinions. Hence, it was recommended that ESWAMA should be privatised for efficiency.

In the fifth article, titled *An empirical analysis of the effects of materials management on the profitability of small poultry enterprise*, Emerole, Gideon I. (Ph.D) and Edeoga, Georgina I. both of the College of Management Sciences, Michael Okpara University of Agriculture, Umudike, Umuahia, Abia State, analysed the monthly materials records of a small poultry enterprise for 2011-2012, using multiple regression and correlation. It was found that proper materials management enhances the profit of the enterprise. It was, therefore, recommended that firms should formulate and maintain proper material management policy.

Guide to authors is provided in the column on ‘Call for articles.’

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RELATIONSHIP BETWEEN ROAD DISTANCE ACCESSIBILITY AND FUNCTIONAL INDEX OF FACILITY OCCURRENCE IN LAGOS ISLAND, NIGERIA

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Abstract

Transport studies on Nigeria have reported a decline of accessibility from the capital city to the peripheries of the state, accessibility of major centres to the bus transport services, as well as accessibility and occurrence of public facilities. This study sought to find out areas that have below or above average level of occurrence of facilities relative to the level of accessibility in part of a megacity, Lagos Island, Nigeria. Using both simple regression analysis and Pearson's Product Moment Correlation Coefficient, it was found that no strong relationship between road distance accessibility and occurrence of facilities could be established (i.e. r = -0.14). Based on the findings, recommendations that would enhance equitable transport development in Lagos Island were proffered.

Introduction

The purpose of transport is to provide accessibility, or the ability to take a journey for a specific purpose. Transport is not consumed for its own sake, but it is merely a means to an end (a derived demand) (Hoyle and Knowles, 1992; Atubi and Onokala, 2004a, and 2004b). However, studies of accessibility are more concerned with issues of efficiency and equity with respect to location of public facilities. An efficient location of public facilities gives the minimum total systems cost of operation and travel of a given level or volume of service. On the other hand, equity in location of public facilities is one which promotes greater equality of conditions (Rich, 1979; Chandra et al, 2000).

Thus, in the United States of America (U.S.A.), accessibility studies in the late 1970's and 1980's seem to centre on or emphasise access to public facilities (Lineberry, 1977; Couller, 1980; Mclafferty and Gosh, 1982; Rosenberg, 1983; Meyer, 1995). In Nigeria, several studies on accessibility tend to be related to urban centres or urban based activities. Thus, Weinnand (1973) in a study of development in Nigeria observed that spread effects of concentration of development are limited to the vicinity core areas, while much of the periphery is virtually immuned to development impulses. This study is supported by other studies from other developing countries (Robinson and Salih, 1971; Gilbert, 1975; Atubi and Ali, 2006; Atubi, 2007a).

Other works on accessibility in Nigeria include Bardi (1982) and Abumere (1982). Both arrived at the conclusion that accessibility declined from the state capital of Benin-City to the peripheries of the state as well as accessibility of major centres to the bus transport services in Enugu (Ali, 1998) and accessibility and occurrence of public facilities in Lagos Island, Nigeria (Atubi, 2007a).

Study area

Lagos Island is located within Lagos State, which is a coastal state situated in the South-west Nigeria. Lagos Island is one of the 20 Local Government Areas in Lagos State (see Fig. 1.1). It is the second largest urban complex in Nigeria after Kano and claims 2% of the nation's population on a less than 0.2% land area.

Methodology

Areas accessible to the road network and with population upwards of 1,000 were regarded as activity centres. The choice of nodes was based on population size. Based on the adopted operational definition of major centres, 30 major centres were identified (see Fig. 1.3). In order to classify the major centres, data on six areas of central facility provision were collected namely: medical, educational, market, postal services, banking and administrative headquarters. The choice of these facilities was based on the fact that they are capable of generating home-to-facility travels. Data on travel time and cost were collected both by personal observation and oral interviews. To ascertain if a relationship exists between accessibility and functional indices of facility occurrence in the study area, Pearson's Product Moment Correlation Coefficient Statistics (r) was employed.

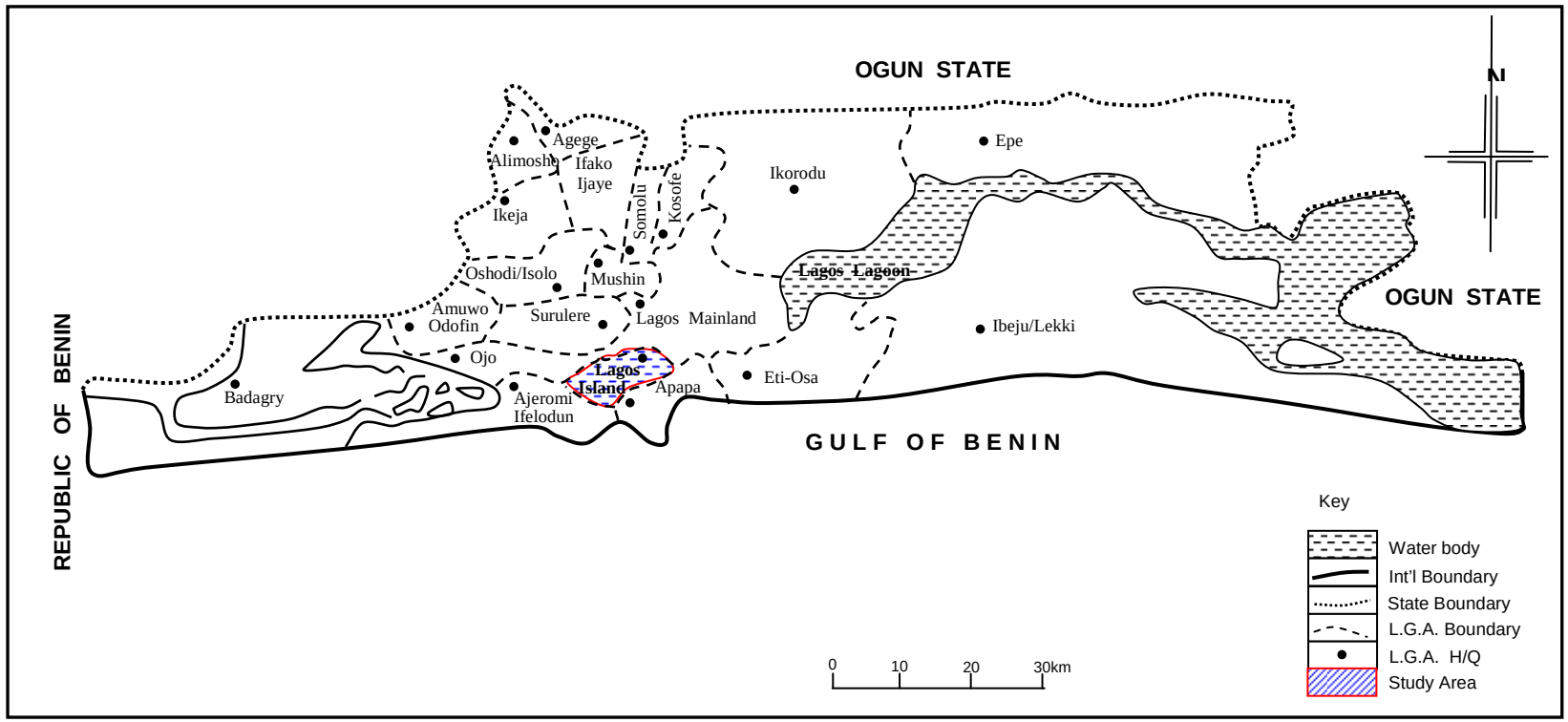


Fig. 1.1: ***Map of Lagos State Showing the 20 LGAs.***
Source: Lagos State Ministry of Environment and Physical Planning (1999)

Results and Discussion

Appendix 1 shows the calculation of the correlation between road distance accessibility and functional index. The correlation coefficient (r) is given as r = -0.14. This is negative and at 1 % probability level. Therefore, it is not significant (Appendix 2 and 3).

The negative correlation coefficient shows that the greater the accessibility index value (hence the less accessible the centre is), the lower the level of facility occurrence. This is consistent with observations in the study area.

Although the coefficient of correlation proves insignificant at 1% level, it is important to approach the correlation with some caution, as there is a tendency for large sample size to indicate high coefficient. We would rather say that the coefficient indicates that the association between accessibility and functional index is not strong. It was also observed that a good number of centres with low accessibility have high functional index, and vice versa. Areas with the shortest road distance to all parts of the study area do not have more facilities. This is further discussed in analysis of residuals.

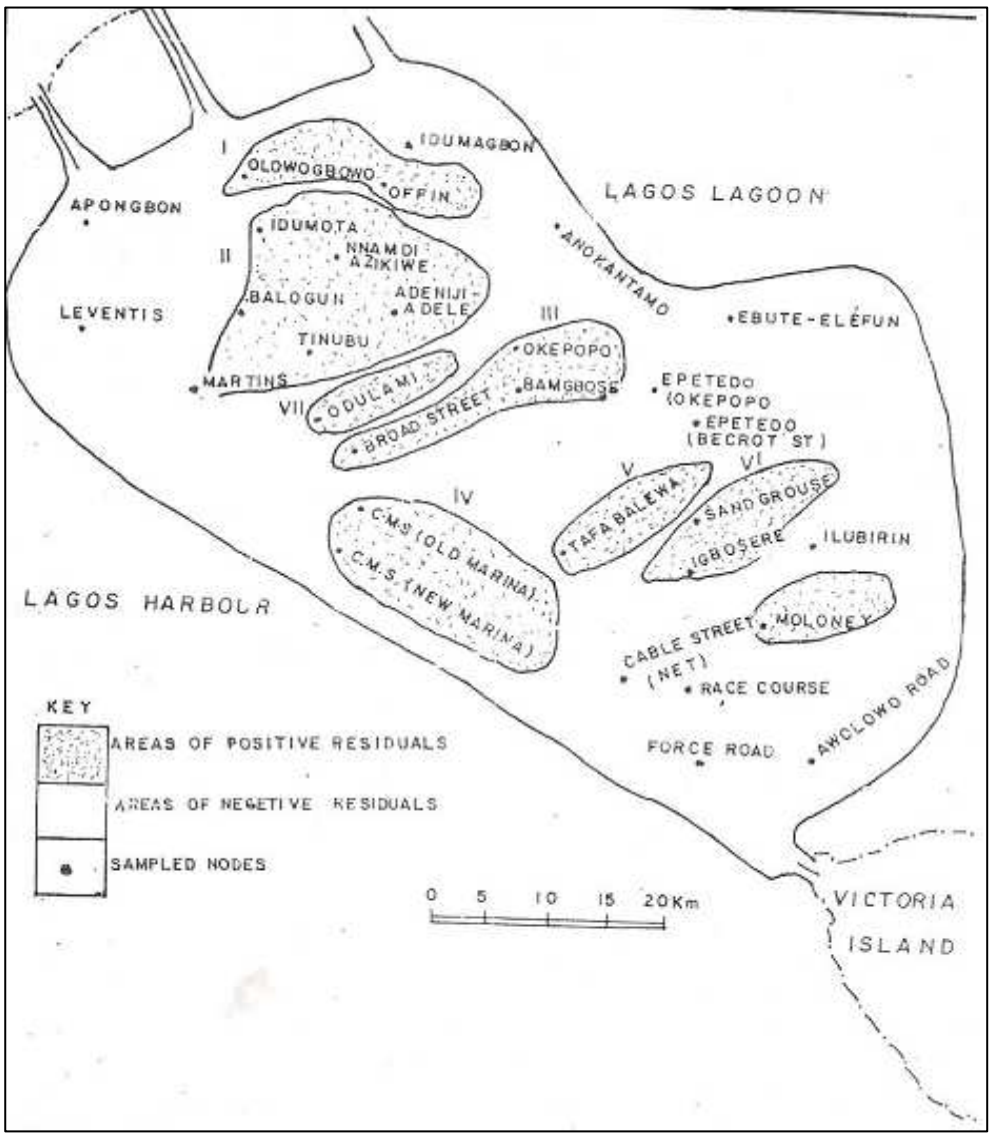
Meanwhile, the calculated regression equation is as shown in Appendix 4. It is of the form:

$$\text{Log } (F_I) = 0.548 \text{ Log (RAI) } 1.897 \text{ - - - (1)}$$

Where: F_1 = Functional index,
RAI = index of road distance accessibility

From the map (Fig. 1.2), it was observed that areas of positive residual (areas that tend to have more facilities than the assumed level of distance accessibility) are widely distributed throughout Lagos Island: not all nodes with high level of accessibility have excess number or type of facilities. Rather, it was observed that there are two areas of positive residuals. The first are those areas which have high accessibility indices and also correspondingly high functional indices. These are identified as II, III, IV and VI or Tinubu areas, Bamgbose, CMS (New Marina) and Sand-Grouse areas respectively. The second are those areas with low accessibility indices, but high functional indices relative to the surrounding centres.

These are marked by I, V and VII. They are identified as Olowogbowo, Tafawa Balewa and Odulami areas respectively



These are marked by I, V and VII. They are identified as Olowogbowo, Tafawa Balewa and Odulami areas respectively.

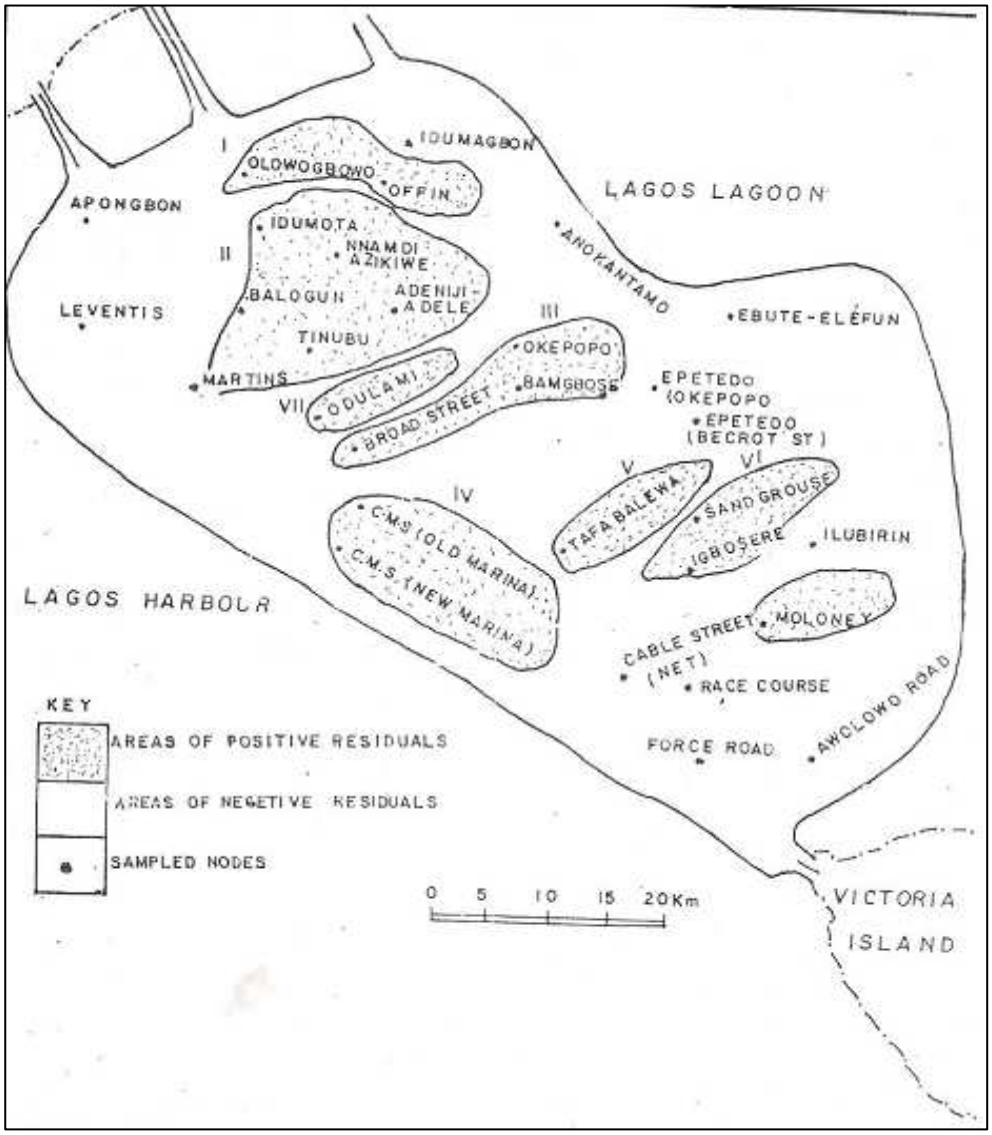


Fig. 1.2: ***Positive and negative residuals from the regression of functional index on accessibility***

Within the first group, it was observed that the network of roads is quite high and nodes are found at short distances from each other. Driving time within the centres in this group ranges from 3 minutes in Tinubu areas to about 15 minutes in Adele–Nnamdi Azikiwe axis. For these areas, it may be plausible to say that high level of accessibility is a contributory factor in attracting the concentration of facilities. Thus, Broad Street with the sixth highest accessibility index also possesses a good number of first order facilities – specialist hospitals, a large daily market and commercial banks. The same may be said to some degree of CMS (Old Marina) and Adeniji Adelel. For these centres, it may be said that accessibility indices and establishment of facilities demand improvement of accessibility.

In the second group it was however noticed that there is a wide variation in levels of accessibility associated with positive residuals. This range from Offin (Ai = 313.7). Nonetheless, we cannot say that road distance accessibility is an important factor in the establishment of facilities. This is especially true when we consider such centres in this area as Olowogbowo, Offin and Tafawa Balewa. Uniquely, Olowogbowo has the fourth greatest functional index, both in number and type of facilities. Yet, Olowogbowo is at the verge of the periphery of the study area. So, its importance has not much to do with its accessibility to other parts of Lagos Island.

In the analysis of areas of negative residuals (areas having less than expected level of facility occurrence), we also noticed a wide distribution of centres throughout Lagos Island. In fact, the areas of negative residuals are around the areas of positive residuals. We have centres that are peripherally located marked by high accessibility indices. These include Ilubiri (Ai = 258.7), Force Road (Ai = 293.4) and Race Course (Ai = 291.3), which have low indices of facility occurrence. This may look like neglect if we can consider distance accessibility alone. However, these centres have low population and this could account for the level of facility occurrence (see Fig. 1.3 and Appendix 1).

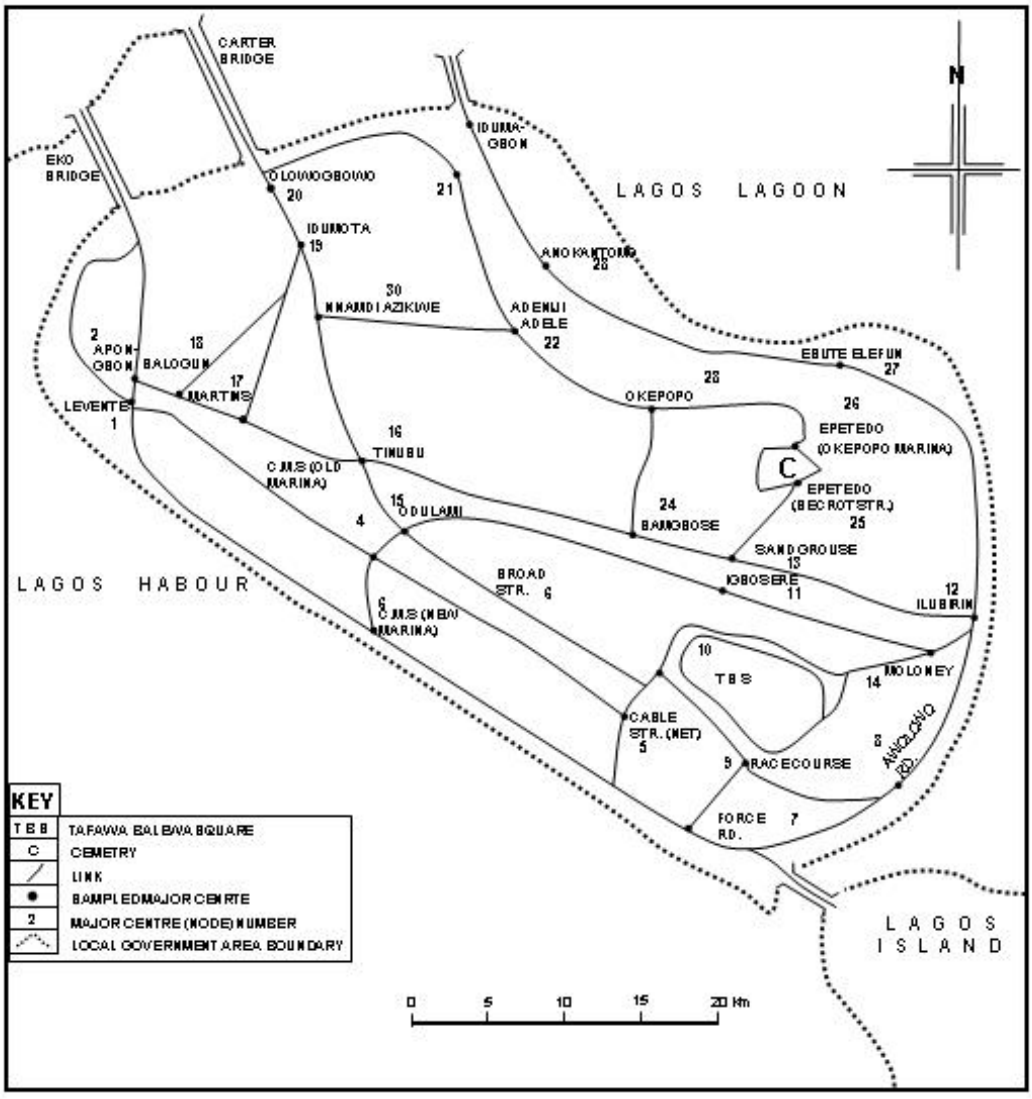


Fig. 1.3: ***Location of sampled major centres in Lagos Island LGA***

Policy Implications and Recommendations

One strategy would be to provide those services, which centres lack, based on extensive surveys of what are available and what are needed. This centre-based approach might prove more useful if the people are guided to choose out of their preferences.

To ease traffic flow along the routes, better road network characteristics must be ensured. For example, the roads have to be better connected to improve their accessibility. Also, roads have to be widened to more lanes to increase their carrying capacity and these are especially true for the routes headed to the Island. Better road network characteristics would not only lead to a faster flow of traffic along the routes, it would also make for a well structured road network system and also a faster pace at curbing congestion problem in Lagos Island.

In a pilot survey, it was found out in Idomota that the major facility the centre desired was a commercial bank, while at Nnamdi Azikiwe it was a hospital. In these centres, the nearest commercial bank for Idumota is located at Martins street, and for Nnamdi Azikiwe the nearest hospital is located at Idumota. Providing them with these facilities would reduce the distance travelled to obtain these services. This suggestion can be achieved by purchasing structures on the ground. Moreover, landuse intensity here is quite high and this is marked by the great concentration of skyscrapers along these centres.

The strategy of constructing new links or expanding the width of the roads or increasing the number of lanes to improve accessibility may involve heavier financial investment. Thus, a proper cost benefit analysis may be needed to determine the desirability of such investment, as this would help to increase accessibility, reduce cost and time to other centres.

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APPENDIX

Appendix I: ***Logarithmic transformation of accessibility and functional indices data***

Node No.	Accessibility Index (RAI)	Log (RAI) = X	Functional Index (FI)	Log (FI) = Y
1	336.8	2.52737	0	0
2	320.4	2.5056925	0	0
3	268.5	2.4289443	20	1.30102999
4	242.9	2.38542752	90	1.95424251
5	324.0	2.5117497	5	0.6989700
6	247.8	2.3941013	177	2.27797327
7	293.4	2.467460	0	0
8	300.5	2.4778445	24	1.38021124
9	291.3	2.46434049	16	1.20411998
10	275.7	2.44043677	50	1.6989700
11	262	2.41830129	20	1.30102999
12	258.7	2.41279645	5	0.6989700
13	252.8	2.4027771	42	1.6232493
14	256	2.40823997	17	1.2304489
15	212.4	2.3271545	10	1.0000000
16	214.1	2.33061667	27	1.43136376
17	246.4	2.3916407	34	1.53147892
18	263.3	2.42045086	15	1.17609126
19	268.7	2.42926767	40	1.60205999
20	291.4	2.46448955	61	1.78532984
21	313.7	2.49651452	31	1.49136169
22	266.2	2.42520805	70	1.845098
23	268.8	2.4294293	19	1.2787536
24	233.2	2.36772855	53	1.7242759
25	306	2.48572143	5	0.6989700
26	379.3	2.57898284	5	0.6989700
27	430.8	2.63427569	33	1.5185139
28	508.8	2.7065471	33	1.5185139
29	631.5	2.80037336	35	1.5440680
30	228	2.35793485	20	1.3010299

Σx	=	73,891818	Σy	=	37.4850939
Σx^2	=	182.316441	Σy^2	=	56.0592696
$\bar{x}$	=	2.4630606	$\bar{y}$	=	1.24950313
σx	=	0.1044547	σy	=	0.3955683
Σxy	=	92.08256785			

Appendix 2: ***Correlation between road distance accessibility index (RAI) and functional index (FI)***

Correlation Coefficient (rxy) is given as:

$$rxy = \frac{n\sum xy - \left(\sum x\right)\left(\sum y\right)}{\sqrt{n\sum x^2 . \left(\sum x\right)^2} \times \sqrt{n\sum y^2 - \left(\sum y\right)^2}}$$

$$= \frac{30\times 92.0825679 - (73.8912)(37.435094}{\sqrt{30\times 182.316441 - (73.89182)^2} \times \sqrt{30\times 56.0592696 - (37.485004)^2}}$$

$$= \frac{-7.3648}{51.24410196}$$

= -0.1437 (Approximately -0.144)

Hence the correlation coefficient (rxy) between road distance accessibility and functional index is -0.144.

TEST OF SIGNIFICANCE FOR THE CORRELATION COEFFICIENT BETWEEN RAI AND FI

The student's test is given by

$$t = \frac{r\sqrt{n-2}}{\sqrt{(1-r^2)}}$$

Where r = 0.14
n = 30

Hence $t = \frac{0.14\sqrt{28}}{\sqrt{(1-(0.14)^2}}$

$$t = \frac{0.741}{0.990}$$

= 0.75

Ho: There is no relationship between accessibility and functional index.
Hi: There is relationship between the two.

Table value n-2 degree of freedom
30 – 2 = 28
0.01 = 1 – 0.01 = 0.99
= 2.47

But t 0.01 < t calculated

Hence, at 0.01 probability level we cannot reject Ho but state that there is no significant relationship between accessibility and functional index of facility occurrence.

Appendix 3: ***Calculation of single regression equation of functional index (FI) and road distance accessibility (RAI)***

The regression of y (Log FI) on x (Log RAI) is given by:

$$y - \bar{y} = ryx \frac{(6y)}{(6x)}(x - \bar{x})$$ (Theakstone and Harrison, 1970, p. 90)

Where y = 1.249
x = 2.463
Oy = 0.396
Ox = 0.104
ryx = -0.144

Hence, y – 1.249 = - 0.144 $y - \bar{y} = ryx \frac{(0.396)}{(0.104)}(x - 2.463)$

i.e y – 1.249 = - 0.548 (x – 2.463)
y – 1.249 = 0.548 + 1.349
y = - 0.548x + 1.897

Hence, regression equation becomes:

Log FI = -0.548 Log RAI + 1.897.

Appendix 4: ***Calculation of standard error and confidence limits of the FI – RAI***

Standard error of y on x (S.EY on x) is given as:

S.EY on $x = y\sqrt{(r - r^2)}$ for estimate of y.

S.E = $0.396\ \sqrt{1 - (0.144)^2}$
S.E = 0.396 x 0.989
= 0.392

Hence, at 68% coefficient limits or 1 (S.E) the regression equation would be:

Log FI = 0.548 Log RAI + 1.897 ± 0.39

DEFORESTATION AND CLIMATE CHANGE IN NIGERIA

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Abstract

Empirical studies reveal that Nigeria has a vast amount of forest resource base whose diversity reflects the country's large land area of 923,765 km^2. Its diverse tropical ecological environment comprise coastal mangrove and rain forest in the South, and Guinea Sudan and Sahel Savanna to the North. But, various estimates confirm the very high rate of deforestation in the country as a result of primarily persistent high and ever-increasing rate of demand from wood and wood products from both domestic and external sources. Thus, the natural function of the forest in purifying the environment is impaired. Integration of development planning and environmental management of all levels of political and economic decision making needs to be adopted to ensure sustainable development.

Introduction

Climate change is one of the endemic environmental problems plaguing the global environment. Indeed, it is now being recognized as the greatest and most serious environmental challenge facing the world in the 21st century, to the extent that global warming and climate change issues now top the global agenda (Nwafor, 2006).

On the other hand, deforestation in Nigeria is another major area of environmental concern. It is one of the most important issues of the last ten decades because of its effects on global climate, via its impacts on the biogeochemical cycle of carbon. In view of its link with global warming and climate change through the decrease in the global carbon sink, deforestation is a local environmental problem with a global dimension. Although it has occurred since the dawn of civilization, reports from various parts of the world indicate that it is now on the increase due to increased socio-economic activities. This paper therefore traces the impacts of deforestation on climate change in Nigeria.

Deforestation trend in Nigeria

Deforestation is the removal of forest and other forms of vegetative cover from a site without its replacement. There is considerable uncertainty about the rate of deforestation in the tropics because detecting and interpreting change is difficult (Cunninghan and Cunninghan, 2005). Nigeria has a vast amount of forest resource base whose diversity reflects the country's large land area of 923,765 km^2. Its diverse tropical ecological environment comprise coastal mangrove and rainforest in the south, and Guinea, Sudan and Sahel savanna to the north. About 96,000 km^2 of the total area of forest types in Nigeria constitute the forest estate. This represents about 10% of the total land area of Nigeria compared to 20%, which is the target in the forest policy (Isimekhai, 2002).

Various estimates confirm the very high rate of deforestation in Nigeria. The high forest cover in the country decreased from 20 million hectares in the beginning of the 20th century to only 2 million hectares in the 1990s (Oguntala, 1996). In the Sudan-Sàhel States of Sokoto, Katsina, Kano, Bauchi and Borno, shortages of fuel wood are already critical.

The major causes of deforestation in Nigeria are population growth and the expansion of economic activities, including logging or timber exploitation, urbanization, farming, bush burning, firewood collection, grazing, and infrastructural development (Emodi, 2012). During the oil boom years of the 1970s, there was a massive increase in construction activity which heightened the demand for both construction and furniture timber from forests in Ondo, Edo, Delta and Cross River States (Atoyobi, 2000). Hence, the country's standing crop of valuable species (e.g. Iroko, Mahogany) of merchantable size has been severally depleted. In Ajoda New Town Ibadan, in Agbara, Ogun State and in Abuja Federal Capital Territory, forests and woodlands have been and are being destroyed to make way for new cities, industrial and housing estates. The phenomenal growth of Lagos along Badagry or Ikorodu roads amply illustrates the consequences of urban population growth. Nearly all farmlands between Lagos and Ikorodu have been engulfed.

According to Okezie (1999), in the past 30 years, the country had been loosing on the average about 23,000 hectares of the gazetted forest estate per annum through government dereservation. For instance, 410 hectares of Ogba forest in Edo State was used for government projects and airport. The Army School of Artillery, the Nigerian Defence Academy and the Police Mobile Training School have together claimed about 7,420 hectares of forest reserves in Kaduna State. In Kwara State, the Ilorin airport claimed 1,140 hectares of the Ajaokuta Forest Reserve (NEST, 1991).

Also, a lot of forested land have been lost through indiscriminate bush burning and over exploitation. For example, between 1980 and 1982, over 900 hectares of gmelina pulpwood plantation in Oluwa Forest Reserve, Ondo State, and 490 hectares of pine pulpwood plantation in Anambra state were lost to fire.

Climate change and the implications

Climate change refers to a statistical significant variation in either the mean State of the climate or its variability, persisting for an extended period typically for decades or longer (Nwafor, 2008). In Intergovernmental panel on climate change (IPCC) usage, climate change refers to any change in climate over time, whether due to natural variability or as a result of human activities altering the atmospheric composition (IPCC, 2001). However, Anyadike (2009) observed that climate change is any change in the climate directly or indirectly attributable to astronomical cause, earth based causes and/or human activities.

Climate change could be noticed through global warming caused by: Green house gases through a phenomenon known as "green house effect". The green house effect is analogous to the glass panel of a garden green house that lets heat but prevents some of it from escaping, thus warming the plants enclosed inside. It is the cumulative effects of this heat that scientists concluded as causing global warming. However, according to Anyadike, climate change could be brought about through solar spot cycle, meteorites, milantovitch variations, volcanic eruptions and other human activities such as transportation emissions and gas flaring.

Greenhouse gases absorb and emit radiation within the thermal infrared range. The earth receives energy from the sun in form of radiation, and reflects about 30% of the incoming solar radiation. The remaining 70% is absorbed, thus increasing the temperature of earth. According to Miller (1991), the major greenhouse gases are; carbon dioxide, chlorofluorocarbon (CFC), methane, nitrous oxide.

The implication of climate change cannot be over emphasized. According to Inter governmental Panel on Climate Change (IPCC), unless urgent action is taken, it is likely that, global temperature will rise by a further 1.8 - 4.^{o}c. In a few decades, it is expected that heat waves will become more intense and frequent in urban areas. Warming will seriously affect rainfall. Precipitation will increase and some regions will get drier. Not knowing what to expect will be one of the greatest difficulties for the agricultural sector in coping with climate change. Meanwhile, farmers have already started counting their losses because of unfavourable weather. As the climate changes, the vagaries of weather will be more pronounced and losses in crop production are likely to increase. The effect of global warming will be felt in the rise in sea level because of the thermal expansion as ocean waters warm. Besides, there will be melting of glaciers and ice field at the polar region. The warming at the poles could have great consequences when the ice melts because so much water is stored in form of ice in this region. This will give rise to flooding in many costal areas, forcing many people to abandon their property and migrate into the hinterland. Furthermore, water quality will be a thing of concern in many regions.

Effects of deforestation on climate change in Nigeria

Forest perform a number of valuable natural services as they process energy and circulate matter in the normal course of their functioning. They are involved in the regulation of global temperature, precipitation and other biological mediated climate processes at global or local levels.

Because plants absorb considerable amount of solar radiation and release water vapour through transpiration, forests moderate temperature and help to maintain an even climate. Forests are also involved in maintenance of hydrological cycle. Plants absorb water from soils and release it through transpiration, returning the water to atmosphere. Hence, forests maintain a favourable distribution and even flow of water, absorbing it when it is abundant and releasing it gradually to bring about ideal climatic condition (Emodi, 2005). Besides it is generally understood that plants absorb carbon dioxide and give out oxygen in return in the process of respiration. Thus, the excessive carbon dioxide within the environment are naturally removed by plants and the needed oxygen by man provided by these plants, maintaining a good balance in the system for both man and other living organisms to exist.

In their normal functioning, all natural and altered forest areas perform some or all of the proceeding natural services free of charge. They also do it repeatedly year after year, and we tend to take these services for granted until the forests and their services are lost. For example, deforestation in India is largely responsible for the massive siltation that caused repeated human tragedy and suffering in Bangladesh. Centuries of forest removal and overgrazing in the Mediterranean basin have produced a climate that is much hotter and drier than it once was (Wright and Nobel, 2002).

In Nigeria, the federal government in recent past, in a bid to cut cost had on many occasions adjusted upwards prices of petroleum products like kerosene. In many instances, the product is not available for purchase. Where it is available, it is highly priced by independent marketers, considering their cost of procuring it.

Consequently, the product kerosene is tilting towards being beyond the reach of the common man. Hence, a lot of people have resorted to the old usage of firewood as the source of fuel for cooking. Firewood has become a good source of revenue particularly to those living in the hinterland. No wonder the rate at which our forest land especially those near the cities are being deforested for want of firewood. For instance, in Enugu metropolis, on every Oye day, the rate at which firewood is being moved from the neighbourhood of Amorji-Nike, Nchatancha, etc. to Oye Emene market is very alarming. The firewood comes from the forested neighbourhood around Enugu metropolis, leaving the forested neighbourhood dilapidated. This invariably boils down to deforestation of the area which has serious effects on the micro and macro climate of the environment.

In an attempt to proffer solution, the federal government initiated among others the following programs:

i. The Arid Zone Afforestation Programe (AZAP) to combat the devastating effects of the drought in the northern part of the country by establishing several hundred of hectares of woodloths.
ii. Federal Government of Nigeria Assisted Pulpwood plantation Project (in the forest reserves).
iii. The World Bank Assisted Forestry Project; aimed at promoting the establishment of shelter belts and community wood loths in the arid zones of the north.
iv. African Development Bank (ADP) assisted Forestry Plantation Project.
v. F.G.N/Katsina Afforestation Project to improve the living conditions of the people by planting trees on farmland, establishment of wind brakes and community woodloths.
vi. Initiation of national tree planting campaign by the federal government.
vii. Establishment of national parks.

Despite the initiation of these programs, there have not been effective and efficient implementation measures taken to obtain good results.

Recommendations

Having identified deforestation as a major factor among others in climate change as it affects Nigeria, the following measures are suggested:

- There is need for integration of development planning and environmental management of all levels of political and economic decision making to ensure sustainable environment.
- Education through lectures, seminars and workshops sponsored by the three tiers of government and well spirited individuals, non-governmental
- As vegetation plays the role of carbon sink, reforestation needs to be done to compensate for over harvesting.
- The wanton destruction of our forest must be checked, and forestry authority empowered, to act accordingly.
- Creation of public awareness by sponsored jingles, through the electronic and print media, including the information highway, internet.

organization and stakeholders in the environment.

- Reforestation is one of the best ways of countering deforestation. Hence, federal and state governments should substantially step up their financial commitment to reforestation.
- The federal and state governments should enlist the co-operation of large scale farmers and open-cast miners by including in their agreements the need to rehabilitate and reforest, with woody species, their areas of operation before quitting them.
- Private individuals or communities should also be encouraged to establish and own woodlots by creating necessary incentives such as free or subsidized supply of seedlings, operational machinery or rebates.
- There is need for the redesigning of the species composition and structure of our plantation in order to incorporate all forest components, including plant and animal species being threatened with extinction.
- Reclamation and stabilization of degraded areas could be realized in savanna through reforestation, using drought-hardy and relatively fast establishing trees (local and naturalized) like Balanites aegyptiaca, Salvadora persica. Also fire tolerant species like monotes Kertingii, Maranthes and Combretum nigricans could be used as firebreaks.
- There is need for the development of multi purpose forest ecosystems that will support grazing, in addition to providing other benefits, especially in the Sudan Sahel belt now experiencing acute shortages of browse materials.
- Selective cutting of trees could be adopted to allow natural regeneration from the surrounding frees, thereby avoiding the financial and environmental costs of starting afresh.

Conclusion

One of the greatest of man's contributions to climate change is the enhancement of greenhouse gases by the enhancement of carbon dioxide in the atmosphere through deforestation. It has been proved that if carbondioxide emissions and concentration continuous unchecked, according to scientific mid-range projections the global average surface temperature is expected to rise by 0.2 to 0.4 degrees celcius per decade throughout the 21st century and beyond. This entails a global average temperature of approximately 3 to 5 degree Celsius is to be expected by the year 2100. From scientific analysis, an increase beyond 2-2.5 degrees celcius will mean a sharp rising risk of crossing a tipping point that can cause adverse effect on our planet's living and non-living organisms.

Sound forest management provides enormous benefits on sustainable basis. If we wish to reduce the rate at which primary tropical forest, particularly Nigerian forests are being depleted, better forest management will suffice. Far more radical economic, social and political reforms will be needed. Therefore, there is need for collective efforts of individuals, non governmental organizations, corporate groups, stakeholders and governments in a united effort at saving our environment through tackling the problem of deforestation.

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THE INFLUENCE OF TRAVEL TIME ON ACCESSIBILITY IN LAGOS ISLAND

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Abstract

The influence of travel time on accessibility in Lagos Island, Nigeria was determined. It was observed that generally, average driving speed was observed to be lower over short than over long distance routes. High speeds tend to be concentrated within a distance band of over 2.7 km. But beyond 6.0 km, average driving speed was low, probably as a result of interruptions on the route. The mean driving speed for all nodes of the network was calculated to be 0.31 kmpm (approximately 19 kmph). The average driving speed was found to be significantly related to the link distance, with a correlation value of (r = 0.76). Based on the findings, recommendations were proffered towards reducing financial and time costs and increasing accessibility.

Introduction

Kansky (1963: p. 1), defined network as "a set of geographical locations connected in a system by a number of routes". Atubi (2007a: p. 7) also defined network as "a set of interconnected route-ways along which movement takes place". Network has the basic function of linking places together for example a farm to a market, a factory to a railway station or one town to another.

Rather than merely asking planners what philosophy they assume when making transport and landuse plans, it is thought more revealing to internalise the problem. By this it is meant that actual planning cases should be cited and accessibilities to work etc determined both before and after the plans have taken effect. Access in this case can be thought of a s a surrogate measure of spatial justice, from which the social justice concept used can be inferred (Bruinsma, 1994).

Connectivity of a network in this context means the degree of connection between all centres (vertices) or the degree of completeness of the routes (links) between centres (vertices) (Atubi and Onokala, 2004a; Atubi and Ali, 2006). Apparently, the more routes there are in any transportation network the more complex will be the connection between the various routes.

For several decades now, accessibility has been the focus of much literature in various fields of study. This undoubtedly reflects the different study purposes for which any particular measure may have been proposed. However, there does not appear to be a common definition of accessibility. Some researchers discuss accessibility to some place (or places) as opposed to accessibility from some place (or places). Some researchers characterise accessibility as a measure of transportation system (Ikhrata and Michell, 1997). In the context of this study, therefore, relative accessibility is used to imply the relative ease of movement along transport route (road) from one centre to another.

Gravity-type accessibility measures have been used to measure access to medical facilities (Knox, 1978); Grocery stores (Handy, 1992); railway stations (Giannopoulos and Boulonguris, 1989); Shopping (Lee and Goulias, 1997; Bhat et al, 1999; employment (Kockelman, 1997; Niemeier, 1997; Cervero et al, 1999 and access to public facilities (Atubi, 2008 and 2012).

Study area

The study area is located within Lagos State. Lagos State is situated at the South-Western corner of Nigeria and is a coastal state. Lagos Island, which is the study area, is one of the 20 Local Government Areas in Lagos State (see Fig. 1). Lagos Island is the second largest urban complex in Nigeria after Kano and claims 2% of the nation's population on a less than 0.2% land area.

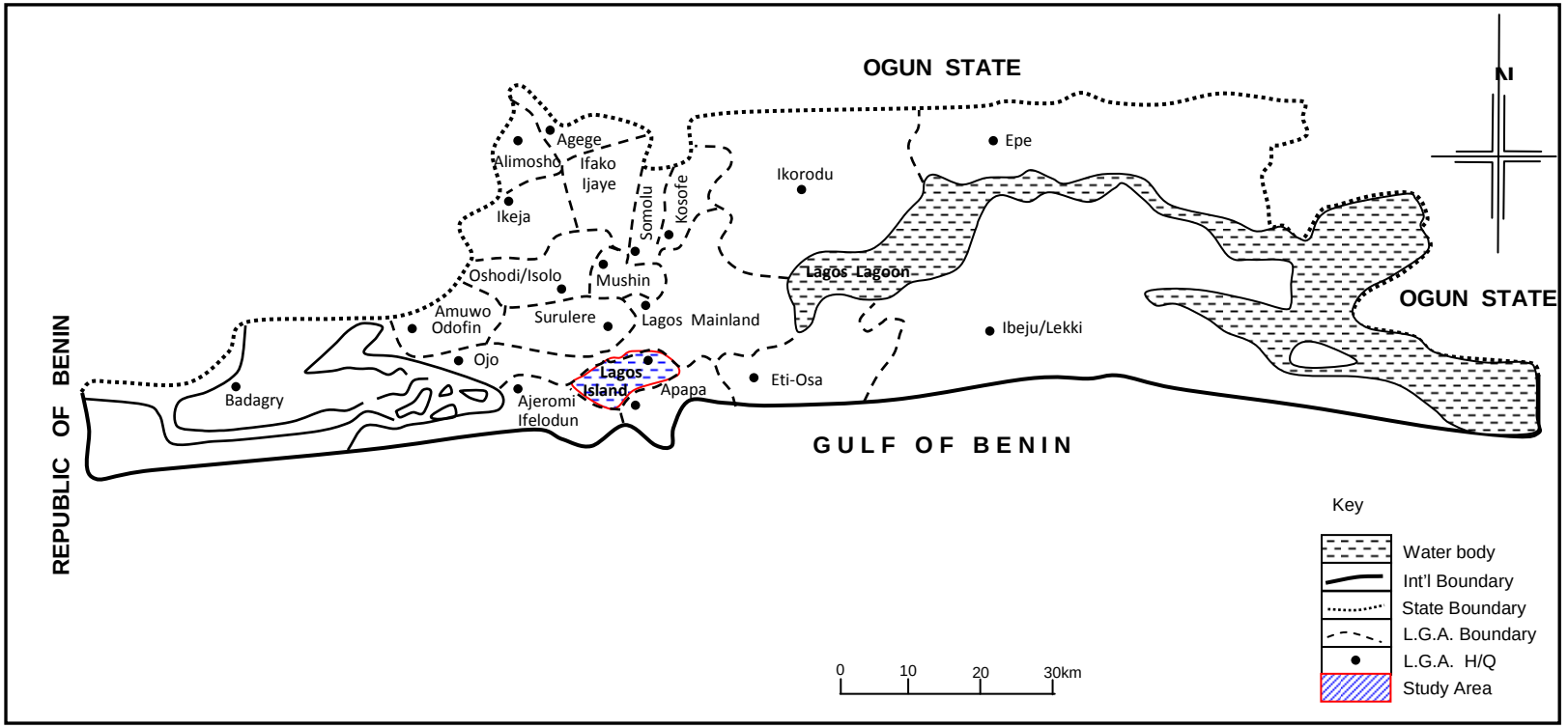

Fig. 3.1: ***Map of Lagis State showing the 20 LGAs***
Source: Lagos State Ministry of Environment and Physical Planning (1999)

Methodology

Travel time was differentiated into transit time and waiting time. Transit or driving time describes the period a traveller takes off from the park at the origin point and alights at the park on arriving at his destination point. Waiting time on the other hand refers to the time the traveller waits for the vehicle to arrive or to be fully loaded.

Generally, the waiting time is affected by such variables as traffic volume, mode of transport and route. Although waiting time may increase the total journey time, it is the driving time, when the traveller has actually boarded the vehicle that determines the time he reaches the destination.

Results and Discussion

The length of time a traveller takes to reach his destination may have a lot of influence on his ability or even willingness to use a particular facility. Like travel cost two types of arriving time can be calculated along the same link – i.e. direct driving time between two major centres, say Ilubirin and Idumagbo, assuming the driver does not stop en route and the time considering that driver stops at intermediate centres (See Fig. 2). Based on these two values of driving time 39 links were considered along with the 30 sampled centres (See Fig. 3.3).

It was not however easy to record this direct time accurately as drivers often had cause to stop for various purposes: refuelling, alighting passengers, police checks, etc. Nonetheless the figures presented in Appendix 1 gives us a true estimate of actual time spent in travelling. Again the driving time so identified is a function of many variables such as the road surface, traffic flow the condition of the vehicle and even the personal disposition of the driver. Because of these factors more detailed data and investigation are necessary to throw greater understanding on the issue than the present study can contain. Here, only a single reading of driving time along a particular link was recorded.

To further investigate the importance of time we can also calculate the average driving speed along each link by dividing the link distance by the driving time. This is given in kilometre per minute (kpm) in Appendix 2. The average speed may reveal variations in the nature of the road surface.

The mean driving speed for all nodes of the network was calculated to be 0.31mpm approximately 19mph. The average driving speed was found to be significantly related to the link distance ($r = 0.76$, Appendix 3).

However, when the frequencies of observed speeds are grouped according to link distances as given in Table 1, we observe the following points – that majority of the links are concentrated within a distance band of 0-2.7km which collectively make up about 53.9% of the observations, that high average driving speeds of over 0.52kmpm (or 31kmph) are not common with short distances of under 2.7km. Rather, speeds of over 0.52kmpm occur within a distance band of 4.9 and over 6.0km which makes up about 5.2% of total observation. Ironically on distances of over 6.0km drivers tend to operate an average speed of under 0.52 kmpm. This apparent low speed on long distance journeys may be attributed to constant stops en route and the road surface.

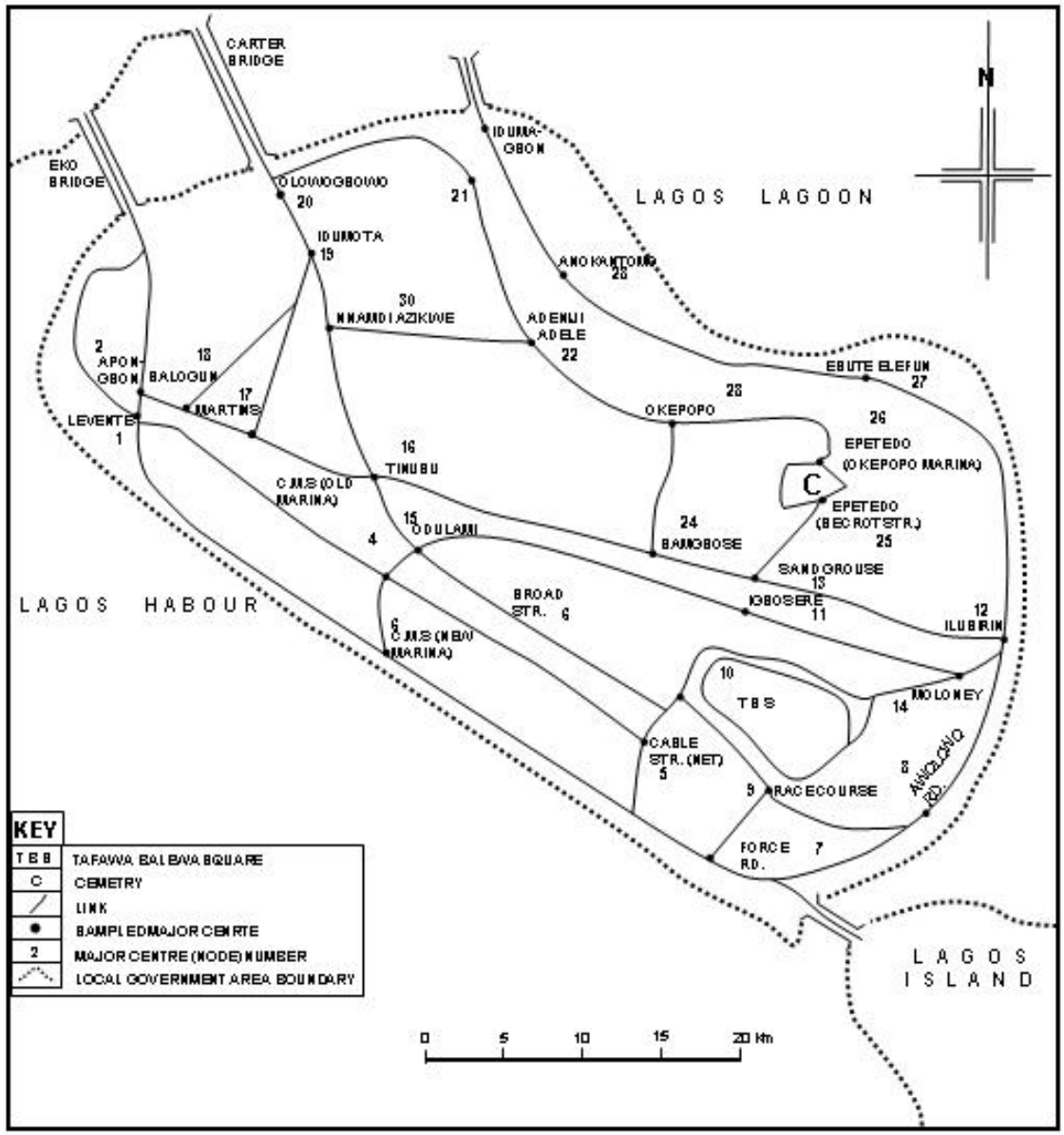

Fig. 3.2: ***Location of sampled major centres in Lagos Island LGA***
Source: Fieldwork, 1998, revalidated 2009

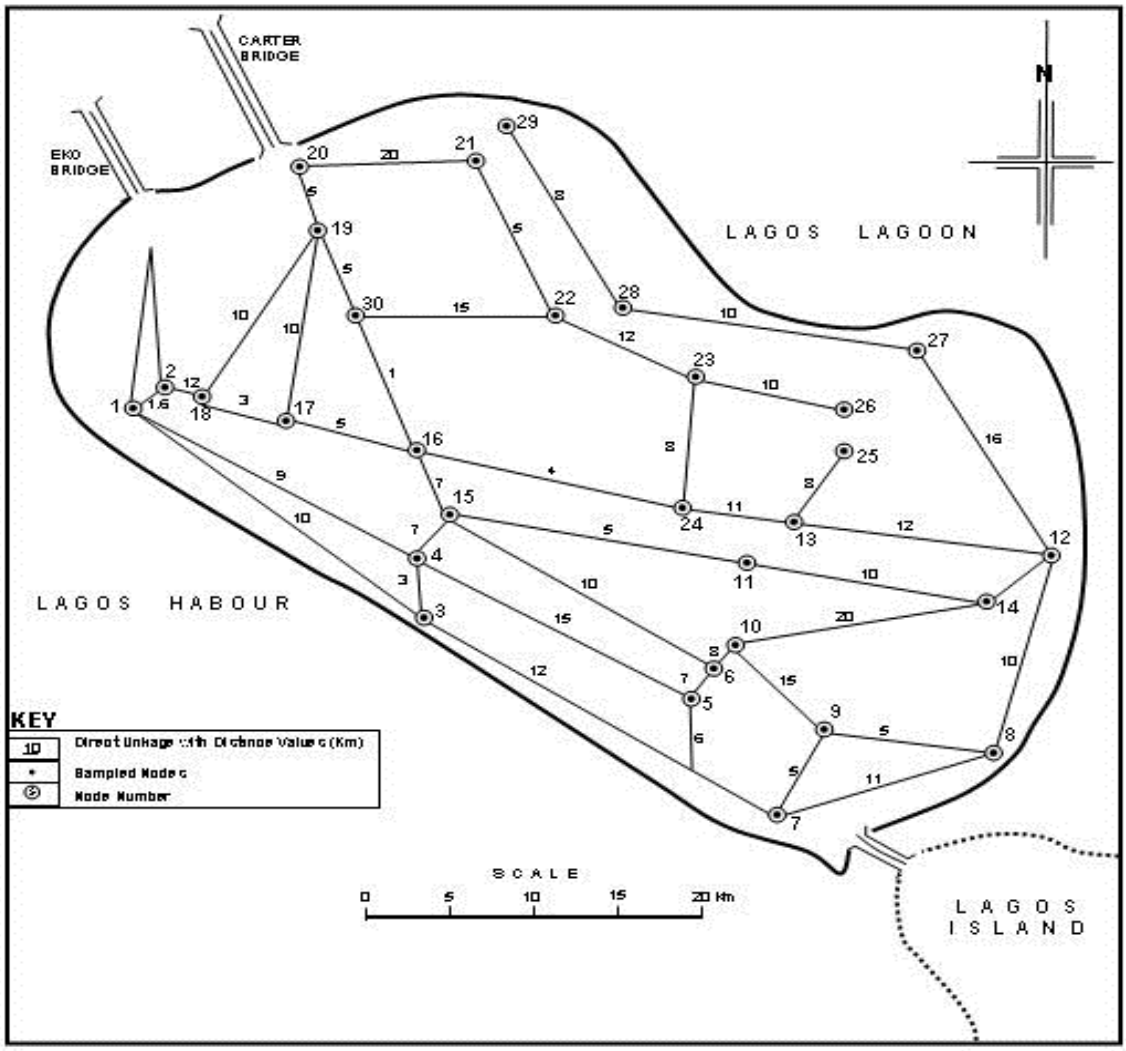

Fig. 3.3: ***Graph representation of road network with travel time values***

Table 3.1: ***Frequency distribution of average driving speeds with link distance***

Link Distance (km)	0.0-0.10	0.2-0.30	0.31-0.41	0.42-0.52	Over 0.52	Total
0-1.6	1 2.56%	7 17.9%	2 5.1%	0	0	10 25.64%
1.7-2.7	0	10 25.6%	1 2.6%	0	0	11 28.21%
2.8-3.8	0	5 12.8%	1 2.6%	1 2.6%	0	7 17.95%
3.9-4.9	0	0	2 8.10%	2 8.10%	1 2.60%	5 12.82%
5.0-6.0	0	0	1 2.60%	3 7.70%	0	4 10.25%
Over 6.0	0	0	0	1 2.60%	1 2.60%	2 5.13%
Total	1 2.56%	22 56.3%	7 18.00%	7 18.00%	2 5.20%	39 100%

Finally, low average speed of under 0.10kmpm (i.e. 6.0kmph) is found within short distances of under 1.6km. It contributes about 2.56% of the links. This observed general pattern of average speeds would imply that drivers tend to drive faster within a distance of 2.7 – 4.7km but beyond, that their average speed may be reduced by other obstructions such as carrying "half-way" passengers, or refuelling. This would mean that travellers for long distance journeys may not arrive at their destination as early as they expected if the journey were direct. Thus we find that the Anokantamo – Idumagbo road has higher average speed (0.54kmpm or 33kmph) than the journey from Odulami to Igbosere with average speed of about 25kmph.

Another implication of the observation is that nodes in the study area located at short distance journeys may be just as disadvantaged as those at long distances journey as drivers tend to operate on relatively low speeds. But another factor in addition to the constant need to alight passengers en route could be urban traffic. The combined effect of all this is to extend driving time beyond the expected.

Policy Implications and Recommendations

To ease traffic flow along the routes, better road network characteristics must be ensured. For example, the roads have to be better connected to improve their accessibility, also roads have to be widened to more lanes to increase their carrying capacity and these are especially true for the routes headed to the island. Better road network characteristics would not only lead to a faster flow of traffic along the routes, it would also make for a well structured road network system and also a faster pace at curbing traffic delays in the study area.

The strategy of constructing new links to improve accessibility may involve heavier financial investment. Thus a proper cost benefit analysis may be needed to determine the desirability of such investment. For example, it will normally take a traveller going to Olowogbowo from Idumagbo Avenue some 18.1km. But when a direct road is constructed linking Idumagbo to Olowogbowo it would definitely reduce cost, time, and accessibility will increase. The same thing can be said of other centres like Anokantamo to Adeniji Adele and Ebute-Elefun to Sand Grouse.

Conclusion

We touch upon the very issue of financing road projects. Since we have recommended some roads to be constructed, someone might ask where is the money all going to come from? What of the cost – benefit analysis? These are important questions and the specialist may have an answer. However, it is pertinent to point out that the social benefit of constructing a road that increase accessibility, saves time and reduces cost goes beyond the financial evaluation. It touches on human value. It takes the political will to provide such needs.

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Appendix

Appendix I: ***Analysis of link cost and the characteristic***

S/N	Route Title	Link distance (LD)	Travel cost (N) (TC)	Cost/ Km (TR)	Driving (Min.) (DT)	Average Speed (ADS)
1	Leventis-Apongbon	1.6	5.0	3.13	4.0	0.40
2	Leventis-C.M.S (New Marina)	4.4	5.0	1.14	10.0	0.44
3	Leventis-C.M.S (Old Marina)	4.3	5.0	1.16	9.0	0.48
4	Apongbon-C.M.S. (Old Marina)	5.9	10.0	1.69	13.0	0.45
5	Apongbon-C.M.S. (New Marina)	6.0	10.0	1.67	14.0	0.43
6	Apongbon-Balogun	2.7	5.0	1.85	12.0	0.23
7	C.M.S. (Old-Cable Net)	5.7	5.0	0.88	15.0	0.38
8	C.M.S. (New)-Force road	7.2	5.0	0.69	12.0	0.60
9	Force road-race course	1.0	5.0	5.00	5.0	0.20
10	Force road-Awolowo road	2.3	5.0	2.17	11.0	0.21
11	Cable (net)-C.M.S. (New)	1.5	10.0	6.67	18.0	0.08
12	Cable (net)- force road	1.5	5.0	3.33	6.0	0.25
13	Awolowo-race course	1.2	5.0	4.17	4.0	0.30
14	Tafawa Balewa-Broad street	3.8	5.0	1.32	8.0	0.48
15	Broad street – Tinubu	3.3	10.0	3.03	17.0	0.19
16	Tinubu-Nnamdi-Azikiwe	1.0	5.0	5.00	5.0	0.20
17	Nnamdi-Azikiwe-idumota	2.0	5.0	2.58	10.0	0.20
18	Idumota-Balogun	1.5	5.0	3.33	10.0	0.15
19	Idumota-Martina	3.0	5.0	1.67	10.0	0.30
20	Martins-Tinubu	1.7	5.0	2.94	5.0	0.34
21	Awolowo-Ilubirin	4.0	5.0	1.25	10.0	0.40
22	Ilubirin-Ebute-Elefun	7.0	10.0	1.43	16.0	0.44
23	Ebute-Elefun-Anokantamo	3.0	10.0	3.33	10.0	0.30
24	Anokantamo-Idumagbon	4.3	5.0	1.16	8.0	0.54
25	C.M.S. (Old)-Odulomi	1.8	5.0	2.78	7.0	0.26
26	Odulami-Igbosere	5.0	10.0	2.00	12.0	0.42
27	Igbosere-Moloney	2.0	5.0	2.50	12.0	0.20
28	C.M.S. (Old)-C.M.S. (New)	1.0	5.0	5.00	3.0	0.33
29	Moloney-Ilubirin	1.0	5.0	5.00	4.0	0.25
30	Ilubirin-Sand-grouse	2.7	10.0	3.70	12.0	0.23
31	Sand-grouse-Bamgbose	2.5	5.0	2.00	11.0	0.23
32	Sand-grouse-Enetado (Becret)	2.0	5.0	2.50	8.0	0.25
33	Bamgbose—Tinubu	4.0	10.0	2.50	10.0	0.40
34	Bamgbose-Okepopo Marina	1.8	5.0	2.78	8.0	0.23
35	Adenidi-Adele-Nnamdi Azikiwe	3.0	10.0	3.33	15.0	0.20
36	Epetedo (Okepopo)- Okepopo Marina	3.8	5.0	1.32	10.0	0.38
37	Okepopo Marina-Adeniji-Adele	2.5	5.0	2.00	12.0	0.21
38	Adeniji-Adele-Offin	1.2	5.0	4.17	5.0	0.24
39	Offin-Olowogbowo	3.5	10.0	2.86	20.0	0.18

Observation (n)	=	39
Sum of link distances Σ(LD)	=	117.7
Mean link distance (LD)	=	3.02
Standard deviation (σLD)	=	1.71
Sum of travel cost (ΣTC)	=	250

Mean travel cost (TC)	=	6.41
Standard deviation (σTC)	=	2.28
Sum of driving time (ΣDT)	=	389
Mean driving time (DT)	=	9.97
Standard deviation (σDT)	=	4.12
Sum of average driving speed (ΣADS)	=	12.0
Mean average driving speed (ADS)	=	0.31 kmpm
Standard deviation (σADS)	=	0.12 kmpm

Appendix 2: ***Correlation between link distance (LD) and travel cost (TC)***

Correlation coefficient (r) is given by:

$$\text{rLD.TC} = \frac{n\left(\sum LD.TC\right) - \left(\sum LD\right)\left(\sum TC\right)}{\sqrt{n\sum LD^2 - (LD)^2\, x}\ \sqrt{n\sum TC^2 - (TC)^2}}$$

$$= \frac{39(813) - 1177 \times 250}{\sqrt{39(466.43) - (13853.29)x}\ \sqrt{39(1800) - 62500}}$$

$$= \frac{2282}{2779.22}$$

$$= 0.39$$

The correlation coefficient (r) between link distance and travel cost is 0.39. In testing for the significance of the correlation we use the student's 't' test which is given by

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

Where

t	=	Calculated value
r	=	Correlation coefficient
n	=	The number of observations

Hence

$$t = \frac{0.39\sqrt{37}}{\sqrt{1-0.39}}$$

$$t = \frac{2.37}{0.92}$$

$$= 2.57$$

Ho: There is no significant relationship between link distance and link cost.

Hi: There is some statistically significant relationship between link distance and link cost.

Table value n – 2 degree of freedom

39 – 2 = 37
0.01 = 1 – 0.01 = 0.99 = 2.42
But t cal. > t = 0.01

Hence at 0.01 probability level we reject Ho and state that there is some statistically significant relationship between link distance and cost.

Appendix 3: ***Correlation between link distance and average driving speed***
Correlation coefficient between link distance (LD) and average driving speed (ADS) is given by:

$$\text{rLD.ADS} = \frac{n\left(\sum LD.ADS\right) - \left(\sum LD\right)\left(\sum ADS\right)}{\sqrt{n\sum LD^2 - (LD)^2}\ x\ \sqrt{n\sum ADS^2 - (ADS)^2}}$$

Where: n = 39, LD = 117.7, ADS = 12.0

$$= \frac{39 \times 41.94 - 117.7 \times 12.0}{\sqrt{39 \times 466.43 - 13853.29}\ x\ \sqrt{39 \times 4.2 - 144}}$$

$$= \frac{223.26}{293.08}$$

Hence r = 0.76.

In testing for the significance of the correlation we use the student's 't' test which is given by

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

Where r = 0.76, n = 39

Hence

$$t = \frac{0.76\sqrt{37}}{\sqrt{1-0.76}}$$

$$t = \frac{4.62}{0.65}$$

Approximately = 7.11

Ho: There is no significant relationship between link distance and average driving speed.
Hi: There is some statistically significant relationship between link distance and average driving speed.
Table value n – 2 degree of freedom
39 – 2 = 37
0.01 = 1 – 0.01 = 0.99 = 2.42
But t cal. > t = 0.01
Hence at 0.01 probability level, we reject Ho and state that there is some statistical significant relationship between link distance and average driving speed.

AN APPRAISAL OF THE EFFECTIVENESS OF THE ENUGU STATE WASTE MANAGEMENT AUTHORITY

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Abstract

Waste management is a cardinal point of environmental sustainability and crucial to environmental health. This study was aimed at assessing the effectiveness of the Enugu State Waste Management Authority (ESWAMA), as perceived by consumers (the public). A multistage sampling technique was used. The first stage involved simple random sampling to select three neighbourhoods to represent high-density, medium-density and low-density neighbourhoods and to select target households. Questionnaire was administered to the households. The data were analysed by means of tables of frequency and simple percentage. Average Mean Score technique was used to test null hypotheses. Findings showed that ESWAMA was ineffective in all the 9 (out of 12) statutory responsibilities assessed. Most adverse public opinion (92.5 %) was on recycling of solid wastes, followed closely by 90 % for designing, operating and maintaining waste disposal facilities, 86.5 % for removal and disposal of abandoned vehicles, 81.7 % for approving and keeping close watch on all waste disposal systems, 80 % for monitoring, cleaning, clearing and maintaining drainage facilities, 75 % for removing and disposing carcasses of dead animals from public places, 65 % for clearing the streets of solid wastes, 64 % for collecting, removing, processing, treating and safe disposal of domestic, hospital, commercial, institutional and industrial solid wastes, and 64 % for taking requisite, advantageous and convenient actions for or in connection with the carrying out of its functions or incidental to their proper discharge. Like most state-owned enterprises, ESWAMA was found wanting by consumer opinions. Hence, it was recommended that ESWAMA should be privatised for efficiency.

INTRODUCTION

The United Nations Environment Programme (UNEP, 1997) revealed in 1987 that per capita municipal waste disposed in 1980 amounted to 103 kg per year in the United States of America (USA), 377 kg in Japan, and 333 kg in the United Kingdom (UK). Increase in population and in the level of consumption strengthens the potential for urban waste generation in terms of both quantity and quality. There has been a phenomenal increase in the volume and range of solid wastes generated daily in Nigeria within the past few years. This is attributed largely to the increasing rate of population growth, urbanization, industrialization and general economic growth. Solid wastes generation per capita per day was estimated at 20 kg. With the 2006 National Population Census figure of 150 million people, the solid waste generation is, therefore, up to 3 million tones a day. This amount of solid waste is enormous to tackle. Yet, the method of disposal is very poor, and the legal framework, facilities and technologies are lacking.

Wastes may be toxic, flammable or non-biodegradable. Solid wastes, like leaves, bones, cotton rages and various food items, are quite biodegradable and are thus taken care of by nature. Other wastes are more of a nuisance than danger to man. If adequate provision is not made for waste disposal, the physical environment soon deteriorates, particularly in urban areas. The contribution of solid waste to environmental deterioration is an essential part of environmental hygiene studies, which needs to be integrated into the overall environmental planning process. Eneh (2007) posited that the need to control those factors in man's physical environment, which exercise a deleterious effect on his physical development, health and survival, neccessitates waste management, which involves the collection, sorting, storage, transportation, treatment, disposal and recycling of wastes. Waste management is the organized and systematic channeling of waste through pathways to ensure that they are disposed of with attention to acceptable public health and environmental safeguards.

The problem of solid waste collection and disposal, especially in cities, has been one of the most intractable environmental problems in Nigeria. In many cities, the volume of solid wastes overwhelm urban administrator's capacity to plan for their collection and disposal. Urban streets and roads are practically blocked by solid wastes, contributing to the problem of flood disasters in cities like Ibadan. Uchegbu (1998) reported that municipal solid waste (MSW) disposal is a great concern in developing countries, like Nigeria, because poverty, high rate of population growth, high urbanization rates, ineffectual and underfunded government projects, all combine to prevent efficient management of wastes. Thus, the problem of solid waste collection and disposal has persisted for years in the Nigerian urban areas, despite attempts by government agencies to deal with the problem. Heaps of uncollected refuse still characterize most of the urban areas. The problem of solid waste management is a global one and Nigerian situation is assuming an alarming proportion, as it is evident in urban cities like Lagos, Port Harcourt, Enugu, among others.

Nnamani (2010) observed that since after the Nigerian Civil War (1966-1970), urban areas and cities in Nigeria are already facing sanitation problems, especially refuse collection and disposal. The management of municipal solid waste in Nigeria, up to the 1970s has been the responsibility of the municipal authorities or city councils authorities or local government authorities. However, in 1984, government response in solving the ever increasing challenging problem of municipal solid waste management seems to be rather slow. To stem the tide, the Federal Government launched the campaign on "War Against Indiscipline" (WAI) and introduced the monthly clean-up exercise held on the last Saturday of the month in 1984. The monthly clean-up exercise was enforced by the law enforcement agents. Waste was collected at designated dumps for onward collection and disposal by the refuse disposal agency. Mobile courts were established and instant prosecution of defaulters of the programme introduced. This entrenched hygiene culture on citizens.

In 1985, the State Environmental Sanitation Agency (SESA) was established in each of the States. In 1988, the Federal Environmental Protection Agency (FEPA) was established by Decree No. 58 of 1988 and charged with the overall environmental protection and management in Nigeria. Nnamani (2010) posited that the awareness on Nigerian environment did not start with the above-mentioned decree, since we can still remember that the above decree was preceded by the Harmful Wastes (Special Criminal Provision) Decree No. 42 of 1988, which prohibited activities relating to purchase, sale, importation, transit, transportation, deposit, storage of harmful wastes into Nigeria, and consequently the need for FEPA to implement the stipulations of the decree.

According to Nnamani (2010), the problems of SESA and FEPA include inadequate, ill-trained and ill-equipped staff without specialized environmentalists at management and execution levels; lack of modern sanitation equipment for refuse and effluent collection, storage, transportation and discharge or treatment; inadequate operating fund from government and the generators of wastes (polluters); and non-implementation of the stipulations of various laws, decrees and edicts. Besides, there are also problems of poor road network that makes the operations of the refuse collection vehicles difficult, lack of dumpsites in a number of areas, and poor perception and attitude of the public regarding to solid waste management.

Ezera (2006) stated that in most developing countries like Mexico and Egypt, solid waste in high-income areas is collected by informal organization known as Zabbalean in Egypt, while medium and low-income areas dispose their wastes in organized dumps. These are managed by municipal agencies. In Nigeria, a centralized system of solid waste management is adopted. There is no decentralization; every area is managed by somebody or organization. Sorting is not practiced. This is the case in Enugu municipality, where different methods of solid waste management have been attempted since the colonial era in 1932. These attempts had their weaknesses and strengths.

A decentralized waste management system recognizes that low-income and middle/upper-income neighbourhoods have different physical and socio-economic conditions and that the wastes generated in these areas tend to differ in composition. There are claims that middle/upper-income residents' lifestyle and consumption tend to follow those of the developed world and so the type/nature of solid waste generated by them tend also to follow that of the developed world (Okoye, 1996).

The collection and disposal modes include incinerating plants or simple domestic incinerators; refuse transfer depots, house-to-house collection, open dumps, sorting and composting centres, as well as final disposal sites. Collection and disposal methods include the transportation of waste in trucks, compactors, barges, trains and various containers in high ways, railways and waterways. The types of collection receptacles, storage facilities and transport vehicles depend on the characteristics of the solid waste.

Oformata (1998) submitted that as far back as 1985, Enugu had twenty-four (24) built-up refuse transfer depots and sixty (60) ground dumps. These were considered grossly inadequate for the residents to discharge their solid wastes. In 1996, due to the public outcry against the poor performance of the Enugu State Environmental Sanitation Authority (ESESA), Enugu State Environmental Protection Agency (ESEPA) was established by edict No. 3 of 1996 to replace ESESA. ENSEPA took over the function of solid waste management (Okoye, 1996).

In 2002, the solid waste depots were cleared, built up and used as ENSEPA offices. ENSEPA placed refuse collection bins/containers at some designated areas. This never helped matters because the bins were small and not regularly emptied, the bins were not many in number and so were placed very far from the residents, the bins had no cover and so the solid waste was a good breeding ground for rodents, mice, mosquitoes and disease vectors.

In 2004, the Enugu State Waste Management Authority (ESWAMA) was established by Law No. 8 of 2004 and was charged with waste management. ESWAMA, with support of the British Department for International Development (DFID), has a landfill site located at Ugwuaji-Enugu (Oformata and Phil-Eze, 2004). ESWAMA alone has not been able to cope with management of waste in Enugu State.

It plays supervisory role, supervising the private sector participants (PSPs) as well as controlling the cities in Enugu State. The statutory responsibilities of ESWAMA are (Enugu State Government, 2004):

1. To collect, remove, process, treat and safe dispose of domestic, hospital, commercial, institutional and industrial waste.
2. To recycle waste.
3. To design blue prints for the establishment of sewage disposal system and clearing sewage.
4. To advise and make recommendations to the ministry for improvements in collection, removal, processing, treatment and safe disposal of wastes.
5. To clear streets
6. To remove and dispose of carcasses of dead animals from public places.
7. Monitor the cleaning, clearing and maintenance of the drainage facilities within the state.
8. To remove and dispose of abandoned vehicles.
9. To design, operate and maintain waste disposal facilities.
10. To prepare and uphdate from time to time master plan for waste collection and disposal in the cities, towns and villages within the state and to control the resultant waste system within the state.
11. To approve and close watch on all waste disposal system in the state and
12. To do all such acts as appear to it to be requisite advantageous, convenient for or in connection with the carrying out of its function or incidental to their proper discharge.

The aim of this study was to appraise the effectiveness of ESWAMA in carrying out its statutory responsibilities. The specific objectives were to get consumer (public) opinions on the effectiveness of ESWAMA on responsilities 1, 2, 5, 6, 7, 8, 9, 11 and 12. The public was not deemed as the rightful assessors of ESWAMA on the other responsibilities (3, 4 and 10). A null hypothesis was tested regarding each of the assessed responsibilities.

Objectives

To assess by consumer opinion the effectiveness of ESWAMA in:

1. Collection, removal, processing, treatment and safe disposal of domestic, hospital, commercial, institutional and industrial wastes;
2. Recycling solid waste;
3. Clearing streets of solid wastes;
4. Removal and disposal of carcasses of dead animals from public places;
5. Monitoring the cleaning, clearing and maintenance of the drainage facilities within the State;
6. Removal and disposal of abandoned vehicles;
7. Designing, operation and maintenance of waste disposal facilities;
8. Approval and keeping close watch on all waste disposal system in the State;
9. Taking all requisite, advantageous and convenient actions for or in connection with the carrying out of its function or incidental to their proper discharge.

Hypotheses

The following null hypotheses guided the study:

1. ESWAMA is not effective in collection, removal, processing, treatment and safe disposal of domestic, hospital, commercial, institutional and industrial wastes.

2. ESWAMA is not effective in recycling solid wastes.
3. ESWAMA is not effective in clearing streets of solid wastes.
4. ESWAMA is not effective in removal and disposal of carcasses of dead animals from public places.
5. ESWAMA is not effective in monitoring the cleaning, clearing and maintenance of the drainage facilities Enugu State.
6. ESWAMA is not effective in removal and disposal of abandoned vehicles.
7. ESWAMA is not effective in designing, operation and maintenance of waste disposal facilities.
8. ESWAMA is not effective in approval and keeping close watch on all waste disposal system in Enugu State.
9. ESWAMA is not effective in taking all requisite, advantageous and convenient actions for or in connection with the carrying out of its functions or incidental to their proper discharge.

Research questions:

The following research questions guided the study:

1. What is the level of effectiveness of ESWAMA in the collection, removal, processing, treatment and safe disposal of domestic, hospital, commercial, institutional and industrial wastes?
2. What is the level of effectiveness of ESWAMA in recycling solid wastes?
3. What is the level of effectiveness of ESWAMA in clearing streets of solid wastes?
4. What is the level of effectiveness of ESWAMA in removal and disposal of carcasses of dead animals from public places?
5. What is the level of effectiveness of ESWAMA in monitoring the cleaning, clearing and maintenance of the drainage facilities Enugu State?
6. What is the level of effectiveness of ESWAMA in removal and disposal of abandoned vehicles?
7. What is the level of effectiveness of ESWAMA in designing, operation and maintenance of waste disposal facilities?
8. What is the level of effectiveness of ESWAMA in approval and keeping close watch on all waste disposal system in Enugu State?
9. What is the level of effectiveness of ESWAMA in taking all requisite, advantageous and convenient actions for or in connection with the carrying out of its functions or incidental to their proper discharge?

REVIEW OF RELATED LITERATURE

Concepts of waste management vary in their usages among countries and regions. This sections examines conceptual definitions and empirical literature.

Conceptual definitions

Wastes are things that are left after people have used something. Eneh (2007: 360) stated that "Waste is useless or unwanted material arising from man's activity." Asomugha (2002) opined that practically every material used by man appears at a stage as a waste.

According to Adedibu (1988), wastes are generated by production and consumption conducted within the course of daily human activities and also by the biological metabolism of man and animals.

Waste is, therefore, an aspect of man's existence. As long as there is life, waste must be generated by man in his bid to survive.

The *Encyclopaedia of Occupational Health Safety* (2006) groups waste into three major categories, based on its production, as follows: from the primary sector of production (mining, forestry, agriculture, animal breeding, fishery), from the production and transformation industry (foods, equipment, productions of all types), and from the consumption sector (households, enterprises, transportation, trade, construction, services and others). Waste can also be classified by legislative decree, as (1) municipal waste and mixed waste from enterprises which may be aggregated as municipal waste, since both consist of the same categories of waste and are of small size (vegetables, paper, metals, glass, plastics and so on), although in differing proportions; (2) bulky urban waste (furniture, equipment, vehicles, construction and demolition waste other than inert material); and (3) waste subject to special treatment, e.g. chemically hazardous waste, radioactive wastes.

Solid wastes are traditionally described as residual products which represent a cost when they have to be disposed of. Solid waste consists of everyday items, such as bottles, cans, newspapers, computers, furniture, food and appliance, that could be thrown away or recycled. It can be divided into two major categories: industrial solid wastes and commercial and domestic solid wastes. Industrial solid wastes are waste materials generated in the course of manufacturing processes. They include metal scraps, chips and grits from machine shops, sawdust, waste paper, pieces of glass, among others. Domestic solid wastes are by-products of housekeeping activities and consumption. They include fuel residues, wrapping papers and leaves and empty cans or containers. The extraction and processing of industrial raw materials produce far greater quantities of solid wastes than come from people's homes. Refuse, a major part of solid wastes, consists of useless unwanted or discarded materials that arise from man's activities.

Municipal solid waste (MSW) represents all solid wastes generated in an area except industrial and agricultural wastes. Sometimes, it includes construction and demolition debris and other special wastes that may enter the waste stream. It generally excludes hazardous wastes, except to the extent that they enter the municipal waste streams. Sometimes, MSW is defined to mean all solid wastes that a city authority accepts responsibility for managing in some way. MSW is non-air and sewage emissions created within and disposed of by a municipality. It includes household garbage, commercial refuse, construction and demolition debris, dead animals and abandoned vehicles. The majority of substances composing municipal solid waste include paper, vegetable matter, plastics, textiles, rubber and glass. MSW is more commonly known as trash or garbage. MSW is a waste type that includes predominantly household waste (domestic waste) with sometimes the addition of commercial wastes collected by a municipality within a given areas. It is in either solid or semisolid form and generally excludes industrial hazardous wastes.

The term residual waste relates to waste left from household sources containing materials that have not been separated out or sent for reprocessing. The four broad categories of MSW are (1) bioldegradable waste - food and kitchen waste, green waste, and paper, (2) inert waste - construction and demolition waste, dirt, rocks, and debris, (3) composite wastes - waste clothing, Tetra Paks, waste plastics, such as toys, (4) domestic hazardous waste (also called "household hazardous waste") and toxic waste - medication, paints, chemicals, light bulbs, fluorescent tubes, spray cans, fertilizer and pesticide containers, batteries, and shoe polish.

Waste management is the organized and systematic channeling of waste through pathways to ensure that they are disposed of with attention to acceptable public health and environmental safeguards. However, proper management cannot be achieved without a well-designed waste management plan.

Waste management planning strategies advocate avoiding waste generation, using cleaner technologies, promoting waste recycling and recovery, using suitable treatment for generated waste and adequate waste final disposal. Waste management has been defined as the collection, transport, processing, recycling or disposal and monitoring of waste materials. Solid waste management is everything that must be done to handle the trash produced in a community. It is also controlling, handling and disposal of all solid wastes. One goal of solid waste management is to reduce waste to the least amount possible (Muogharu, 2002).

Thus, waste management is the collection, transportation, processing, recycling or disposal of waste materials, usually ones produced by human activity, in an effort to reduce their effect on human health or local aesthetics or amenity. The focus in recent decades has been on reducing waste materials' effect on the natural world and the environment and on recovering resources from them. Waste management practices differ for developed and developing nations, for urban and rural areas and for residential, industrial and commercial producers. Waste management for non-hazardous residential and institutional waste in metropolitan and municipal areas is usually the responsibility of local government authorities, while management of non-hazardous commercial waste is usually the responsibility of the generator.

Empirical literature

The United Nations Environment Programme (UNEP, 1997) reported that in Japan, waste disposal method consists of landfill (28 %) and incineration (60 %). In the UK, 69 % waste goes for landfill and 10 % is incinerated. About 50% of the people in cities in Ghana, for example, do not have adequate sanitation facilities and this is better than in some cities in parts of Africa. In Sudan, Zaire, Nigeria, Ivory Coast and Liberia, the figure is up to 75 %. In Ghana, about 900 tonnes of waste is generated daily in Accra. Solid waste has virtually turned the capital into a shanty town as at 1993. A waste management board was set up to remedy the situation and deal with the waste disposal aspect, while the waste collection aspect was contracted to a German government sponsored company. The disposal authority aimed at treating waste with minimal air pollution, and so treatment was done at the disposal site.

The problem of solid waste collection and disposal, especially in cities, was one of the most intractable environmental problems. There was a phenomenal increase in the volume and range of solid wastes generated daily in the country within the past few years and this was due largely to the increasing rate of population growth, urbanization, industrialization and general economic growth. In many Nigerian cities, the volume of solid wastes overwhelmed urban administrator's capacity to plan for their collection and disposal. It was common to find urban streets and roads practically blocked by solid waste, contributing to the problem of flood disasters in cities like Ibadan.

About 71 % of households throw their refuse in any available open space, to be collected later, if at all, by the garbage trucks. Twenty-two percent (22 %) of the sampled household disposed of their refuse in proper depots for which there were containers either of metal, plastic, concrete block or mud walls. About 6 % of the households threw their solid wastes in pits and the remaining 1% disposed theirs through other means.

A study by Birgisdottir, Bhander, Hauschild, and Christensen (1994), showed that the "Waste Hierarchy" has been an important tool in waste management policy of many countries for years. In the hierarchy, prevention of waste production has the highest priority. Among the waste management options, recycling ranks higher than incineration with energy recovery, and land filling ranks lowest. The study revealed that in Denmark, approximately 3.3 miotons or 26 % of the total flow of municipal solid waste is incinerated. These results in a yearly production of municipal solid waste incineration (MSWI) residues of approximately 0.73 miotons with bottom ash constituting approximately 0.64 miotons.

The Official Gazette of the Federal Ministry of Housing and Environment (2007) listed 15 cities in Nigeria and their waste generation estimates and projections for 1982, 1985, 1990 and 2000 (Tables 1). Lagos city is consistently top, followed by Ibadan, Kano, Kaduna, Onitsha, Port Harcourt, Oshogbo, Aba, Jos, Warri, Gusau, Potiskum, Uyo, Suleja, and New Bussa.

Again, the Official Gazette of the Federal Ministry of Housing and Environment (2007) categorised solid waste depots or dumps and their frequency in the 15 Nigeria cities (Table 2). Ground surface ranked highest in frequency (71 %), followed far behind by metal/plastic container (17.8 %), pit (6.4 %), wallet structure (4 %), and others 0.8%.

Mba (2009) reported on the concern for waste disposal problems increasing in urban areas and manifesting in many ways considered to have serious health-related consequences. The most visible of these problems are litters around buildings, streets and highways. Indiscriminate disposal of refuse has resulted in unsightly environment, pollution, blocking of drainage channels, erosion menace and flooding. Recommendations for more cost-effective and efficient solid waste management techniques were house-to-house collection, more efficient sanitation rate collection, public enlightenment on the functions of solid waste management agencies, use of contractors to cover different areas of the state or city, and the involvement of private entrepreneurs in solid waste disposal mode and methods.

The United States Environmental Protection Agency (US EPA, 1996) reported that in many countries, businesses and individuals have found creative ways to reduce and better manage MSW through a co-ordinated mix practices that include source reduction; recycling (including) composting and disposal. The most environmentally sound management of MSW is achieved when the approaches are implemented according to EPA's preferred order: source reduction first, recycling and composting second and disposal in landfills or waste combustors last.

There are reports on the existing solid waste collection and disposal methods in Enugu. Okapla (1986) on the use of incineration - a controlled process of oxidizing solid, liquid and gaseous combustible wastes to carbon dioxide, waste and ash. It was introduced by the colonial administrators to solve solid waste problem. Simple domestic incinerators were commonplace. Some were found at strategic places, while others were attached to public buildings. Most of the public incinerators are no longer seen. The private ones survive in low-density neighbourhoods. It must be emphasized that all solid wastes are not combustible. Incineration therefore, is aimed at reducing the volume of the solid wastes.

Okapla (1986) reported on the the refuse transfer depot system in Enugu by which households take their solid wastes to designated places for the government agency to collect to the final disposal points. Indiscriminate dumping prevails in some neighbourhoods without waste designated places. Idaw River layout is a typical example of layouts without refuse transfer depots. It does not even have any designated dump centre.

Thirty-eight refuse transfer depots are built up, while sixty ground dumps were designated as at 1995 in Enugu urban.

Oluwade (2009) reported on the house-to-house collection method practiced in a few neighbourhood, like the Government Reserved Area (GRA) and Independence Layout, Enugu, where the streets are more accessible and refuse transfer depots are non-existent. In recent times, parts of Asata, Ogui and Ogui New Lay-out got this facility. Pick-up vans are used at the major streets, while carts and trucks are used to reach more obscure corners. The dustbin collection method is also currently employed in New Haven and Trans-Ekulu Layouts. ESWAMA, through its sub-contractors, distribute refuse bins to willing residents at a fee. At regular intervals the bins are evacuated into pick-up vans, tipper lorries and at times the compactor vehicles, which carry them to their final disposal sites.

Ogbonnaya (2005) asserted that the problem of solid waste management still lingered, despite all the efforts. In a bid to solve the problem of solid waste disposal in Enugu State, the Enugu State government subvented ESWAMA with fifteen (15) mammoth compactor vehicles and one thousand (1,000) dump stands in 2007 for urban areas like Enugu, Nsukka, Oji River and Udi (Okoroafor, 2005). The period of five years (2007-2012) is enough duration to assess the effectiveness of ESWAMA. So far, no empirical study has assessed the effeciveness of ESWAMA in Enugu municipality from the perspective of consumers (the public). This study, therefore, was aimed at getting the consumer opinions of the effectiveness of the ESWAMA in solid waste management in Enugu municipality. The study concentrated on the municipal solid waste only; liquid waste, such as sludge, was not covered. Environmental problems, like air pollution, soil contamination and industrial wastes, were not covered. The study, which promises to present a synthesis of ideas, experience, and issues on people-oriented solid waste management for practitioners and researchers, will be of immense value to policymakers, planners, administrators and managers of the environment, the academia and in fact, all stakeholders in the environment.

METHODOLOGY

The methodology for data collection and analysis, as well as the procedure for realizing the objectives are discussed in this chapter.

Research design

This study is based on waste management concept popularly known as Integrated Waste Management Approach (IWMA). Survey design method was adopted for this study, since the research focussed on people, their values, opinions, altitudes and behaviour.

Study area

Enugu is the capital city of Enugu State, Nigeria. It has a population of about two million by 2005 estimate living in the vast city and its suburbs. The city has a population of 722,664 by 2006 census.

The people of Enugu belong largely to the Igbo ethnic group, which is one of the largest ethnic groups in Nigeria. The name Enugu comes from the two Igbo words, *enu* and *ugwu*, meaning "top of the hill" (Okoroafor, 2005).

Enugu was originally the capital of the Eastern Region from Nigerian independence in 1960, until 30 May 1967, when it was declared the first capital of the short-lived Republic of Biafra. On 28 September 1967, when Enugu was captured by Nigerian troops, the Biafran capital was moved to Umuahia (Emengini, 2004). After the end of the Nigerian Civil War in 1970, the old Eastern Region was divided into a number of states, including the East Central State, with Enugu as its capital (Ikegbunam, 2008).

In 1976, East Central State was split into Anambra and Imo States, and Enugu remained the capital of the former. In 1991, Anambra State was divided into the old Anambra State into two Enugu and Anambra States, with Enugu remaining the capital of the former.

The layouts making up Enugu metropolis are Abakpa-Nike, Trans-Ekulu, Emene, Government Reservation Area (G.R.A.), Iva Valley, Ogui, Coal Camp, Uwani, Awkunanaw, Independence Layout, Maryland, Ogui New Layout, New Haven, City Layout, Achara Layout, Golf Estate, Ebeano Estate, Loma Linda Estate and Ugwu Aaron (Okoye, 2008). They have been grouped according to their population densities (Table 3).

High-density neighbourhoods, which harbour about 70% of the city's population, are mostly made up of the earliest groups of layouts developed in Enugu. They include Coal Camp (Ogbete), Asata, Ogui, Ogui New Layout and Uwani. Their predominant tenement house types have made them susceptible to low-income habitation. Densities of more than 700 persons per hectare and an average monthly household income range of ₦20,000 - ₦50,000 have been reported for these neighbourhoods (Emodi, 2012).

Most of these layouts were designed in the colonial era. Typical of such neighbouhoods are the rigid grid street pattern with their characteristic small plot sizes of about 15n x 24m dominated by tenement structures. These structures commonly maintain a back-to-back set back of about 2 metres, side and front setbacks of about 1.2 metres and 4.5 metres respectively. Storey-building tenement structures with increased plot sizes were developed later and are common features in some areas, such as Uwani extension, Ogui-New Layout and parts of Awkunanaw. However, due to conversion, the number of other house types, especially flats, has been on the increase. There has also been a continual increase in the number of residential buildings being converted to mixed-use, especially residential-commercial use. This phenomenon may be incidental to the gradual decline in number of households per building, which has been observed within the core of these neighbourhoods (Chukwurah, 1998).

Medium-density neighbourhoods absorb about 28% of the entire population. These are mostly second-generation layouts, such as Awkunanaw, Maryland, New Haven, and Ugwu Aaron. The dominance of blocks of flats building type is the most distinctive feature of these neighbourhoods. Households paying average monthly rent range of ₦10,000 to ₦20,000 mostly inhabit them. The neighbourhoods have average density of about 350 to 400 persons per heactare. Most of these neighbourhoods were conceived in the mid 60s and early 1970s. They constitute the first type of layout that was conceived and developed by indigenous planners. Although they show more flexibility in the street pattern, the built-up areas give the impression of unimaginative monotony in the use of space. The average plot size is about 20m x 30m, usually with minimum front, side and back setbacks of 6 metres, 3 metres, and 2.5 metres respectively. Unlike most high-density areas, individual compounds have at least minimal space for parking cars. Blocks of lands promote privacy more than the tenement structure. Some of these layouts have appreciable level of mixed residential use due to conversion. For instance, New Haven has about 45% mixed commercial-residential uses. The average household of between 6 to 6.5 persons per household has been observed, with an average of 6 households per building. Their solid wastes are handled privately in the flats. One household generates an average of 10 kg of solid wastes daily. Over 800 kg of solid wastes is generated per hectare everyday in the medium-density neighbourhoods (Chukwurah, 1998).

Low-density neighbourhoods of Enugu contain about 2 % of the urban population. However, due to the generous use of space, which characterizes their design and planning, they cover not less than 20 % of the urban areas. They include GRA, Ono Quarters, Independence Layout, Tinkers' Corner, Upper New Haven extending to City Layout, Trans-Ekulu, etc. They have varying low densities of between 18 persons to 60 persons per hectare. They are basically developed for the affluent members of the society. Dominant house types include storey building, mansions and semi-detached duplexes. There are also appreciable number of bungalows and blocks of flats in these areas. However, the composition of these building types varies in these neighbourhoods due to the fact that some of them are "less exclusive" than others (Chukwurah, 1998).

The population of Enugu neighbourhoods was estimated by the 2006 population census (see Table 4).

Study Population

Out of the about 20 neighbourhoods, 3 were selected. One came from each of the 3 density levels. Abakpa represented the high-density neighbourhoods, New Haven represented the medium-density neighbourhoods, and Trans-Ekulu represented the low-density neighbourhoods. They gave a total population of 133,045 by 2006 census.

Sample size determination

The infinite sample size determination formula,

$$\eta = \frac{Z^2P(1-P)}{d^2}$$

Where η = minimum sample size

Z = confidence co-efficient

P = proportion of persons with knowledge of the existence of Agency responsible for solid waste collection and disposal.

d = tolerable error chosen by the researcher, was used to determine the appropriate, statistically acceptable sample size for this study.

With Z = 1.96 based on a 95 % confidence level, P = 0.15; d = 0.03.

$$\eta = \frac{(1.96)^2(0.15)(0.85)}{(0.03)^2} = 544$$

Accomodating 10 % (54.4) attrition rate brought the sample size to 598.4, which was rounded up to 600.

Accordingly, 600 copies of structured questionnaire were produced and distributued prorata to the 3 selected neighbourhood, as calculated below:

Abakpa = $\frac{80,200}{133,045}$ x 600 = 362

New Haven = $\frac{40,017}{133,045}$ x 600 = 180

$$\text{Trans-Ekulu} = \frac{12,828}{133,045} \times 600 = 58$$

Sampling technique

The multi-stage sampling technique was used. First stage sampling employed the simple random sampling to select Abakpa among the high-density neighbourhoods, New Haven among the medium-density neighbourhoods, and Trans-Ekulu among the low-density neighbourhoods.

In the second stage, a systematic selection of the households. In the high density neighbourhood, one out of every twenty buildings was selected. In the medium density neighbourhood, one out of every ten buildings was selected. And in the low density area, one out of every five buildings was selected.

Method of data collection

The questionnaire was administered to adult heads of the households visited in the selected neighbourhoods. Questions covered the perception of the consumer respondents on the effectiveness of ESWAMA (their assessment of ESWAMA performance vis-à-vis their statutory responsibilities). The answer options were arranged in a 4-point liker-scale of Strongly Agree (SA: 4 point), Agree (A: 3 point), Disagree (D: 2 point), and Strongly Disagree (SD: 1 point).

Data analysis and hypotheses testing

The data were presented in frequency tables and simple percentage tables. The Average Mean Score (AMS) technique was employed to test hypotheses. The AMS was obtained by taking the average of all the options (4, 3, 2, 1), follows:

Total score = 4 + 3 + 2 + 1 = 10

$$\text{Average Mean Score} = \frac{10}{4} = 2.5$$

For the collated answers and their scales from the selected neighbourhoods,

$$CV = \frac{\sum fx}{\sum f}$$

Where f is frequency
x is scale of supplied answer

A calculated value (CV) was compared with the decision value (DV).

Decision rule

If DV > CV, H_o is accepted as being true. But, if DV < C.V., H_o is rejected as untrue and the alternative hypotheses will be accepted as true.

RESULTS AND DISCUSSION

Only 17.5 % of the respondents strongly agreed that ESWAMA effectively collects, removes, processes, treats and safe-disposes of domestic, hospital, commercial, institutional and industrial solid wastes, while 18 % agreed. About 36 % disagreed, and 28 % strongly disagreed. Thus, respondents agreeing totalled 35.5 %, while those disagreeing totalled 64 %, showing unfavourable public opinions.

Only 3.8 % strongly agreed that ESWAMA effectively recycles solid wastes, while 3.7 % agreed. About 40.3 % disagreed, and 23.7 % strongly disagreed. Thus, respondents agreeing totalled 7.5 %, while those disagreeing totalled 92.5 %, showing patrons' extreme negative impressions about the performance of ESWAMA in recycling wastes.

Only 17 % strongly agreed that ESWAMA effectively clears the streets of solid wastes, while 18 % agreed. About 37.8 % disagreed, and 27.2 % strongly disagreed. Thus, respondents agreeing totalled 35 %, while those disagreeing totalled 65 %, showing unfavourable public opinions.

Only 5 % strongly agreed that ESWAMA was effective in removal and disposal of abandoned vehicles, while 8.5 % agreed. About 40 % disagreed, and 46.5 % strongly disagreed. Thus, respondents agreeing totalled 13.5 %, while those disagreeing totalled 86.5 %, showing overwhelming public disapproval.

Only 10.3 % strongly agreed that ESWAMA was effective in removing and disposing carcasses of dead animals from public places, while 14.7 % disagreed. About 37.8 % disagreed, and 37.2 % strongly disagreed. Thus, respondents agreeing totalled 25 %, while those disagreeing totalled 75 %, showing overriding public disapproval.

Only 5.3 % respondents strongly agreed that ESWAMA effectively monitors, cleans, clears and maintains drainage facilities in Enugu State, while 14.8 % agreed. About 43.3 % disagreed, and 36.6 % strongly disagreed. Thus, respondents agreeing totalled 20 %, while those disagreeing totalled 80 %, showing overwhelming public dissatisfaction.

Only 4.5 % of the respondents strongly agreed that ESWAMA effectively designs, operates and maintains waste disposal facilities in Enugu State, while 5.5 % agreed. About 46.7 % disagreed, 43.3 % strongly disagreed. Thus, respondents agreeing totalled 10 %, while those disagreeing totalled 90 %, showing non-performance by public disapproval.

Only 7.5 % respondents strongly agreed that ESWAMA was effective in approving and keeping close watch on all waste disposal systems in Enugu State, while 10.8 % agreed. About 35 % disagreed, and 46.7 % strongly disagreed. Thus, respondents agreeing totalled 18.3 %, while those disagreeing totalled 81.7 %, showing abject dysfunctionality by consumer opinion.

Only 17.7 % repondents strongly agreed that ESWAMA effectively takes requisite, advantageous and convenient actions for or in connection with the carrying out of its functions or incidental to their proper discharge, while 18.3% agreed. About 40.3 % disagreed, and 23.7 % strongly disagreed. Thus, respondents agreeing totalled 36 %, while those disagreeing totalled 64 %, showing unfavourable public opinions.

Comparatively, public opinion was most adverse (92.5 %) regarding the performance of ESWAMA in the area of recycling solid wastes. This was followed closely by 90 % for designing, operating and maintaining waste disposal facilities in Enugu State, 86.5 % for removal and disposal of abandoned vehicles, 81.7 % for approving and keeping close watch on all waste disposal systems in Enugu State, 80 % for monitoring, cleaning, clearing and maintaining drainage facilities in Enugu State, 75 % for removing and disposing carcasses of dead animals

from public places, 65 % for clearing the streets of solid wastes, 64 % for collecting, removing, processing, treating and safe disposal of domestic, hospital, commercial, institutional and industrial solid wastes, and 64 % for taking requisite, advantageous and convenient actions for or in connection with the carrying out of its functions or incidental to their proper discharge.

Hypotheses testing

The CVs for null hypotheses for a, b, e, f, g, h, i, k and l statutory reponsibilities of ESWAMA were 2.25, 1.72, 2.25, 1.72, 1.69, 1.89, 1.76, 2.03, and 2.3 respectively. The DV (2.5) is greater than each of the CVs, showing that all the null hypotheses should be accepted as being true.

SUMMARY OF FINDINGS

The statutory responsibilities of ESWAMA, the null hypotheses, the CVs and decision are summarised on Table 13, which shows that ESWAMA is not effective in all the 9 (out of 12) statutory responsibilities assessed, as itemised below:

a. Collection, removal, processing, treatment and safe disposal of domestic, hospital, commercial, institutional and industrial wastes.
b. Recycling solid wastes.
c. Clearing streets of solid wastes.
d. Removal and disposal of carcasses of dead animals from public places.
e. Monitoring the cleaning, clearing and maintenance of the drainage facilities in Enugu State.
f. Removal and disposal of abandoned vehicles.
g. Approval and keeping close watch on all waste disposal systems in Enugu State.
h. Taking all requisite, advantageous and convenient actions for or in connection with the carrying out of its functions or incidental to their proper discharge.

In other words, ESWAMA is not effective in all the aspects of its statutory responsibilities. This finding agreed with earlier reports. Uchegbu (1998) reported that waste disposal and management was inefficient in developing countries, like Nigeria, attributing it to poverty, high rate of population growth, high urbanization rates, ineffectual and underfunded government projects. Despite the attempts by government agencies, heaps of uncollected refuse still characterize most cities like Lagos, Port Harcourt, Enugu, among others. Okoye (2008) attributed the prevalence of wastes in all nooks and crannies of Nigerian cities to the non-performance of the public waste management authorities.

There is a link between this finding and the reports of Eneh and Ndayako (2009) and Eneh (2005) that state-owned enterprises (SOEs) were ineffective. Although Nigerian government began at Independence with the establishment of SOEs to provide goods and services to the people and to grow the country's economy, the SOEs soon degenerated into inefficient and monopolistic concerns that tax government attention and treasury, thereby necessitating privatization and commercialization, which have become important phenomena in both developed and developing countries. Successive Nigerian governments invested up to N800 billion in over 1,000 state-owned enterprises in Nigeria, but annual returns on this huge investment have been well below 10%. These inefficiencies and, in many cases huge losses, are charged against the public treasury. Therefore, the government began to jettison many public enterprises to private ownership.

CONCLUSION AND RECOMMENDATION

Increasing inefficiency among public enterprises has led to the decision by governments to favour private sector-driven economy by, among others, relinguishing many public enterprises to private ownership. Since ESWAMA is not effective in all the aspects of its statutory responsibilities, it is recommended that ESWAMA should be privatised for efficiency.

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APPENDIX

TABLES

Table 1: ***Estimated and projected volumes of solid waste generation in some Nigerian cities***

Urban Areas	**Tones Per Year**			
	1982	**1985**	**1990**	**2000**
Lagos	625,399	681,394	786,079	998,081
Ibadan	350,823	382,224	440,956	559,882
Kano	319,935	348,580	402,133	525,186
Kaduna	257,837	280,925	324,084	431,314
Onitsha	242,240	263,929	304,477	386,593
Port Harcourt	210,934	229,821	265,129	352,853
Oshogbo	131,903	143,712	173,720	253,841
Aba	131,903	143,712	169,719	236,703
Jos	99,871	111,905	135,272	197,660
Warri	67,477	75,607	91,396	133,660
Gusau	44,488	48,471	57,243	79,835
Urban Areas	**Tones Per Year**			
	1982	**1985**	**1990**	**2000**
Potiskum	15,434	16,816	19,399	28,347
Uyo	12,508	13,628	15,399	20,923
Soleja	9,383	10,514	13,311	21,336
New Bussa	5,690	6,200	7,152	9,518

*Source***:** Federal Ministry of Housing and Environment, Official Gazette (2007)

Table 2: ***Nature of solid waste depots or dumps in 15 Nigerian cities***

Types of depots/dumps	**Frequency (%)**
Ground surface	71.0
Metal/Plastic container	17.8
Pit	6.4
Walled structure	4.0
Others	0.8
Total	**100.0**

*Source***:** Federal Ministry of Housing and Environment, Official Gazette (2007)

Table 3: ***Population Density Groups.***

High density	**Medium density**	**Low density**
Abakpa Nike	Awkunanaw	Trans-Ekulu
Emene	Maryland	G.R.A
Iva Valley	New Haven	Ebeano Estate
Ogui	Ugwu Aaron	Independence Layout
Coal Camp (Ogbete)		City Layout
Uwani		Golf Estate
Ogui New Layout		Loma Linda Estate
Achara Layout.		
Asata		

These characterize also the nature and quantity of solid wastes generated.

Table 4: ***Population distribution of Enugu by neighbourhoods and sex (2006)***

Neighbourhoods	**Population density level**	**Males**	**Females**	**2006 Population**
Maryland	MD	15,924	24,607	40,531
Garriki	HD	37.281	32,851	70,132
Uwani	MD	20,201	20,383	40,584
Achara Layout	MD	25,922	22,090	48,012
Emene	HD	30,440	39,581	70,021
Abakpa	HD	39,406	40,794	80,200
Trans-Ekulu	LD	6,048	6,780	12,828
Iva Valley	HD	30,656	39,889	70,545
GRA	LD	8,055	7,182	14,237
Ogbete	HD	39,860	30,600	70,460
Ogui	HD	39,996	40,024	80,020
Independence Layout	LD	6,255	7,071	12,326
Neighbourhoods	**Population density level**	**Males**	**Females**	**2006 Population**
New Haven	MD	19,213	20,804	40,017
Nike	HD	49,424	30,601	80,025
Awkunanaw	MD	18,610	21,750	40,360
Obiagu	HD	49,900	30,201	80,101
Akwuike	HD	35,824	34,186	70,010
Total		**473,015**	**449,394**	**920,409**

Source: National Population Commission (NPC), 2006.
Note: LD = low density, MD = medium density, and HD = high density

Table 5: ***Effective collection, removal, processing, treatment and safe-disposal of domestic, hospital, commercial, institutional and industrial solid wastes***

Response	**Scale, x**	**Frequency, f**	**fx**	**Percentage**
SA	4	105	420	17.5
A	3	109	327	18.2
D	2	218	436	36.3
SD	1	168	168	28
Total		**600**	**1351**	**100**

$$CV = \frac{\sum fx}{\sum f} = \frac{1531}{600} = 2.25$$

Table 6: ***Effective recycling of solid wastes***

Response	**Scale, x**	**Frequency, f**	**fx**	**Percentage**
SA	4	23	92	3.8
A	3	22	66	3.7
D	2	330	660	55
SD	1	225	225	37.5
Total		**600**	**1033**	**100**

$$CV = \frac{\sum fx}{\sum f} = \frac{1033}{600} = 1.72$$

Table 7: ***Effective clearing the streets of solid wastes***

Response	Scale, x	Frequency, f	fx	Percentage
SA	4	102	408	17
A	3	108	324	18
D	2	227	454	37.8
SD	1	163	163	27.2
Total		**600**	**1349**	**100**

$$CV = \frac{\sum fx}{\sum f} = \frac{1349}{600} = 2.25$$

Table 8: ***Removal and disposal of abandoned vehicles***

Response	Scale, x	Frequency, f	fx	Percentage
SA	4	30	120	5
A	3	50	150	8.5
D	2	240	480	40
SD	1	280	280	46.7
Total		**600**	**1030**	**100**

$$CV = \frac{\sum fx}{\sum f} = \frac{1030}{600} = 1.72$$

Table 9: ***Effective removal and disposal of carcasses of dead animals from public places***

Response	Scale, x	Frequency, f	fx	Percentage
SA	4	62	248	10.3
A	3	88	264	14.7
D	2	227	454	37.8
SD	1	223	45	37.2
Total		**600**	**1011**	**100**

$$CV = \frac{\sum fx}{\sum f} = \frac{1011}{600} = 1.69$$

Table 10: ***Effectively monitoring, cleaning, clearing and maintenance of the drainage facilities within Enugu State***

Response	Scale, x	Frequency, f	fx	Percentage
SA	4	32	128	5.3
A	3	89	267	14.8
D	2	260	520	43.3
SD	1	219	219	36.6
Total		**600**	**1134**	**100**

$$CV = \frac{\sum fx}{\sum f} = \frac{1134}{600} = 1.89$$

Table 11: ***Effective design, operation and maintenance of waste disposal facilities***

Response	Scale, x	Frequency, f	fx	Percentage
SA	4	27	108	4.5
A	3	33	99	5.5
D	2	280	560	46.7
SD	1	260	260	43.3
Total		**600**	**1057**	**100**

$$CV = \frac{\sum fx}{\sum f} = \frac{1057}{600} = 1.76$$

Table 11: ***Approval and keeping close watch on all waste disposal systems in Enugu State***

Response	Scale, x	Frequency, f	fx	Percentage
SA	4	45	180	7.5
A	3	65	195	10.8
D	2	210	420	35
SD	1	280	280	46.7
Total		**600**	**1215**	**100**

$$CV = \frac{\sum fx}{\sum f} = \frac{1215}{600} = 2.03$$

Table 12: ***Taking requisite, advantageous, and convenient actions for or in connection with the carrying out of ESWAMA functions or incidental to their proper discharge***

Response	Scale, x	Frequency, f	fx	Percentage
SA	4	106	424	17.7
A	3	110	330	18.3
D	2	242	484	40.3
SD	1	142	142	23.7
Total		**600**	**1380**	**100**

$$CV = \frac{\sum fx}{\sum f} = \frac{1380}{600} = 2.30$$

Table 13: ***Asseessed statutory responsibilities of ESWAMA, hull hypotheses, CVs and decisions***

No	ESWAMA statutory responsibility	Null hypothesis	CV	Decision
a	To collect, remove, process, treat and safe dispose domestic, hospital,	ESWAMA does not effectively collect, remove, process, treat and safe dispose of domestic,	2.25	Accept n.h.

	commercial, institutional and industrial wastes	hospital, commercial, institutional and industrial waste		
b	To recycle waste	Does not recycle waste effectively	2.3	Accept n.h.
e	To clear streets of solid wastes	Does not clear streets of solid wastes effectively	2.25	Accept n.h.
f	To remove and dispose of carcasses of dead animals from public places	Does not effectively remove and dispose of carcasses of dead animals from public places	1.72	Accept n.h.
g	To monitor the cleaning, clearing and maintenance of the drainage facilities within the state	Does not effectively monitor the cleaning, clearing and maintenance of the drainage facilities within the state	1.69	Accept n.h.
H	To remove and dispose of abandoned vehicles	Does not effectively remove and dispose of abandoned vehicles	1.89	Accept n.h.
i	To design, operate and maintain waste disposal facilities	Does not effectively design, operate and maintain waste disposal facilities	1.76	Accept n.h.
k	To approve and keep close watch on all waste disposal system in the state	Does not effectively approve and close watch on all waste disposal system in the state	2.03	Accept n.h.
l	To take requisite advantageous, convenient actions for or in connection with the carrying out of its function or incidental to their proper discharge	Does not effectively take requisite advantageous, convenient for or in connection with the carrying out of its function or incidental to their proper discharge	1.72	Accept n.h.

AN EMPIRICAL ANALYSIS OF THE EFFECT OF MATERIAL MANAGEMENT ON THE PROFITABILITY OF A SMALL POULTRY ENTERPRISE

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ABSTRACT

This study empirically analysed the effect of material management on the profitability of small poultry enterprises using City Poultry Enterprise, Umuahia as a case study. The monthly material records of the enterprise from 2011-2012 was used for the study. The study used regression and correlation analyses to examine the effect and relationship between purchase, work-in-progress and finished goods on the profits and sales of small poultry enterprises. It was found that proper materials management enhances the profit of the enterprise. It is, therefore, recommended that firms should formulate and maintain proper material management policy.

INTRODUCTION

Material management can be described as a set of integrated functions whose focus is the effective co-ordination of activities relating to the planning, requisition, storage of input material and work-in-progress, their conversion into finished goods and the keeping of the end-products until they are delivered to the customers (Unyimadu, 2012). Material management is one of the most important parts of any competitive enterprise. A scientific technique that deals with the whole distribution and management process beginning from the purchase to delivery of the product is known as material management (Deena, 2012). In the words of Unyimadu (2012), ”material management is specifically concerned with the flow of materials, spare parts, components and other supply.” The various types of materials to be managed in any enterprise include purchased materials, work-in-process and finished goods (Banjoko, 2000). A cost effective material management can contribute significantly to the profitability (Deena, 2012).

Materials management encompasses all operations of management function from purchasing of raw materials through the production process to the final delivery of the end products (Unam, 2012). Material management ensures that the costs of production are cut down in order to enhance profitability and remain competitive in the market. Thomas et al (1989) indicated that proper material management have the potential to save cost for the enterprise. Material management is very critical for most Agribusinesses, such as poultry, that involve the movement of materials from the stage of

the day old chick to the sales of the mature fowl.

The issues of food security and climate change inform the importance of material management, which reduces cost and ensures environmental sustainability. Most poultry enterprises are faced with the challenge and constraints of proper materials management to reduce wastages, ensure environmental sustainability as well as maximize their profit. The main objective of this paper is to analyze the effect of material management on the poultry enterprise, using City Poultry Farm, Umuahia a casse study. The study assumed that material management has no significant effect on the profit of the poultry enterprise, and that there is no significant relationship existing between material management, sales and profit of the poultry enterprise.

REVIEW OF RELATED LITERATURE

Concept of Materials Management

According to Asaolu et al (2012), materials are simply industrial goods that become part of another physical product. They represent the major component of business cost and profitability. According to Ramakrishna (2005), on an average, half the sales income in an organization is spent on materials. This implies that to boost a firm's profit, there is the need to reduce materials cost, which leads to a reduction in manufacturing cost. Ogbadu (2009) identified basic price, purchasing costs, inventory carrying cost, transportation cost, materials handling cost, office cost, packing cost, marketing cost, obsolescence and wastages as the various costs involved in these materials. Thus, the management of these materials so as to reduce the costs associated is what is known as Materials Management.

An integrated approach to Materials Management defines it as "the function responsible for the co-ordination of planning, sourcing, purchasing, moving, storing and controlling materials in an optimum manner so as to provide a predetermined service to the customer at a minimum cost" (Ramakrishna, 2005; Gopalakrishnan & Sundaresan, 2006). International Federation of Purchasing and Materials Management (IFPMM) defined it as a total concept having its definite organization to plan and control all types of materials, its supply, and its flow from raw stage to finished stage so as to deliver the product to customer as per his requirements in time. These definitions provide the scope of Materials Management which includes decision on purchasing raw materials, staffing, inventories, stores and warehouse management, production levels, and distribution of finished goods at minimum cost at due time (Banjoko, 2000; Osotimehin, 2006; Ogbadu, 2009).

Objectives and Role of Materials Management

According to Ogbadu (2009), the classical definition of the objectives of materials management is the acquisition of materials and services of the right quality, in the right quantity, at the right price, from the right source and at the right time. Apart from these general objectives, the following under-listed points also constitute some of the objectives of materials management:

- To support the company operations with an uninterrupted flow of materials and services. This can be achieved through detailed planning of the supply of materials, parts and components so that they are brought together at the right time and in the right work location.
- To keep inventory investment losses (due to deterioration, obsolescence and theft) under control. Also making the most economical use of plant and equipment by smoothing out production processes and scheduling to the best of utilization.
- To buy wisely and competitively which include two distinct

considerations: keeping abreast the forces of supply and elements that regulate prices and availability of materials; and a constant search for better values that yield the best combination of competitive buying and wise buying that contributes most to maximizing a company's profit.

- To reduce transportation cost of moving materials by making decisions on route to follow, the means of transportation and the vehicle to use.
- To provide information service for controlling the distribution of products, production management, instruction, manufacturing, routes and other background production information.
- To have better control of quality of company's product and to provide required level of customer services. This can be done by maintaining favorable relationship with suppliers' consistency of quality.

The major role of materials manager is to ensure the materials flow of the manufacturing company that includes the production, planning, procurement, storage, production control and distribution.

METHODOLOGY

The secondary data for this study were obtained through the records of City Poultry Enterprise, Umuahia, Abia State. A case study approach was adopted since it successfully enhances the understanding of complex issues and can further anchor what has been previously known, while emphasizing detail contextual analysis of limited conditions and their relationship (Dooley, 2002 in Unam, 2012). City Poultry Enterprise is a small poultry enterprise situated at the outskirts of Umuahia town in Abia State in south eastern Nigeria. The enterprise was established in 2010, and has a labor size of 15 employees.

The study made use of the material record of the enterprise for two years (2011-2012). The data collected include the monthly purchase, monthly work in process, monthly finished good, monthly sales and monthly profit of the enterprise.

The study made use of time series, multiple regression and correlation analyses, using the Statistical Package for Social Sciences (SPSS).

DATA PRESENTATION, ANALYSIS AND DISCUSSION

The data used for analyses and discussion, which consist of the monthly purchase of the materials, monthly work-in-process materials, monthly finished product materials, monthly sales and monthly profit of the poultry enterprise, are given on Table 4.1 (Appendix).

Time series of materials management, profit and sales of the enterprise

The time series in Figure 4.1 shows the trend in the poultry monthly material management, sales and profit. The materials, sales and profit of the poultry enterprise has a similar zig-zag trend over the months. The monthly purchase of the poultry maintained a trend, a below the monthly work-in-process, indicating that more materials are being put in the process every month. Especially, materials purchased from the previous month are being carried over to the next month. The monthly finished goods maintained a trend below the monthly work-in-process. This indicated that the poultry enterprise ensured that the process of the production is always sustained. The finished goods trend is at a low level because the poultry enterprise makes available the finished

goods based on the demand, since the poultry products are mostly perishables. The monthly sales trend falls between the monthly purchase and work in process trends. The profit trend of the poultry enterprise is above all other trends indicating that the materials management of the enterprise ensures the high profit level of the poultry enterprise. This implies that proper material management of the poultry enterprise sustains production and ensures the profitability of the enterprise.

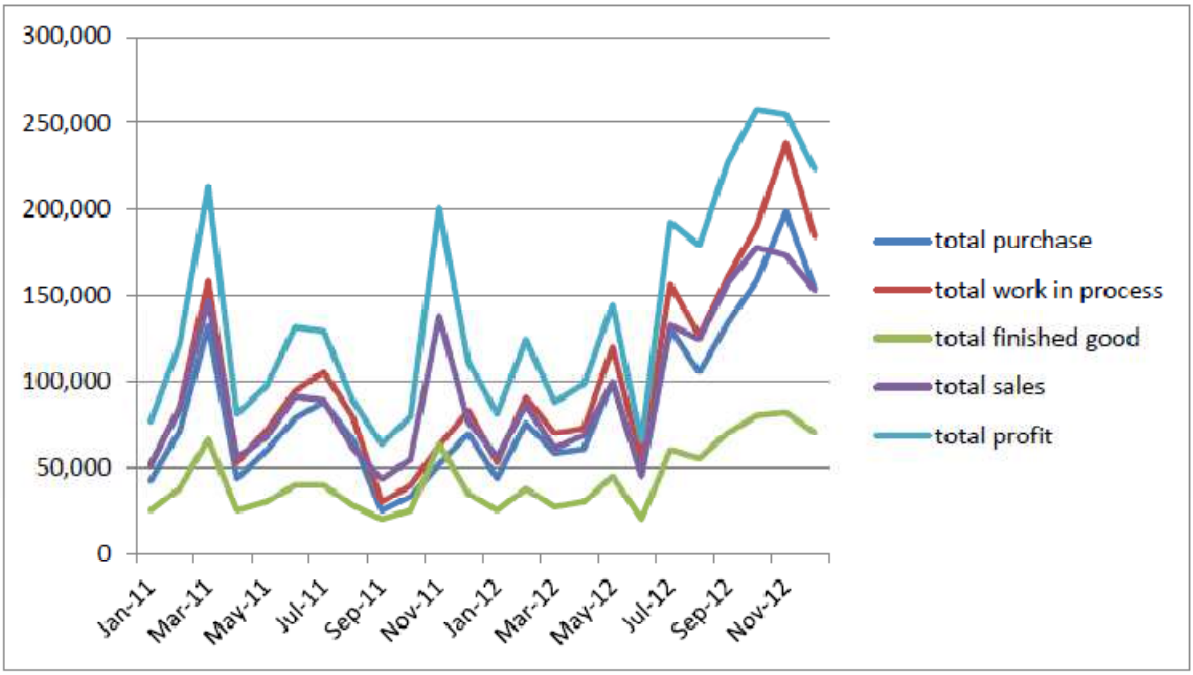

Fig. 4.1*: Trend of materials management of City Poultry Enterprise, Umuahia, 2011-2012*
Source: SPSS analysis of materials management records.

The Effect of Materials Management on the Profit of the Poultry Enterprise

From Table 4.2 shows the results of regression analysis. The adjusted R^2 value of 0.998 indicated that 99.8 per cent of the total variation in the dependent variable is being accounted for by the independent variables included in the model. Monthly total finished goods was found to be statistically significant at 1 percent (0.01) and positively related to the enterprise profit. This indicated that as the finished products increased, there were enough products for sale, and thus, an increase in the profit of the poultry enterprise. Total monthly purchase was not statistically significant but positively related to the enterprise profit, indicating that as the quantity of purchased material increased, the profit of the poultry enterprise increased. The monthly total work-in-process was not statistically significant, but negatively affected the profit of the enterprise, indicating that as the quantity of materials-in-process increased the profit of the enterprise decreases.

Table 4.2: ***Regression of the effect of materials management on the profit of the poultry enterprise***

Variable	Coefficient	Std. Error	t-Statistic	Prob.
TTPURCH	198.9705	1165.649	0.170695	0.8661
TTWIP	-165.8271	971.3776	-0.170713	0.8661
TTFG	3.246494	0.055695	58.29098	0.0000
R-squared	0.998647	Mean dependent var		138580.4
Adjusted R-squared	0.998518	S.D. dependent var		63007.42
S.E. of regression	2425.571	Akaike info criterion		18.54199
Sum squared resid	1.24E+08	Schwarz criterion		18.68925
Log likelihood	-219.5039	Durbin-Watson stat		1.343472

Source: SPSS multiple regression analysis of the materials management record of City Poultry Enterprise, Umuahia, 2011-2012

The relationship between materials management, sales and profit

From Table 4.3, which present the correlation coefficient between the materials, sales and profit, there is a strong positive relationship existing between the materials, sales and profit.

Table 4.3: ***Correlation coefficients analysis***

	total purchase	*total work in process*	*total finished good*	*total sales*	*total profit*
total purchase	1				
total work in process	0.92	1			
total finished good	0.91	0.91	1		
total sales	0.98	0.93	0.99	1	
total profit	0.91	0.91	0.95	0.98	1

Source: SPSS multiple regression analysis of the materials management record of City Poultry Enterprise, Umuahia, 2011-2012

CONCLUSION AND RECOMMENDATIONS

In today's high competitive world, the success of any enterprise depends on how effective the purchase, work-in-process and finished goods of the enterprise are managed. This study found out that the small poultry enterprise under stsudy maintained a monthly purchase that enabled it to enhance its work-in-progress and finished goods, thereby insuring that the enterprise operated profitably. The finished goods of the poultry enterprise (egg and meat), was found to be significant and positively influencing the profit of the poultry enterprise, as the finished goods enabled the enterprise to meet up the rising demand for its products. Since the sales and profit of the enterprise are enhanced through proper materials management, the paper recommend proper materials management by small poultry enterprises, proper training of the materials management staff, and materials management policy that encourages proper materials management.

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Appendix

	Purchase						work in progress						finished products			sales
	Water	feed	drugs	chicken	others	total	water	feed	drugs	chicken	others	total	broiler	egg	total	meat
Jan-11	8000	20,200	1376.471	5,295	20,236	59,911	4,800	24,240	1,412	7,556	33,888	71,880	17,000	8,000	25,000	348010.71
Feb-11	8000	26,800	1376.471	9,630	40,354	85,960	4,800	36,960	1,412	11,556	48,424	103,152	26,000	12,000	38,000	53392.86
Mar-11	8000	51,000	1376.471	15,185	63,079	134,440	4,800	61,200	1,412	19,222	75,895	161,329	41,000	25,000	66,000	84196.85
Apr-11	8000	16,000	1376.471	5,556	26,702	56,434	4,800	22,800	1,412	6,667	32,042	67,720	15,000	10,000	25,000	30803.57
May-11	8500	22,000	1323.529	6,667	31,954	66,644	5,400	27,300	1,588	8,000	37,995	80,283	18,000	12,000	30,000	36964.29
Jun-11	9500	28,000	1323.529	7,407	37,191	79,421	5,400	33,900	1,588	8,889	44,629	94,106	20,000	20,000	40,000	41071.43
Jul-11	8000	31,000	1411.765	9,259	41,421	87,092	5,760	37,200	1,694	11,111	49,705	105,470	25,000	15,000	40,000	51339.29
Aug-11	9500	23,200	1529.412	7,407	31,096	66,233	4,200	27,840	1,235	8,889	37,316	79,480	20,000	8,000	28,000	41071.43
Sep-11	8000	17,000	941.1765	5,556	23,668	50,363	3,840	20,400	1,129	6,667	28,400	60,436	15,000	5,000	20,000	30803.57
Oct-11	7800	20,800	823.5294	6,667	27,454	59,544	3,360	24,960	988	8,000	32,945	70,253	18,000	7,000	25,000	36964.29
Nov-11	8950	52,200	838.2353	16,667	63,464	136,019	3,420	62,640	1,006	20,000	76,157	163,223	45,000	18,000	63,000	92410.71
Dec-11	8000	28,000	1376.471	9,259	38,385	81,021	4,800	34,800	1,412	11,111	46,062	98,185	25,000	10,000	35,000	51339.29
Jan-12	8000	16,000	1376.471	5,556	26,702	56,434	4,800	22,800	1,412	6,667	32,042	67,720	15,000	10,000	25,000	30803.57
Feb-12	8000	27,200	1376.471	7,407	35,743	75,527	4,800	32,640	1,412	8,889	42,892	90,633	20,000	18,000	38,000	41071.43
Mar-12	8000	16,000	1376.471	5,556	27,502	58,034	4,800	23,760	1,412	6,667	33,002	69,640	15,000	12,000	27,000	30803.57
Apr-12	8000	21,000	1376.471	5,556	26,702	60,434	4,800	25,200	1,412	6,667	34,442	72,520	15,000	15,000	30,000	30803.57
May-12	8500	36,000	1323.529	11,111	46,674	99,609	5,400	43,200	1,588	13,333	56,249	119,770	30,000	15,000	45,000	61607.14
Jun-12	9500	14,000	1323.529	3,704	21,507	48,034	5,400	16,800	1,588	4,444	26,808	54,041	10,000	10,000	20,000	20535.71
Jul-12	8000	48,000	1411.765	14,815	60,946	129,972	5,760	57,600	1,694	17,778	73,135	155,967	40,000	20,000	60,000	82142.86
Aug-12	9500	40,000	1529.412	11,111	49,580	105,220	4,200	48,000	1,235	13,333	59,496	126,265	30,000	25,000	55,000	61607.14
Sep-12	8000	52,000	941.1765	14,815	62,875	133,831	3,840	62,400	1,129	17,778	75,450	160,597	40,000	30,000	70,000	82142.86
Oct-12	7800	62,000	823.5294	18,519	74,041	158,183	3,360	74,400	988	22,222	88,849	189,820	50,000	30,000	80,000	102678.6
Nov-12	8950	78,000	838.2353	26,667	91,809	196,164	3,420	93,600	1,006	32,000	110,171	237,797	72,000	10000	82,000	147857.1
Dec-12	8000	58,000	1376.471	18,519	71,594	153,289	4,800	69,600	1,412	22,222	85,913	183,947	50,000	20,000	70,000	102678.6

		profit		
egg		meat	egg	total
14428.57	51339.29	17,911	8,431	26,339
30000	83392.86	27,393	18,000	45,393
62500	146696.4	43,196	37,500	80,696
25000	55803.57	15,804	15,000	30,804

30000	66964.29	18,964	18,000	36,964
50000	91071.43	21,071	30,000	51,071
17500	88839.29	26,339	22,500	48,839
20000	61071.43	21,071	12,000	33,071
12500	43303.57	15,804	7,500	23,304
17500	54464.29	18,964	10,500	29,464
45000	137410.7	47,411	27,000	74,411
25000	76339.29	26,339	15,000	41,339
25000	55803.57	15,804	15,000	30,804
45000	86071.43	21,071	27,000	48,071
30000	60803.57	15,804	18,000	33,804
17500	68303.57	15,804	22,500	38,304
17500	99107.14	31,607	22,500	54,107
25000	45535.7:	10,536	15,000	25,536
50000	1321429	42,143	30,000	72,143
62500	124107.1	31,607	37,500	69,107
75000	1571429	42,143	45,000	87,143
75000	177678.6	52,679	45,000	97,679
25000	172857.1	73,857	15,000	88,857
50000	152678.6	52,679	30,000	82,679

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