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Towards Sustainable Measures for Urban Development to Improve City Conditions in Nigeria

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ABSTRACT

Sustainable measures for urban development have been neglected in Nigeria's urban centres thereby making the cities unhealthy. The study identifies Onitsha, a city in Anambra state, South East of Nigeria, to have poor solid waste management and the most air polluted in the country. The aim of the study focuses on the assessment of sustainable measures employed in urban centres with the view to improve the air quality and solid waste management problems in Onitsha city with a reflection on other Nigerian cities. The purpose is solemnly aimed at making Nigerian cities healthy and sustainable. The research employed a content analysis to identify themes and organize qualitative data from the literature. First, data on 20 cities in the world and 12 cities of 12 states in Nigeria were identified with worst air quality, 10 countries with good air quality; and second, data on solid waste component generation and disposal in Onitsha were collected from 1997 to 2003 and 13 countries with sustainable waste management system were also collected. The results obtained indicate that Onitsha has the worst air quality in Nigeria, carrying 594 micrograms of PM10s (particles measuring 10 microns in diameter). The findings on solid waste indicate that population growth and commercial activities stand the major factors of solid waste generated in Onitsha. The other factor may be attributed to ineffective solid waste management system generated in the city. The study recommends adoption of sustainable measures in enhancing healthy Onitsha and other Nigerian cities with good air quality and solid waste management through implementing models of sustainable city, urban transportation, urban waste management, urban energy and resource use.

Keywords: *air quality, Nigeria, Onitsha, solid waste management, sustainable measures*

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INTRODUCTION

A sustainable city is a city designed with considerations for social, economic, environmental impact, and inhabited by people dedicated towards minimization of required inputs of energy, water, food, waste, output of heat, air pollution and water pollution without compromising the future [1]. Nigerian cities and towns are currently facing serious environmental problems arising from air pollution and poor solid waste management. The rate of air pollution and solid waste generation in Nigeria has increased with rapid urbanization [2]. Many Nigerian cities are on the record of the world's worst PM10 air pollution. For instance, Onitsha's mean annual concentration was recorded at 594 $\mu g/m^3$ by the World Health Organization (WHO) massively exceeding the WHO's annual guideline limit for PM10s. Source of both includes dust storms, gases emitted by

vehicles, all types of combustion, and industrial activities such as cement manufacturing, construction, mining and smelting (United Nation [UN], 1978). Onitsha scores highly on most of the above as do other rapidly growing Nigerian cities such as Kaduna, Aba and Umuahia, all of which also featured in the WHO's 20 worst offenders of PM10.

According to the United Nations Environment Program (UNEP), around 600,000 deaths throughout Africa are associated with air pollution, while an October 2016 report by the Organization for Economic Co-operation and Development (EOCD) suggested that polluted air could be killing 712,000 people prematurely every year across the continent.

Onitsha is grossly polluted, not just in terms of the air quality, but also the solid waste that litters the streets, blocking drainages and canals with not a single waste bin in sight, heaps of unregulated rubbish dumps occupy road sides and street corners [2]. The scope of this study is focused on Onitsha city in order to assess sustainable measures employed in different urban centres which can be explored to improve air quality and solid waste management problems in Onitsha city, Nigeria.

LITERATURE REVIEW

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs [3]. The 1992 UN Conference on Environment and Development, otherwise known as the Earth Summit, produced a growing global consensus on the need for sustainable development, and codified many related principles in the long document known as Agenda 21 [4]. In the mid-1990s, many other international development agencies, including the United States (U.S.) Agency for International Development and various United Nations branches, developed approaches to sustainable development, which include sustainable site initiative, sustainable architecture, urban energy, urban waste management, urban transport and climate change.

From the different aspects of sustainability and sustainable development, various models or visions of the sustainable city are developed by different researchers. Those visions and models are, for example, the models for sustainable urban development and eco-cities [5, 6]. The concept of the eco-city means to restore damaged urban environment, revise land use, promote recycling, innovative appropriate technology and resource conservation, while reducing pollution and hazardous wastes [6].

Air pollution in Nigeria manifested by air quality degrading substances which include sulphur dioxide, hydrogen sulphide, nitrogen oxide, cement kiln dust, and other particulate matter and heavy metals [7]. Okpala identified source of pollution in Onitsha, a city in Anambra state, with 100 petrol stations in the city often selling low-quality fuel, dozens of unregulated rubbish dumps, major fuel spills and high levels of arsenic, mercury, lead, copper and iron in its water [8].

Chukwu notes that many cities in the country today are suffering from sudden increase in solid waste and their poor disposal [9]. Agbogu observes that Onitsha has been made uninhabitable due to indiscriminate disposal of waste by industries, poor implementation of legislation on waste disposal, inconsistency in waste collection by the Anambra State Environmental Protection Agency, as well as the activities of town planning officials towards plan approval [10]. Adesanya notes that poor evacuation of central refuse dump

is a major factor influencing high volumes of solid waste in Nigerian cities [11].

URBAN TRANSPORTATION AND CLIMATE CHANGE

Public transport provides people with a more suitable means of transportation, thus sacrificing mobility, which is an amenity that plays a vital role to economic health and quality of life in cities [12]. While there are many advantages for using public transportation and decreasing automobile dependence, research tends to focus on its ability to reduce greenhouse gas emissions. "By reducing the growth in the vehicle miles of travel, easing congestion and supporting more efficient land-use patterns, public transportation can reduce harmful CO_2 emissions by 37 million metric tons annually. These savings represent the beginning of public transportation potential contribution to national efforts to reduce greenhouse gas emissions and promote energy conservation" [13]. The result is fewer miles travelled in personal vehicles, reduced emissions, less time spent in traffic jams and greater fuel efficiency from less congested roads [14]. Improvements to public health are yet another benefit to support alternative transportation options such as walking or bicycling.

Accessibility to alternative transportation not only improves public health, but can address air pollution, increase housing values, contribute to a sense of place and community, promote economic development in the area, and save a household money [12].

URBAN WASTE MANAGEMENT

In order for waste management in cities to run effectively and sustainably, each step in the cycle-waste generation, collection and disposal must be addressed. "A city that cannot effectively manage its waste is rarely able to manage more complex services such as health, education or transportation. And no one wants to live in a city surrounded by garbage" [15]. Reducing overall outputs of trash will result in fewer trips to the landfills, saving in fuel costs and emissions. With most of the world's people in cities, they produce a majority of the world's trash: one of the largest expenses in a city's budget is solid waste management [15]. Waste management includes making wise decision about material use and disposal method [16]. It is the process of treating solid wastes, disposing of substances in a safe way, handling items that do not belong in the trash, and finding ways to repurpose them [17, 18].

Ultimately, prevention is the most effective way to minimize waste generation and associated emissions [16]. While the solution may seem obvious, less trash generation means less energy expenditure towards waste collection, transport and distribution. On a large scale, government agencies at the state level enforce regulations for guiding waste and management, and also responsible for educating the public about proper waste management [19]. The key to good urban waste management is providing waste collection and recycling services in a consistent and ethical way.

URBAN ENERGY AND RESOURCE USE

Certainly, one of the most important areas in which to focus on urban sustainability has to do with the flows of energy and materials through human society [20]. Traditionally, these resource flows have resulted in many of the most egregious environmental problems – polluted air and water, wasteful consumption of fossil fuels, and overflowing landfills [20]. All of these can be overcome. Energy conservation and materials recycling is the area in which ordinary citizens can most directly take action towards sustainability through daily

initiatives, and so is a good focus for public involvement efforts [21, 22].

METHODOLOGY

The study presents a systematic literature review of the literature on urban sustainability assessment, following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. After a search for literature, the research employed a content analysis to identify themes and organize qualitative data from the literature to better understand how sustainability, air pollution and solid waste assessment are applied in urban contexts via Onitsha, a city in Anambra state, Nigeria.

Data Collection and Method of Assessment

The data used in this assessment were collected from a secondary source. First, data on 20 cities with the worst air quality in the world, 12 cities in Nigeria were also identified with worst air quality and 10 countries in the world with good air quality. The sources of these data were WHO Urban Ambient Air Pollution Database (2016). Second, data on solid waste generation and disposal in Onitsha were collected from 1999 to 2003. Using the exponential model, the population figures from 1999 to 2003 were projected based on the 1991 national census. The sources of these data were Anambra State Environmental Protection Agency and National Population Commission.

Tables 1 and 2 identified Onitsha's mean annual concentration, recorded at 594 $\mu g/m^3$ by the WHO massively exceeding the WHO's annual guideline limit for PM10s. Sources of both include dust storms, gases emitted by vehicles, all types of combustion, and industrial activities such as cement manufacturing, construction, mining and smelting.

Table 1. *Cities with the worst air quality in the world.*

City	Country	PM10 annual mean
Onitsha	Nigeria	594
Peshawar	Pakistan	540
Zabol	Iran	527
Rawalpadi	Pakistan	448
Kaduna	Nigeria	423
Aba	Nigeria	373
Riyadh	Saudi Arabia	368
Aljubail	Saudi Arabia	359
Mazar-e-Sharif	Afghanistan	334
Gwalior	India	329
Hamad Town	India	318
Allahabad	India	317
Shijiazhuang	China	305
Karachi	Pakistan	290
Dammam	Saudi Arabia	286
Umuahia	Nigeria	274
Raipur	India	268
Kabul	Afghanistan	260
Ma'ameer	Bahrain	257
Boshehr	Iran	255

Source: *WHO Urban Ambient Air Pollution Database, 2016.*

Table 2. *Cities with the worst air quality in Nigeria.*

City	State	PM10 annual mean	PM2.5 annual mean
Aba	Abia	373	49
Abakaliki	Ebonyi	88	28
Afikpo	Ebonyi	72	25
Enugu	Enugu	115	15
Ile Ife	Osun	103	26
Kaduna	Kaduna	423	90
Nnewi	Anambra	57	24
Nsukka	Enugu	117	14
Onitsha	Anambra	594	66
Orlu	Imo	52	16
Oweri	Imo	158	44
Umuahia	Abia	274	40

Source: *WHO Ambient Air Pollution database 2016 update.*

PRESENTATION OF DATA AND DISCUSSION OF RESULT

Onitsha scores highly on most of the above, as do other rapidly growing Nigerian cities such as Kaduna, Aba and Umuahia, all of which also featured in the WHO's 20 worst offenders for PM10s.

Table 3 identifies cities with the best air quality in the world and how they were obtained sustainably. Adoption of

sustainable measures from Table 3 would greatly improve on the air quality in Onitsha and other related Nigerian cities.

Table 3. *Cities with the best air quality in the world.*

City	Sustainable measures
Whitehorse, Yukon, Canada	Lower population density and stricter regulations for its clean air.
Santa Fe, New Mexico, USA	1.5 million acres of forest, strict regulations to limit the burning of wood in the open air.
Honolulu, Hawaii, USA	A well-designed transit system with dedicated bus lanes helps cut down emission.
Great Falls, Montana, USA	Situated in an area of great natural beauty with hiking trails and nature refuges.
Calgary, Alberta, Canada	Thoughtful urban planning and public transportation. Maintains three sanitary landfill sites for screening garbage and removing biodegradable and recyclable materials.
Ottawa, Ontario, Canada	From a light rail system to a spring cleaning the capital program in which 60,000 volunteers join together to clean parks and other public spaces. The Rideau Canal runs through a good part of the city.
Helsinki, Finland	The city has wide streets to cut down traffic congestion and also advises residents to take public transit when air quality is poorer.
Stockholm, Sweden	Has an extensive public transportation system. The Swedish capital also has the largest percentage of clean vehicles in Europe with about 5% of all of its vehicles being hybrids.
Zurich, Switzerland	Has a well-developed and highly efficient public transportation system of trains, boats, buses and trams.
Tallinn, Estonia	More than half of the country's land is covered by trees and public transit helps to keep emission low.

Source: *International Energy Agency/World Health Organisation (via the Eco Experts)*

The results from Table 4 suggest that there is a link between the population and the volume of solid waste generated in Onitsha metropolis. The implication of this result is that the volume of solid waste generated in Onitsha metropolis increases with the increase in the city's population. The results from Table 4 signify that the rate of solid waste disposal in Onitsha is less than the rate of waste generation. This indicates that the high volume of solid waste generated in Onitsha is not regularly evacuated for disposal, thus resulting in the prevalent refuse and poor sanitary condition in Onitsha metropolis.

Table 4. *The population, volume of solid waste generation and disposal in Onitsha metropolis from 1997 to 2003.*

Year	Population	Volume of solid waste generation in(tones)	Volume of solid waste disposal in (tones)
1997	609,010	304,505	303,326
1998	635,260	317,640	303,326
1999	654,592	327,145	252,446
2000	673,894	336,946	241,920
2001	694,139	347,064	279,520
2002	714,963	357,481	327,880
2003	730,412	370,706	314,846

Source: *Anambra State Environmental Protection Agency (cited in National Population Commission 2004), 2004.*

Components of solid waste from Table 5 indicate that food waste and plastic polythene waste contribute more to the rate of solid waste disposed in Onitsha city. To manage this effectively, food waste should be converted to compost in a well-secured place, while plastic polythene waste and other components can be salvaged, recycled and reused.

Table 5. *Solid waste components in Onitsha City.*

Solid waste type	Percentage
Food waste	40.5
Metal	8.7
Yard waste	6.5
Glass waste	4.5
Paper and paper board waste	8.1
Plastic polythene waste	17.9
Rubber, leather, textile, wood	10.1
Miscellaneous	3.7

Source: *Eze and Asadu (2003).*

Table 6 identified sustainable measures employed in developed nations in tackling solid waste management. All these falls through proper organization of legislation,

industry, or entrepreneurs and culture of environmental sustainability.

Table 6. *Countries in the world with sustainable solid waste management system.*

Country	Sustainable measures (% of recycling)
Germany	65% recycling rate, standardize recycling containers, incinerators.
Poland	It's recycling an astounding 886% more of its waste than it was at the start of millennium. Biological and mechanical waste processing factory.
Estonia	It has increased its recycling rate by 600%
Ireland	Increased by 26% recycling with factory units producing compost from organic waste
United Kingdom	Increased by 250% recycling with green dot packaging products reducing paper, thinner glass and less metal been used therefore limiting amount of waste produced.
Austria	Sits with the 63% of all waste is diverted from landfills and stable recycling of solid waste.
Taiwan	Keeping the pace, hitting the top margin with a 60% success rate of recycling.
Zaballeen, Cairo, Egypt	The system has no established official or contemporary recycling facilities or sanitation services, yet 80% of everything that is gathered is recycled.
Singapore	Sends 59% of its trash to be re-used and recycled.
South Korea	Recycles 49% of tossed goods
United Kingdom	Hits the 39% mark with that percentage going into recycling.
Italy	Recycles 36% of its trash and also slurry separation system
France	Closely behind with 35% recycling with solid control equipment

Source: *Joe McCarthy and Erica Sanchez (2016).*

RECOMMENDATION

Anambra state government should adopt the urban transportation measure which plays infancy on a well-developed and highly efficient public transportation system of trains, buses and trans. Bike riding should be encouraged through minimizing the dependence on the automobile in Onitsha city. Public transport provides people with a suitable way of transportation, thereby sacrificing private mobility and increasing economic health and quality of life in cities, thus reducing harmful CO_2 emission, dust storms and greenhouse gas emissions, and promote energy conservation. The government should partner with federal agencies on pollution management and also engaging policy-makers in implementation of regulations that would effectively address densification of air quality (AQ) monitors, enforcement of the National Environmental Regulations and Acts, development of public advocacy on AQ, and execution of existing frame work for AQ monitoring and prediction.

To keep Onitsha sanitized from solid waste, the state government agencies should enforce regulations for guiding solid waste management and also educate the public about proper solid waste management. Regulations have to be put in place to make sure industries are using consistent materials that can be easily recycled, and everyday citizens have to be encouraged to start their trash in responsible ways. The state government should prohibit street trading in city of Onitsha, and provide adequate alternative trading sites; such actions will limit the intense commercial activity that occurs on the streets and major roads in Onitsha.

The study recommends, among others, the privatization of solid waste management as well as adequate funding of agencies responsible for waste collection and disposal in Onitsha and other Nigerian cities, thereby making them healthy.

CONCLUSION

The study has assessed urban transportation, urban waste management, urban energy and resource use as sustainable measures for urban development employed in urban centres towards improving air quality and solid waste management problems in Onitsha city. It has not only reflected Onitsha but other Nigerian cities affected by the menace. Making Nigerian cities healthy is

a paramount issue to toil on considering the negative effects on the health condition cost by air pollution and poor solid waste management system.

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