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Review

Environmental degradations, strategies and effective management practices in Enugu, Nigeria

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Abstract

Environmental degradation which results in the deterioration of both urban and rural environmental quality is a major problem in Nigeria. However, the situation in urban setting is attaining alarming proportion because rapid urban population growth among other factors shave compounded urban environmental management. The conditions in Enugu are not different. This paper therefore reviewed the major environmental problems plaguing Enugu metropolis. They include solid waste management, the menace of deforestation, and development of slums as well as water and air pollutions in the area. The areas predominantly affected by each of the problems were highlighted. The consequent depletion in the environmental quality in the metropolis brought about health hazards as a result of indiscriminate dumping of wastes, contamination of both surface and ground water which adversely impacts on the domestic usage in the area, depletion of trees which reduce the stress produced by heat island and decrease the noise levels of the metropolis. Recommendations were made towards effective management practices, among which are; integration of development planning and environmental management of all levels of political and economic decision making to ensure sustainable environment, reforestation to compensate for ever harvesting, promotion of awareness and education on waste prevention, reduction, recycling, re-use and separation at source to reduce the volume of solid waste generated at all levels.

Key words: Environment, Degradation, Effective, Management, Enugu

INTRODUCTION

The present sate of our environment is of growing concern, particularly as it affects the urban settings. This concern is attaining alarming proportions because of the rapid urban population growth. In Nigeria the rate of rural urban migration has increased over the years inspite of urban unemployment. This suggests that socio-economic conditions in the rural areas of the country have contributed significantly to the urbanization process in the country (Makinwa, 1986). Since 1980 human related activities, especially development projects have led to the acceleration of environmental degradation in the country (Nwafor, 2006). This has resulted in the deterio-ration of Nigeria's urban and rural environmental quality.

In Enugu metropolis, an increasing number of shanties have been springing up at the outskirt of the metropolis. They include those of Nkpologwu, Ugbo Chime, Ugwu Fred, Ugwu Aaron, Ugbo Odogwu. The inhabitants of these shanties adduce that they could not cope with the rents for the dwelling units they were formerly occupying at the inner city. This they claim was as a result of non availability of enough of these dwelling units, hence the rate of demand being greater than the rate of supply. Landlords tend to take advantage of this situation to charge exhorbitant rents; the tenants on their own decided to be making do with what they could lay hands on at the surbub at cheaper costs. Some of these

shanties emerge on undulating hilly areas where developers find virtually no opposition as to title or ownership of land. These areas in most cases develop into slums, creating unappealing sights, with the attendant environmental consequences.

Furthermore, in recent time, there has been a rising volume of wastes seen littering most of the streets within the metropolis. Thus is more pronounced in certain areas often characterized by high population density. Also some areas that surround major markets in the metropolis such as Coal Camp, Ebonyi Paint Road, Obiagu Abakpa, Garki generate massive wastes and develop disposal problems resulting in a treat to the quality of air and water around. In some parts of the high density areas, inhabitants tend to dispose of their solid wastes into running water, these wastes block drainage systems creating problems in the area. Enugu State Waste Management Authority responsible for management of the wastes seems to be having challenges in handling the situation.

The implications of the above situation to our residential environment are numerous and pose enormous problems. This study therefore examined the problems of environmental degradation as well as effective management practices in Enugu metropolis.

Overview of the Core Environmental Problems in Enugu

The core environmental problems of Enugu metropolis are the same generic problems characteristic of other developing countries. The problems which are generally referred to as primary environmental problems are mainly attributable to poverty underdevelopment and the attendant poor housing, improper and inefficient system of sewage drainage and urban solid waste management. Others are gross inadequate management of traffic and the attendance chaos in traffic flow, and air pollution from gaseous and particulate emission from motor vehicles, as well as water pollution from industrial contamination. Thus, the problems are those which result from demographic factors namely rapid rate of population growth leading to population explosion and concomitant increases in requirements for food, energy and housing, poverty and poverty induced urbanization as migrants swell the ranks of the unemployed and become added problems without commensurate resources to address urban problems of governance.

Environmental problems in Enugu metropolis have their roots in the peculiar historical, political, social and physical characteristics of the area. The process of socio-economic and political development of the metropolis combines with the environmental problems that characterize other developing countries to create a synergistic effect which heighten the level of environmental duration. Allied to this is an institutional weakness in the area of urban planning characterized by inadequate human resources for enforcement of planning regulations and unplanned (i.e unauthorized) development. The proliferation of petrol stations on small plots in unsuitable location is a case in point. Environmental problems exacerbated by the socio-economic and political circumstances in the metropolis include;

- Physical planning and building construction inadequacies especially the inability of the planning authorities to enforce planning and building construction guidelines, laws and regulations resulting in the non-adherence to building set back. Examples are; construction on natural drainage system, encroachment on right of way during development resulting in such buildings encroaching on the road and parking spaces, and the inability to control available parking spaces.
- Population explosion, and high influx of people into Enugu resulting from environmental-induced rural exodus (i.e environmental exodus-rural-urban migration) and environmental induced diaspora. (i.e environmental refugees). The rural-urban migration into the metropolis represents a mechanism for relocating poverty from the rural to the metropolis, thereby deepening the state of poverty in the areas as well as the concomitant environmental degradation.
- Poverty induced urbanization of Enugu as migrants swell the ranks of the unemployed and become added problem to the myriads of city problem without commensurate resources to address the problems of urban governance-a major cause of environmental problem in Enugu
- High density and rapid increase in the number of motor vehicles and commercial motor cycle operators in the face of poor traffic management, with on and off street parking not given adequate consideration in layouts. All these combine to hinder traffic flow and cause hold ups and congestions on the streets leading to the intensification of air pollution and gaseous and particulate emissions from motor vehicles.
- Rapid deterioration of initially good living quarters, outworn structures and facilities which are offered in response to pressures of economic change.
- The limited absorption, health facilities, and limited social infrastructure resulting in housing shortage, high occupancy ratio and the development of slums all of which exacerbate poverty.
- Lack of proper drainage, access to potable water supply and the concomitant indiscriminate digging of wells and sitting of septic tanks and soakaway pits.
- Indiscriminate dumping of urban solid waste with little attention paid to the management of the health consequences.
- Encroachment into farmlands by urban expansion and biodiversity loss
- Uncontrolled discharge of industrial wastes into the available water bodies without appropriate treatment.

- Indiscriminate felling of trees in the natural grooves without any frantic effort of re planting for replacement or even afforestation.

Activities of Land Degradation

Southgate, (1988) argued that small farmers have been the main agents responsible for land degradation activities, he cited marked and institutional failures as the primary reason for farmers adopting non sustainable practices. Pagiola (1995) showed how government price control on agricultural goods in Kenya has not provided incentives for the small and poor farmers to conserve their lands but mined them for maximum output. Southgate further cited lack of secure land tenure as the primary reason for poor farmers to cultivate their land excessively to exhaustion, for the simple reason that they have no vested interest in preserving the asset which they do not own. A major cause of land degradation in Nigeria in the millennium aged could be traced to development of technology.

Industrialization – which has actually led to the bursting of urbanization and over concentration of the world population on the urban areas of the landmass, resulting in waste management problem and the like?

Inefficiency in solid waste management is one of the endemic environmental problems plaguing most urban areas in Nigeria. Solid waste constitutes a major problem to countries world over. Since the last century and especially after the Second World War there has been a dramatic increase in the production of wastes, indicating unprecedented global level of economic activities. The increase in waste stream of western economics could be attributed to factors which include; the proliferation packaging, the demand for convenience products, changing patterns of taste and consumption as well as cheaper consumption products (Grandy, 1994). Amuno (2011) remarked that academic inquiry into the potential impact of dump sites on soil quality is receiving global attention due to the growing awareness of environmental and epidemiological visits. Associated with municipal solid waste disposal, open dumpsite presents a number of risks to soil due to its propensity to generate toxic chemicals and pathogens which alter the natural environment of the soil. Findings show that soils that formed from dumpsites can be classified as moderate to extremely contaminated with heavy metals such as lead and cadmium. Schwars, (1997) argued that landfill would worsen the soil quality and bring about environmental damage.

According to him, soils are often damaged by untreated industrial and hospital wastes, and population facilities that contaminate soil including metallurgic factories and petrochemical industries such as paints or pharmaceutics, ad well as petrol stations. Ideriah et al (2010), observed that higher concentrations of lead are obtained in the vicinity reducing the overall soil strength and consequently its usefulness as a foundation material.

In Enugu metropolis, like in many other urban areas on Nigeria, inadequate solid waste management which was relatively bearable before 1980 is becoming extremely difficult to cope with, especially with the growing spate of urbanization, rural-urban migration and citing of buildings and other infrastructures in areas designated as solid waste disposal point. Furthermore a proliferation of public and private schools, hospital and eating houses generate more than 95% of the refuse in the metropolis (Eze, 2008). Enugu State Waste Management Authority – agency responsible for management of wastes in the areas – presently adopts stationery, dumpster system for waste collection. This is not without its associated problems in the metropolis. Nwafor (2008), however, observed that the numerous and interlinked causes of solid waste management problems and the attendant environmental problems among others, in the metropolis are the inertia factor, the demographic, institutional factor and absence of public participation. The outcome is that overcrowding and congestion in all spheres, homes, traffic, market, schools and hospitals have been excercebated by urban solid waste problems and inadequate social infrastructure and services. The end result is the inexorable progression in the stifling of urban life in Enugu metropolis with the city displaying an unwelcome image of chaos, indiscipline and insalubrity. The force of inertia operates in three dimensions; difficulty in controling public involvement for change, the perceptual aspect and the response aspect. The force factor makes public involvement for change extremely difficult to sustain a movement and achieve the stated goal e.g the reluctance of the general public to make a shift from the predominating throw away culture of all sorts of wastes to adopt waste separation and sorting at source, recycling and reuse. The perceptual aspect entails the tendency of the urban solid waste management authority to see things only in ways that are familiar and acceptable. This could be seen in the tendency to persistently focus mainly on solid waste collection and disposal (an unsustainable approach in which urban solid waste is perceived as something to be discarded) and adopt an integrated approach which sees urban solid waste as wealth. This indeed, is a societal characteristic that is concomitant with ignorance, indifference and lack of imagination. The response aspect of inertia involves the tendency to accept the continuation of the past and prevailing institutions, even when this acceptance is seen as likely to lead to unacceptable outcomes.

In the last two decades, Enugu has had the privilege of the intervention of international development organizations notable UNDP and DFID, which have been active through their support of initiatives to introduce strategy and policy development for sustainable environment and for the development and implementa-

tion of a comprehensive waste management system. However, all the three dimensions of inertia factor have resulted in the poor or non implementation of the proposals. For instance, in the study and implementation of Enugu Landfill-Towards Integrated Urban Solid Waste Management of Enugu Metropolis (the consultancy of which was carried out by Mequip Engineering Services). Barrat and Diyoke (2003), observed that the study and implementation of the landfill had congenital weaknesses which were aggravated by operational inappropriateness. There was no Environmental Impact Assessment study and monitoring programme for the landfill site, with the result that flooding made operations in the rainy season impossible. Furthermore, the waste management authority ranted Emenite Ltd located at Emene access to the landfill for the disposal of industrial waste which was not provided for in the study.

Emodi (2013), pointed out that rapid population increases, the accelerated rate of urbanization of poverty and the expansion of unplanned residential districts in Enugu have resulted in the astronomical increases in the volume of wastes generated in the metropolis. These demographic trends have combined with major institutional constraints like lack of inter-sectoral communication and coordination to manage the environment, inadequate institutional capacity, among other factors created a situation in which the volume of urban solid waste generated in the metropolis seems to be constantly above the management capacity of the waste management authority in the area.

The Menace of Deforestation

Deforestation is one of the most important environmental problems of the last few decades. It is indeed, not the least because of the effects on global climate via its impact 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 could be said to be a local environmental problem with a global dimension. Equally, the process of deforestation has been a global concern, with forest, woodland and scrub cover declining worldwide by 2% during the 1980s (FAD, 1995). This trend has persistently moved downward since then (Watson et al 2001). Various estimates confirm the very high rate of deforestation in Nigeria. The high forest cover in the country decreased for 20 million hactares in the beginning of the 20th century to only 1 million hectares in the 1990s (Oguntala, 1996). During the oil boom years of the 1970s, there was a massive increase in construction activities which heightened the demand for both construction and furniture timber from forests in Ondo, Edo, Delta and Cross River States (Atoyebi, 2000). Hence the countries standing crop of valuable species (e.g Iroko, Mahogamy) of merchantable size has been severally depleted. Okezie (1999), observed that the country, in the past 30 years has been loosing on the average about 23,000 hectares of the gazatted forest estate per annum through government reservations. For instance, 410 hactares of Ogba forest in Edo State was used for government's projects and airport. The Army School of Artillery, the Nigerian Defence Academy and the Police Mobil Training School have together claimed about 7,420 hactares of forest reserves in Kaduna State. The Ilorin Airport claimed 1,140 hactares of the Ajaokuta forest reserve in Kwara state (NEST, 1991).

The story is never different in Enugu. The metropolis is mostly inhabited by civil servants and the wages of these workers are not proportionately increasing with the rates of inflation in the country. Consequently, many – low class residents of the area have moved out of the core city to the suburbs. These are those who have been forced out by high rent being demanded by their landlords. They resort to erecting shanties, in most at the peripheries of the core city where they pay little to no rent. This is so because people pay virtually nothing here for land acquisition as most of these shanties are erected along undulating hilly areas where individual land ownership is not precisely ascertained. The consequence is that the top cover of the soil is being removed while erecting these shanties hence, there is easy run off from these hilly developed areas down to the city bringing about flooding and eventually erosion. This has been the case with Ugwu Fred, which as a result of the development at the top of the hilly areas has been causing a lot of flooding at its base on the side of the former premises of University of Nigeria Teaching Hospital.

Besides, as a result of the dwindling nature of the Nigerian economy, prices of goods have generally and astronomically gone up. Euen the Federal government, in a bid to adjust has adjusted upwards the prices of petroleum products like kerosene. In many instance, the product kerosine is not available for purchase. Where it is available, it is sold by independent marketers who price it high considering their cost of procuring it. Consequently, kerosine is now tilting towards being beyond the reach of the common man. Hence, people have resorted to the old usage of firewood and charcoal as the alternative sources of fuel for cooking. Firewood has therefore become a good source of revenue particularly to those living in the hinterland. Little wonder the high rate at which our forest land especially those at the hinterland are being deforested in search of firewood. The rate at which firewood is being transported every Oye day to Oye Emene market from Amorji Nike, Nchatancha and the environs is very alarming. The thick forest spanning between Caritas University and Rehab road is no longer so. The area has been devastated through indiscriminate felling of trees for firewood, as well as for developmental purposes. Furthermore, the spate of deforestation in the metropolis to give way for industrial developments and

the likes is something of concern. This is so because no frantic effort is being made to re-afforest in any way in the area.

As there is pressure on the virgin forests in the area and as these areas are cleared for one reason or the other, the temperature of the metropolis is being negatively affected. Man takes in oxygen and gives out carbon dioxide while plants on the other hand take in carbon dioxide and give out oxygen. Under undisturbed vegetation, plants within and around the metropolis generate a lot of oxygen needed by the residents and absorbing excess carbon dioxide given out in the area, thereby bring a balance in the temperature. But as the vegetations of these areas are cleared, it becomes difficult for the excess carbon dioxide generated in the metropolis to be reabsorbed, and no additional source of oxygen into the metropolis. Hence, there is imbalance in temperature which tends to contribute a great deal to the warning of the environment within the metropolis Emodi (2013), observed that "Plants are the lungs of the metropolis the idea being that the excess carbon dioxide produced in the area would be absorbed by the photosynthetic process of plants and oxygen given off. This is a contribution to purification of the air. There is indeed, a lively interaction between the urban atmosphere and the living plants. According to Emodi, the green surfaces mitigate the less desirable aspects of the urban areas. Within their confines and beyond, they certainly reduce the stress produced by the heat island, decrease the noise levels and filter out certain pollutants in the air.

Furthermore, in low density areas of the metropolis like independence layout which hitherto used to be well drained even during the rainy season, with characteristic ecstatic features of trees and flowers within residential premises, is no longer so. This is because in some cases, the tenants tent to erect emergency shanties within the available spaces in the premises they occupy. These, they let to students in most cases, so as to be able to defray the high rent demanded by their landlords. These shanties, on the other hand tend to block the natural and original drainage facilities in these areas. Consequently, flooding is presently being experienced in some parts of the area, which before now was not the case.

Slum Development in the Area

In most third world countries like Nigeria, urban populations have expanded without any associated expansion in the services and facilities essential for adequate healthy urban environment, which usually occurs with little or no effective pollution control. Most of the cities in the developing counties have inadequate affordable housing and their residential environments are commonly characterized as slums. Tadaro (1981) opined that there are 141 nations that make up developing countries. Of these countries, 42 are the poorest, 86 are non-oil-exporting nations, and 13 are petroleum exporting countries. Economically, developing countries are characterized by absolute poverty, high rate of unemployment and low per capita income. The gravity of the shortage is revealed by the percentage of household occupying one room and the number of persons per room in major urban centres in Nigeria. The adoption of European standard in housing construction and neighbourhood development encouraged the substitution of indigenous materials with expensive imported building materials. This in turn drove the cost beyond the affordability of all but the elite unfortunately. Low income groups cannot afford reasonable housing, so they have no alternative but to choose to dwell in Slums. Mabogunje (1995), emphasized that environmental degradation, inappropriate western model, housing, technological innovations, institutional developments and family planning should receive maximum education that can improve an average person's standard of living.

The current housing conditions in Enugu Metropolis are far from being ideal with some perceived inadequacies in housing policies and programs implemented on ad-hoc basis, lacking sound empirical analysis. Slums in Enugu metropolis are usually referred to as face-me-i-face-you, where most of the housing units in the area are of single tenement basis with more than 4 to 5 occupants in a room. Of the total population of 722, 664 in the metropolis, Slums accommodate more than 30% of the population. While the Slums in Enugu may share similar conditions with Slums in other urban areas, they peculiarly possess the following characteristics.

- High population densities per unit areas of land. These could be found in areas like Ugbo Okonkwo, Ugbo Odogwu, Iva Valley Abakpa, Emene, Ugbo Chime and other high density areas of the metropolis.
- Physical layouts are relatively haphazard, thus making it difficult to provide infrastructures and related facilities without carrying out some form of demolition.
- Urban services are minimal or non-existent e.g waste collection
- Housing structures are constructed largely of temporary materials in relation to building regulations
- Majority of the residents are low income earners
- Most of the residents are tenants who outnumber owner residents at a ratio of 9.1
- Morbidity and mortality rates caused by diseases stemming from environmental conditions are significantly higher than in planned areas of the metropolis.

A survey in the metropolis revealed that most of the environmental and other problems are prevalent in the Slum areas of the metropolis. For instance, some of the areas with high density of people and which, indeed, constitute slums are not included in the waste management programs. In Ugbo Odogwu, Ugbo Fred,

Nkpologwu, etc. waste materials are found littered all over the narrow streets. There are no dumpsters located in these areas. So residents dispose off their wastes by any means they find convenient to them. Some of them pour their solid wastes into the running flood water during the raining season. These wastes in turn block the drainages and water channels, bringing about flooding in the area and beyond. Besides, in places like Ugbo Chime Ugbo Aaron, some aspects of Iva Valley, most of the structures are shanties without adequate ventilation. Hence, most of the residents here are exposed to different kinds of diseases and illnesses that could have been averted. Furthermore, in most of the slums within the metropolis, there are no planned streets and appropriate identification of houses. The areas therefore constitute good hide outs for hoodlums and perpetrators of various crimes who find easy places of succor in them. Hence, it has been alleged that most of the armed robbery cases, kidnapping and cultism activities are conceived in these places and eventually carried out in the core areas of the metropolis.

Issues of Water Pollution

The quantity of worldwide water suppliers is declining as a result of pollution in urban areas. At the global level, 22 countries face severe water shortages, 18 could be said to be in danger of facing shortages if fluctuations in rainfall patterns continues (World Bank, 1992). Although water shortage is a major threat, water contamination and pollution poses a more immediate serious problem.

Water pollution has affected both surface and ground water in Enugu metropolis. Industrial activities in the industrial area of Emene culminating in the discharge of effluents in Ekulu river and the environment has actually polluted the river which is one of the sources of domestic water supply in the area. Onwuka el at (2004) studied eighty eight samples of the ground water near industrial effluent discharges in Enugu in order to evaluate its portability. The parameters of interest included common waste, derivable chemical constituents such as nitrates. The result showed that eight out of the ten samples analyzed tested that the bacteriological quality of the ground water showed evidence of sewage and industrial effluent contamination. Emodi (2015), carried a study of the impacts of industrial discharges on surface water. The impacts of the industrial effluents on the receiving Ekulu river were manifested in various dimensions; high level of turbidity (72) was observed, the contaminated water contained total dissolved solid in the neighourhood of 82.6 mg/L in higher proportion to that of the non polluted area, total suspended solid was 10.1 mg/L as against the 6.3 mg/l in the non polluted area, the nitrate level at the contaminated point (3.3 mg/L) is very high, phosphorous content at the point of contamination (0.8 mg/L) is not favourable as against the 0.3 mg/L of the non polluted area, presence of E, Coli at the polluted water is not favourable as against its absence at the point of contamination (36.3 mg/L) as against the 5.8 mg/L in non polluted area is not ideal, the chloride level at the point of pollution in the river is very much higher (72 mg/L) than what was obtained at the non polluted water.

Consequently, it has been noted that high turbidity can significantly reduce the aesthetic quality of lakes, streams, having the harmful impact on recreation and tourism. It can increase the cost of water treatment for drinking and food processing. It can harm fish and other aquatic lives by reducing food supplies, degrading spawning beds and affecting gill functioning. Besides, high turbidity diffuses sunlight and slows photosynthesis. Plants begin to die, reducing the amount of dissolved oxygen and increasing the acidity. Smiths and Davies (2001), observed that if light level gets too low, photosynthesis may stop altogether. Moreover, high turbidity raises water temperature as the suspended particles absorb the suns heat. In addition, some aquatic animals may not adjust well to warmer water, particularly during the eggs and larval stages. Furthermore, high turbid water can clog the gills of fishes, stunt their growth and decrease their resistance to diseases. Turbid water can clog industrial machines and interfer with making food and beverages.

High rate of suspended solids in the surface water can clog the gills of fish, either killing them or reducing their growth rate. They also reduce light penetration and the ability of algae to produce food and oxygen. When water flows down as when it enters a reservoir, the suspended sediments settle, and may smother the bottom dwelling organism, cover breading areas and smother eggs. Suspended solids indirectly affect other parameters such as temperature and dissolved oxygen, because of greater heat absorbency of the particulate matter, the surface water becomes warm and this tends to stabilize the stratification (Layering) in stream pools, embayment and reservoir. This, in turn interferes with mixing, decreasing the dispersion of oxygen and nutrients to deep layers. High sediment loads interfere with coagulation, filtration and disinfection of the water. They also cause problems to industrial uses, interfere with recreational use and aesthetic enjoyment of water. Poor visibility can be dangerous for swimming and diving. Sediment deposition may eventually close up channels or fill up the water body converting it into a wetland. Total dissolved solids, at a high rate may cause the water to be corrosive or salty, result in scale formation and decreased efficiency of hot water heaters. They may equally contain elevated levels of ions that are above the primary and secondary drinking standards. High total dissolved solid affect the quality of the water, interfering with washing clothes and corroding plumbing fixtures.

Instances where phosphate is a growth limiting nutrient, the discharge of raw or untreated industrial waste into a water body may stimulate growth of

photosynthetic aquatic micro organisms in nuisance quantities. Meanwhile, it has been affirmed that E. Coli present in water bodies can bring about diarrhea, urinary tract infection, respiratory illnesses puneumonia and the likes.

Assessing the danger in the use of water bodies as sink for industrial effluent, Anetor et al (2003), emphasized that population explosion, hazardous rapid urbanization, industrial and technological expansion, energy utilization and waste generation from domestic and industrial sources have rendered many water resources unwholesome and hazardous to man and other living resources. Some heavy metals contained in effluents have been found to be carcinogenic while other chemicals equally present are poisonous depending on the dose and duration of exposure. Undoubtedly, waste water from industries and residential areas discharged into another environment without suitable treatment could disturb the ecological balance of such an environment (Bolkin and Kelly, 1998). Davis and Walker, (1986), were of the opinion that when a biodegradable organic waste is discharged into an aquatic ecosystem such as stream or lake, oxygen dissolved in the water is consumed due to the respiration of micro organisms that oxidize the organic matter. On the other hand, Meetems et al (1995) asserted that oxygen depletion due to waste discharge has the effect of increasing the numbers of decomposers organisms at the expense of others. According to Perry et al, (2007), nitrogen or phosphorous or both may bring about aquatic biological productivity to increase, resulting in low dissolved oxygen and eutrophication of lakes, rivers, estuaries and marine waters. However, Mott and Associates (2001), stressed that many serious human diseases are caused by water borne pathogens. In developed countries, the spread of water borne disease has been largely arrested through the introduction of water and sewage facilities and through hygiene, but in many developing countries, such diseases are still major causes of death especially among the young ones (Lamb, 1985). However, Nwachukwu et al (1989), noted that the rush by African countries to industrialize has resulted in the discharge of partially treated or raw wastes into the surrounding bodies of water.

It has equally been observed that pond water is not isolated from being contaminated. Ibekwe et al (2004), analysed the waste water in the accumulation pond and final discharge point in Nigerian Bottling company PLC, to determine their bacteriological and physio-chemical characteristics. The final discharge contained more dissolved solids which was double that of the accumulation pond. It was also found that the dissolved oxygen was slightly higher in the final discharge point than accumulation pond. Although these findings were found to be within the permissible limits of effluent discharge specified by the federal ministry of Environment the consequent long term bioaccumulation effects on microbial ecosystem were not reported.

Air Pollution Activities

It is estimated that 1.3 billion people-most of them from developing countries-live in towns or cities which do not meet minimum World Health Organization standard (WHO. 1992). Approximately two fifths of the world population, most of them located in developing counties do not enjoy the basic right to clean air.

In Enugu Metropolis, transportation and traffic congestion are among the causes of air pollution. The escalation in air pollution from transport and traffic is indeed, typical of Nigerian cities, and is a function of three major factors; first, there has been a significant increase over the years in the number of motor vehicles. Second, the vehicles are mostly old and exhaust gases containing high levels of pollutants. Third, they are badly maintained and the premium motor spirit (PMS) popularly known as petrol used has lead additives. Lead inhibits several steps in the formation of haemoglobin. It can also be lodged in the liver and thereby can lead to cancer of the liver. Diesel-engine heavy duty vehicles are responsible for carbon particulate emissions. The traffic congestions are mainly pronounced around, Oye Emene, liberty area of Abakpa, Ogbete, Mayor Area of Agbani road among others. These congestions are experienced mainly during the peak periods of morning hours and evening hours. Air pollution also arises from biomass based cooking and heating stoves, as well as the usage of coal for domestic purposes. Also the industrial activities of the industries in Emene industrial areas as well as from pockets of industries in Thinkers corner add to the pollution of the metropolis.

The most important negative externality arising from air pollution, indoor or outdoor is health deterioration. Indoor pollution arising from biomas based cooking and heating stoves is known to be a primary contributor to respiratory problems. It is estimated that 300,000 to 700,000 deaths can be prevented if suspended particles matters concentration can be held to world Health Organization standards (World Bank, 1992). Other indoor pollution related impacts are lower productivity among adults and mental retardation among children. It is estimated that urban areas with suspended particle matters levels above the World Health Organization standards lose an equivalent of 0.6 to 2.1 working days per year for every adult in the labour force due to respiratory related illnesses. The low income groups are the hardest hit by deterioration. A day lost due to illness implies a day's loss of wages as well as the possibility of job loss. Lack of health insurance as well as labour laws to protect workers in this group only further heighten their chance of falling into the poverty group.

The effects of outdoor pollution are equally pronounced. Accumulation of lead in the blood stream can bring about serious medical problems which can translate to loss in productivity and high medical costs. In children, the impacts manifests primarily in the form of

mental retardation. Over 600 million people are exposed to hazardous level traffic generated pollutions (U.N, 1998). Human exposure to these air pollutants is believed to have posed severe health problems especially in urban areas where pollution levels are on the increase. Pollution due to traffic constitute up to 90 to 95% of the ambient carbon levels, 80 – 90%. Hydrocarbons and particulate matter in the world posing a serious threat to human health (Savile, 1993). Researches have shown that transportation sources in the U.S.A were responsible for 77% of Co levels, 80-90% of Nox, 36% of volatile organic compounds and 22% of particulate matter (USEPA, 1993). Globally, Seneca and Tausig (1994), concluded that transportation is the major culprit of air pollution accounting for over 80% of total air pollutants.

In Nigeria, much attention is focused on general industrial pollution and pollution form oil industries, with little attention on the effects of air pollution form mobile transportation sources. Traffic emissions from busy urban road sources are on the increase with per capita increase in vehicle ownership. The consequence of this is the congestion of most Nigerian city roads and a corresponding increase in the burden of air pollution and their associated effects. This, indeed, is the situation in Enugu metropolis.

Air quality studies in Enugu is still in its infant stage and encumbered with several challenges. Taiwo (2005), observed that air pollution studies in Nigeria are few and independently carried out, and that government is not often involved in systematic and consistent air quality assessment programmes as is being done in other parts of the world such as in United States. There is the problem of insecurity and difficult terrain that militates against most of community based air sampling initiatives, and then the lack of requisite and adequate technical manpower to carry out the multi faceted and complete air quality studies in the metropolis. Other obvious and prominent drawbacks include;

- Lack of collaboration between key regulatory authorities
- Lack in the enforcement of emission regulations
- Air quality assessment and air pollution studies have often focused primarily on the core city centre with much reference to the fringes of the metropolis.
- Lack of emissions inventory/data base due to lack of consistent and systematic measurement.
- Unavoidability of air pollution, and lack of GHO monitoring stations in Enugu metropolis. Reliance is often on information from World data centre for greenhouse gases.
- Few independent and research-based measurement data

Strategies for Effective Management of the Environmental Problems

Having identified deforestation as a major problem in Enugu metropolis, 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 of the masses through lectures, seminars, workshops is required, sponsored by both the state and local government areas concerned in the metropolis, well spirited individuals and non government organization
- 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 information highway internet.
- State and local governments of the metropolis should substantially step up their financial commitment to reforestation.
- The state government as well as the three local governments of the metropolis 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 area 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, using relatively fast establishing trees (local and naturalized). Also fire tolerant species like Monotes Kertingii could be used as firebreaks.
- Selective cutting of trees could be adopted to allow natural regeneration from the surrounding trees, thereby avoiding the financial and environmental costs of starting afresh.

In order to ensure environmentally sound management, Emodi (2013), advocated reduction in the volume of solid waste generated at all levels, which is next to avoidance of waste. This could be actualized through promotion of awareness and education on waste prevention, reduction, recycling, reuse and separation at source. This is a clean and environmentally sound approach which will reduce the volume of wastes destined for disposal in the

face of increasing population and increasing distances to landfill sites. The enabling conditions, education and communication are essential elements of waste management, particularly waste reduction through formal education as well as vocational training. This will make for the elimination of litter on the streets and promote basic sanitation.

The incorporation of waste to wealth strategy into waste management practices, and the adoption of the concept of resource recognition which treats urban solid waste as an unused resource is, indeed, a sustainability engendering practice in solid waste management. The concept tends to move solid waste management practices away from the focus on primary activity of waste collection and disposal to sustainability approaches. This could equally ensure future waste minimization and avoidance programme including increased public participation and improved understanding of the social and economic benefits of waste recovery. Besides, the approach has the capacity to promote the development and adoption of appropriate and affordable technologies for the conversion of organic waste to organic fertilizer and encourage market for its use as soil conditioners. It can also encourage market for the sale of products recovered from wastes, whether by simple re-use, recycling and recovery or by more complex technological process as a way to create jobs.

There is need for promotion of strict compliance with environmental laws and regulations and the avoidance of command and control approach. This will be in concomitant with provision of adequate waste collection facilities. Enforcement should not rely solely on command and control approach as is the case with the current waste management authority in the metropolis. Experience has shown that countries which have embarked on police type powers which rely on prescriptive legal provisions backed by criminal sanctions to enforce environmental laws do not actualize compliance command and control approach, particularly if over used as is the case in Enugu metropolis elicits resentment and resistance by the general public. However, a more reliable, sustainable and morally just approach could be encouraged and this may include; economic valuation of environmental costs and benefits involving incentives and disincentives as well as self monitoring.

In the light of the experiences of waste management failures in the metropolis, it is essential that the general public-the polluters-be made part of the management of solid waste in the areas. This could be done, having decentralized solid waste management activities in the metropolis, which will be backed by effective public participation at the level of empowerment. The polluter pays principle should be adopted, however, it is necessary to ascertain the extent to which the public is willing to control its consumption pattern and/or pay for services that can produce a unit improvement in environmental quality. The public, however, should be fully informed of all proposed developments, especially when incurring a heavy investment burden for solid waste management in the metropolis. This will enable the people to have a voice in the decision making, especially as it concerns financial obligation for which they will be responsible either directly or indirectly.

Furthermore, the following recommendations could also enhance sustainable sold waste management in Enugu metropolis.

- The state government should set a goal of achieving not less than 70% effective sustainable waste management techniques in the volume of solid waste generated in the metropolis in the next 10 years.
- Markets for recovered products should be encouraged. This may entail encouraging jobless youths in the business, cutting down taxes of companies involved and government institutions patronizing the sale of recycled products.
- Existing laws and regulations should be provided for active sector participation, non-governmental organizations, community based organizations and the commercialization of wastes in the area.
- Local capabilities should be strengthened through effective collaborating, co-operation and provision of necessary technical support.
- Appropriate simple, inexpensive and easy to use technologies should be developed and adopted.
- Industries in the metropolis should be encouraged to produce biodegradable packaging materials.
- Conversion of organic wastes in the area to compost should be encouraged and markets should be developed for its use as soil conditioners.
- The citizens should be well informed about sustainable waste management techniques like re-use, re-cycling and waste prevention. This could be done by involving the media.

Realizing that inadequate housing units and poor housing environmental quality constitute primarily slum development in the metropolis, Emodi, (2012), opined that the government of Enugu State should regard occupation of residential housing units as a need, which should not always serve as a profit making venture. Hence, the government should rise and make every frantic effort towards embarking on realistic housing programme that will effectively complement the efforts of the private sector. The site and services scheme, part of the effort of the state government to encourage private housing investment, should be seriously embarked upon to attract various categories of private investors.

Most of the residents in Enugu metropolis are of low and medium income earnings. Therefore, concerted efforts should be made by both government and private developers to encourage the development of low and medium income houses in the area, rather than embarking on flamboyant detached houses that are rarely rented or purchased by anybody. Low and medium

costs housing units will be of benefit to majority of the residents in the metropolis as most of them are civil servant whose incomes are nothing to write home about considering the present inflation state of Nigeria. This will ease the accommodation problem in the high and medium density areas of the metropolis, and thus reduce pressure on the fringes where the slums primarily develop.

As it has been ascertained that the effluent being discharged from Emene industrial area into the Ekulu River has considerable negative impacts on the water equality of the receiving river, it is therefore recommended that such careless disposal be discouraged. There is need for each industry in the area to install a waste treatment plant with a view to properly treat their industrial wastes before discharging them into the surrounding river. Even where such facility is available, it is recommended that competent personnel's be assigned, that will effectively and efficiently handle the treatment processes, making sure that the waste water discharge is in line with the discharge guidelines. The introduction of cost effective cleaner production technology should be enforced. Industries should be encouraged to evolve site waste separation and reduction as well as reducing their waste water for use in some other areas.

Federal Environmental Protection Agency (Agency responsible for monitoring environmental quality in Nigeria) should rise to its responsibility by imposing levies or prosecuting owners of industries that discharge their untreated or partially treated wastes into the surrounding water. Such industries should also be made to take remediation measures to ameliorate the situation.

The bacteriological analysis of water should be mostly done if it is to be used for human consumption. The bacterial quality of drinking water is becoming an increased cause of concern world wide as the practice of disposing fecal wastes into streams, rivers or on land close to water bodies become common. Only water that comes from protected source such as a properly constructed well or a source which has been subjected to some kind of treatment, that is chlorination, ultraviolet light is considered suitable for drinking.

In curbing the air pollution problem, it has been observed that the land use in some parts of Emene and thinkers Corner is that of mixed development – residential housing units and industrial out fits. It is therefore very essential that residential areas be totally separated from industrial areas so as to avoid the effects of industrial dusts and other emissions from industries in the area which elicit negative impacts on the health of the residents in the area.

Enugu state government should, as a matter of urgency intervene in the state of some roads in the metropolis. The roads include; the major road linking Opara Avenue and Ogui road through Ogbete main market, the old Emene road connecting rehabilitation roads at Oye Emene, as well as the road linking the densely populated Abakpa area with Enugu-Onitsha Express way at Army barracks. Besides, it is essential that the Nigerian National Petroleum Corporation Depot at Emene be relocated outside the metropolis as residential development has engulfed the area. These measures will tend to ease the vehicular movement in the areas affected and concentrated emission of carbon monoxide avoided.

Furthermore, Enugu is known for being rich in Coal mineral. The exploitation of this mineral and usage by individuals and industrialists at the very rapid rate tend to negatively impact on human health and environment. The recent economic melt-down as it affects prices of petroleum products like cooking gas and kerosene is nothing to write home about. The price of kerosene being used by majority of the people within the metropolis has recently gone up astronomically beyond the reach of the common man, so also is the price of cooking gas. Many people in the area have, therefore resorted to the use of coal. Combustion of coal instills a major air pollutant – sulfur IV oxide – into the environment. The situation exposes the residents in the area to danger of respiratory illness like chronic bronchitis. The federal government of Nigeria is therefore being called upon as a matter of urgency to intervene in making these products available and also affordable. This will enable most of the residents have access to the products and indeed, desist from using coal, Hence, less combustion of coal and less pollution of the environment.

For improvement on the current air quality monitoring and assessment programmes in Enugu metropolis, this is needed to embark on the following.

- Usage of emission abatement control mechanism by polluters be enforced
- There is need to engage in renewable energy, clean energy and clean air initiatives.
- Institute planning polices to minimize pollution that can be caused by future development.
- Existing air quality monitoring prgrammes should be re-examined and new ones introduced to determine the most effective means of mainstreaming national programmes with regional projects to improve air quality.
- There should be a focus on the reduction of pollution levels from vehicles, industries and domestic burnining of timber to permissible levels as defined in national and international standards.
- Motor vehicles annual testing and other regulations should be strictly enforced.
- Developing monitoring mechanisms, regulations and enforcement measures.

CONCLUSION

Some of the environmental problems bedeviling Enugu metropolis have been identified. They include,

deforestation, as is manifested at the outskirts of the metropolis at Amorji Nike area as well as at Nchatancha where the areas are being deforested primarily for fuel wood. Slums are also emerging, mainly at the fringes of the metropolis and were pronounced at Ugbo Fred, Ugbo Odogwu, parts of Abakpa and Emene. As is the case with many urban areas in Nigeria, solid waste management is constituting a difficult problem to be handled as the present waste management system in the metropolis seems not to be yielding the desired results. Water pollution emerging from contamination of surface and ground water bodies by industrial discharges is a thing of concern. Air from industrial outfits and vehicular emissions do not bring about favourable environment. Various strategies have been suggested as to proffer solutions towards checking the problem or considerably reducing them. The proper implementation of these suggestions will go a long way to determine the degree of success that could be recorded. However, it is not enough to implement strategies to check the effects of environmental degradation, but it is necessary that these strategies are being reviewed. The strategies should be instituted as a continuous process to ensure enduring solutions. Besides, government, institutions, corporate bodies, private organizations and other groups should appreciate the magnitude of the problems and make concerted efforts towards permanent solution.

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