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Review

Urbanization and the environment: The debate and evidence from two new cities in Nigeria

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The rate of urbanization has been increasing rapidly since the second half of the 20th century. The impact urbanization has on the environment has attracted considerable attention. The viewpoints on the impact and the experience in Nigeria, particularly in the two new cities of Abuja and Yenagoa, are analyzed. The data collection involves an extensive review of literature, consultation of government documents and interview of government officials. Three schools of thought on the relationship between urbanization and the environment are identified and discussed. These are the environment deterioration facilitator school, the development-stage dependent facilitator school and the environmental-deterioration dampener school. The position of the environment deterioration facilitator school is that the emergence and functioning of a city always results in environmental decay while the development stage dependent perspective argues that the degree of impact varies with the developmental stage of the city or more appropriately the level of development of the country where the city is located. The third school posits that urbanization, rather than resulting in environmental deterioration, dampens environmental decay. A general impact analysis of Nigerian cities, based on solid waste pollution, sewage pollution, water pollution, air pollution and noise pollution, indicates that, although the impact has declined over the years, it continues to be considerable. A more detailed examination of the situation in the two new towns of Abuja and Yenagoa shows clearly the role effective environmental management plays in an amelioration of the impact. The Nigerian experience indicates that the development-stage-dependent facilitator school of thought is the most relevant.

Key words: Urbanization, environmental deterioration, new towns, Nigeria.

INTRODUCTION

There have been remarkable spatio-temporal dynamics of urbanization over the decades. According to United Nations sources (World Urbanization Prospects), although only 29% of the world's population lived in urban centres in 1950, this increased to 33% in 1960, 36% in 1970, 39% in 1980, 43% in 1990, 47% in 2000, 51% in 2010, and 54% in 2014. Indeed, in 1900 it was only 10% (Grimm et al., 2008). The most urbanized countries are in Europe and North America while the least are in Africa. However, the rate of increase in the number of people living in urban areas is much more in the developing than in the developed countries. The urban population in the

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developing world is expected to grow 2.27% annually between 2007 and 2025 while the corresponding figure for the developed world is a mere 0.40. For instance, between 2005 and 2010, the growth in North America was about 1.0% annually, but in Africa the figure was more than 3.0 (UN-Habitat, 2009, 2013). The annual growth rate in Africa between 1995 and 2015 was 3.44% while it was only 0.31% in Europe and 1.24% in North America. In other words, the growth rate in Africa was more than 11 times that of Europe (UN Habitat, 2016)

Nigeria is not only one of the most urbanized countries in Africa but also one of the most rapidly urbanizing. Although, only 7.2% of the population was urban in 1921, this increased to 10.6 and 19.1% respectively in the 1952 and 1963 census (Mabogunje, 1974). The percentage increased to 36.3 in 1991 (population census) and to 44 in the 2006 census. The official estimate by the National Population Commission for 2014 was 50% (Federal Ministry of Information, Nigeria 2014). This rapid increase in the urban population of Nigeria and the pressure on the urban centres, have socio-economic consequences which have been extensively analyzed. The focus of this paper is not on the several impacts. Rather, drawing from existing works/data and new information on two new cities, it analyzes the trend in environmental challenges consequent on urbanization in the country. As a prelude and a theoretical base, the debate on whether or not urbanization is always accompanied by environmental deterioration is examined. The data were collected between 2010 and 2015. An extensive literature search, identification and analysis provided information on the viewpoints on urbanization-environment relationships and the environmental situation in Nigerian cities. An extensive observation of the environment of major Nigerian cities, particularly solid waste disposal was carried out. Several government documents, including the most recent (2010) population and housing census document of the country, publications of Abuja Environmental Protection Board and Bayelsa State Ministry of Environment provided required information. Officials of Abuja Environmental Protection Board, Bayelsa State Ministry of Environment and Bayelsa State Ministry of Water Resources were interviewed to obtain information on various aspects of the environment of Abuja and Yenagoa

Apart from the introduction and the conclusion, the paper is divided into three broad sections. These are a review of the urbanization – environment relationship debate; a discussion of the trend in Nigeria and an analysis of the situation in two new urban centres of the country; Abuja and Yenagoa.

AN OVERVIEW OF THE DEBATE

Three strands in the urbanization-environment relationship are identifiable from an extensive analysis of the literature. These could be loosely conceived as schools of thought and include:

i) The environmental deterioration facilitator school;
ii) The development-stage-dependent facilitator school; and
iii) The environmental deterioration dampener school.

The facilitator perspective posits that the emergence and functioning of cities always result in environmental deterioration. In this regard, whereas some theorists emphasize the damage cities cause in the hinterland and other regions, others are more interested in the within city situation (Clement, 2010). A number of proponents (Buttel and Flinn, 1977; Foster, 1999, 2000; Chew, 2001; Shandra et al., 2003; York et al., 2003; Clark and York, 2005; Clausen and Clark, 2005; Marcus, 2007) explicitly or implicitly, employing a Marxian framework, argue that it is production systems that link urban and non-urban areas. In a simple scheme, for instance, urban centres depend on rural areas for raw materials and in certain cases, energy. Thus, as more and more raw materials are exploited to support the city industries, environmental deterioration becomes more and more pronounced in the rural areas. This "metabolic rift", as some proponents, following Marx, christen this ecological imprint, is more complex. Production activities in the city generate wastes, such as greenhouse gases, which affect more extensive areas. Thus, it is argued that, although the environmental problems of the city and those of the region are interdependent, the impact is much more in the latter than in the former.

This emphasis on the rural areas is, however, disputed by others (e.g. Schnaiberg, 1980; Frickel and Elliot, 2008; Clement, 2009; Han et al, 2015) who argue that urban environmental problems are much more critical within the cities themselves. As Brennan (1999: 12) puts it:

… it is widely recognized that environmental degradation in many of the world's megacities is becoming worse. Given this fact, it is ironic that the greatest attention-even at international fora…has been paid to issues of managing the "global commons" rather than the critical "brown issues" such as polluted air, filthy water and inadequate sanitation that affect hundreds of millions of the world's urban inhabitants.

Be this as it may, given the increasing threat of climate change, the impact of urbanization on the "global commons" cannot be ignored. At a global scale, it has been established that cities generate much more greenhouse gases and hence contribute more to climate change than rural areas (World Bank, 2010; UN Habitat, 2011; Cui and Shi, 2012; Creutzig et al., 2015; Churkina, 2016). For instance, the World Bank (2010) asserts that

although only half of the world's population lives in cities, these areas, given their relative development, consume as much as 80% of the world's energy production and are responsible for about the same percentage of the global greenhouse gas emission. Some scholars (e.g. Leon, 2008; Zhang et al., 2010; Rahman et al., 2011; Awadalla, 2013) conceive the impact as congestion and its implications on living conditions and human health. Others have emphasized air pollution (e.g. Liu et al., 2015; Wang et al., 2017; Xu, 2017; Amegan and Agyei-Mensah, 2017), thermal heat (Grossman-Clarke et al., 2010; Srivanit et al., 2012; Liu et al., 2015; Bounoua et al., 2015; Yang et al., 2017; Yao, 2018) and biodiversity loss (McKinney, 2002; Seto et al., 2012; Ibanez-Alamo et al., 2017; Ding and Peng, 2018; Mayer-Pinto et al., 2018).

The development-stage-dependent facilitator perspective is more or less a variant of the facilitator school. This school argues that whereas urbanization is accompanied by environmental damage; the intensity varies with the developmental stage of the city or more aptly the country where the city is located. Furthermore, even within the same city, the incidence varies spatially depending on the geography of the classes within the city. This variation on the basis of the development cycle is commonly defined in terms of the Environmental Kuznets Curve while the spatial variation within cities has thrown up the idea of environmental justice.

The Environmental Kuznets Curve, with its origin in the early 1990s, particularly with the works of Krueger and Grossman (1993, 1995), posits that there is a relationship between economic development and pollution. The trajectory of the relationship curve is an inverted U. In the early stages of a country's development, pollution rises sharply, flattens at a stage and declines at very high levels of development (Dasgupta, 2002; Aldy, 2005; Fonkych and Lempert, 2005). The shape is explained by the fact that in the early stages of development, people, and indeed governments are much more interested in increasing incomes and other indices of development than in a clean environment; consequently pollution regulation is not taken seriously. However, as a society becomes more affluent, environmental considerations become significant.

This argument is relevant to the setting of a city. Indeed, the principle of a Kuznets Curve has been explicitly applied to urbanization with considerable fit (e.g. White et al., 2007; Martinez-Zarzoso, 2008; Li and Ma, 2014; Shahbaz et al., 2016; Wei and Zhang, 2017). Martinez–Zarzoso (2008: 14-15) summarizes the argument thus:

. . . Once urbanization reaches a certain level, the effect on emission turns out to be negative, contributing to reduced environmental damage. This result is also confirmed when we observe the evolution over time of the emission – urbanization elasticity. We obtained a positive and decreasing elasticity for low-income countries and a negative and increasing elasticity for upper-middle-income countries . . . Although, cities embody the environmental rainage; namely, increasing emissions due to transportation, energy consumption and other factors, policy-makers and experts increasingly recognize the potential value of cities to long-term sustainability. It could be that these potential benefits of urbanization outweigh the disadvantages.

Asian cities, according to UN Habitat (2013), are good examples. As the report puts it:

Asian cities demonstrate the classic Environmental Kuznets Curve scenario where the initial stage of economic development sees environmental quality deteriorate before improving markedly as a certain income level is reached. In practice, polluting heavy and natural resource intensive industries predominate at the early stages of development. Subsequently, the benefits of economic growth enable industries to deploy less polluting, more resource efficient technologies (96).

Indeed, Li and Ma (2014), based on a study in China, posit that the "turning point" towards improved environment in the inverted U is around 60% urbanization rate and that the inverted U-shaped relationship between economic growth/urbanization and the environmental quality is universal.

The perspective that even within cities, the incidence and impact of pollution are distributed unevenly to the disadvantage of the poor and minorities and characterized as environmental injustice since its beginnings in a report by the United Church of Christ Commission for Racial Justice (1987) has attracted several denotations such as environmental civil rights, environmental racism, toxic colonialism, environmental blackmail and environmental ethics (Ikporukpo, 2004, 2011). Environmental injustice, it is argued, is characteristic of most cities; for, environment-damaging facilities, such as waste dumps, waste treatment plants and incinerators, are disproportionately located in areas inhabited by economically or socially disadvantaged groups (Maantay, 2004; Mennie, 2005; Downey, 2006, 2007; Downey et al., 2008). Indeed, the structure of a city could influence the degree of decay. Therefore, the impact of urbanization, other things being equal, will vary among cities of different physical structure and even among different structural areas of a given city. A study of 50 Japanese cities (Makido et al., 2012) provides a typical example of the per capita emissions of CO_2 variation among city forms.

While the preceding perspectives believe that urbanization damages the environment, the dampener school asserts that rather than being an environmental challenge in itself, urbanization reduces environmental

deterioration (e.g. Moi, 1997; Gonzalez, 2005; Newman, 2006; Meyer, 2013; Song et al., 2016). The argument has several dimensions. The ecological modernization theorists posit that urbanism creates a setting where individuals are largely "delinked" from the environment-damaging process and hence the effect of the city on the environment is much less than that in the rural areas. Citing the rapid growth of recycling, it is argued that cities provide the conducive setting for the amelioration of environmental damage. A further argument is based on the per capita potential environmental effect of an urban area vis-à-vis the rural. As Ichimura (2003: 3) succinctly puts it:

It should be noted that urban growth has a number of positive impacts on the environment and human well-being, i.e. higher population densities mean lower per capita cost of providing energy, health care, infrastructure and services. Also, urbanization has historically been associated with declining birth rates which reduce population pressure on land and natural resources.

Similarly, based on available facts and figures, Meyer (2013) also asserts that adjusting for population density and wealth, cities have environment enhancing advantages over rural areas. In other words, urban environmental advantages are much more than urban environmental penalties. He argues that urban environmental penalties are illusions based on preconceived ideas and that "urbanness" often results in environmental advantages and not penalties. Dodman (2009), based on an analysis of greenhouse gas emission inventories of several cities, indicates that, in most cases, the per capita emissions of cities are less than the average for the countries the cities are in. According to Newman (2006), some have identified an environmental negativity because of their use of population impact and ecological footprint approaches rather than a sustainability assessment approach in their analysis of the environmental impact of urbanization. In some cases, urbanization instead of generating heat islands, may have a cooling effect. For instance, a study in the United States (Bounoua et al., 2015) indicates that although cities within forested areas display the heat effect, those within arid lands, such as Phoenix, were cooler than the surrounding areas.

As the preceding analysis has shown, there is now considerable interest in the relationship between urbanization and the environment. Be this as it may, this is a post-1960s phenomenon, catalyzed by the environmental revolution whose worldwide formal origins and acceptance may be traced to the United Nations conference on Human Environment held in Stockholm in June 1972. Before this environmental revolution, the analysis of urbanization gave little attention explicitly to environmental deterioration.

TREND IN NIGERIA

The analysis of the environmental dimension of urbanization in the country did not really emerge until the environmental revolution. The pioneering works of A. L. Mabogunje on urbanization came in the early 1960s at a time when the basic interest of the government and people of Nigeria, just emerging as an independent country in October 1st, 1960, was obviously nation building and development. Furthermore, this was a time when very little or nothing was known about urbanization processes and patterns. Understandably, the early works of Professor Mabogunje, particularly in the early 1960s (e.g. Mabogunje, 1962, 1965, 1968) paid particular attention to unraveling the intricacies of this unexplored domain. While his seminal work, *Yoruba Towns* (Mabogunje, 1962) provided an incisive analysis of the characteristics of urbanization in south west Nigeria, his later works essentially covered the whole country (e.g. Mabogunje, 1968).

Perhaps, given the pioneer's bent, it was not expected that issues of environment will become prominent in his analysis of urbanization. However, as if in apparent reaction to the environmental movement/revolution, by the 1970s, Professor Mabogunje's interest in environmental issues of urbanization became apparent; perhaps fundamentally because of the noticeable deterioration in the urban centres because of rapid uncontrolled development. His concept of "liveability" of Nigerian urban centres emerging in early 1970s (e.g. Mabogunje, 1974a, b) encapsulated various dimensions of the environmental challenges. Characteristically, he put forward proposals for addressing these challenges. For instance, in terms of the housing challenge and its related environmental implications he asserts that:

Nowhere, except in the few and scattered estates of government Housing Corporation is there any attempt to develop these sites prior to housing construction. Very often, some desultory efforts are made at upgrading roads, putting in electricity and water supply long after houses have been put up. The result is the prevailing air of slumminess over large parts of our urban centres . . . Thus, only to the extent that the government accepts and rigorously pursue a policy of anticipatory site development well in advance of urban expansion can it ensure orderly growth and enhance the environment quality of our towns and cities (Mabogunje, 1977: 48)

Has the urban environment in Nigeria improved since these early analyses by Professor Mabogunje? Indeed, how environment-friendly has urbanization been in Nigeria? The remaining part of this section and the subsequent one essentially address these issues. This analysis is based on the following:

i) Solid waste pollution

ii) Sewage pollution
iii) Water pollution
iv) Air pollution
v) Noise pollution

Apart from the environmental challenges implicit in these, some are implicated in global warming through their role in the emission of greenhouse gases. For instance, at a global scale, power generation, industrial development and transport, which are significant urban activities respectively account for 26, 19 and 13% of greenhouse gas emission. Waste and waste water account for 3% (World Bank, 2010).

There is considerable evidence that the quantity of solid waste generated in Nigerian cities has been increasing. Table 1 which depicts the situation in those cities where data are available, shows such a trend.

The larger cities of Lagos, Ibadan and Kano are very typical. For instance, the generation of solid waste in Lagos increased by 9.1% between 1982 and 1985 followed by 16.1% between 1985 and 1990. This increasing trend was also evident in earlier years. For instance, about 140,000 tonnes of solid waste were generated in Ibadan in 1970/71, and by 1979/80 the quantity had increased to about 180,000 tonnes (Akintola, 1978). Although the composition of the solid waste varies from one city to another, depending on factors such as location in terms of ecological zones and cultural areas, the variation is usually not very significant.

Table 2, which shows the situation in one traditional residential district in Ibadan, indicates how significant paper and plastic/nylon waste could be. In most Nigerian cities, the increasing popularity of sachet water (popularly referred to as 'Pure water') has increased the significance of plastic/nylon waste in solid waste composition.

It is not just the mere generation of solid waste that defines the pollution problem but the ineffectiveness of waste collection and disposal systems. Typically, many households do not have access to modern disposal facilities and hence dispose waste in any convenient area such as gutters, depressions and even roads. Even where there are city-authority designated collection sites, collection in most cities is often ineffective. Table 3 shows that unconventional disposal of refuse is significant in most of the cities. For instance, more than 43% of the households in Lokoja, about 35% in both Umuahia and Warri, nearly 36% in Ilorin and about 34% in Jalingo dump refuse in unapproved sites. It is only in Benin and Sokoto that the percentage is less than ten. Similarly, a large percentage of the households in many of the cities burn their refuse. Heaps of refuse usually dot the landscape of many of the cities. One census of such heaps in 15 Nigerian cities in the early 1980s identified 118 in Lagos, 104 in Ibadan, 99 in Port- Harcourt, 92 in Kano, 83 in Aba, 81 in Onitsha, 51 in Potiskum, 50 in Kaduna, 48 in Uyo, 32 in Warri, 24 in each of Jos and New Bussa, 20 in Gussau, 17 in Suleja and 10 in Oshogbo (Abumere, 1983). Although, in cities such as Lagos, Port Harcourt and Uyo, there have been recent improvements, in others such as Ibadan, Aba and Owerri, there is no such improvement if not a deterioration. Indeed, an ignorant visitor to Owerri, (particularly in 2010) may mistake heaps of solid waste lining the major thorough fares as part of the landscaping strategy! In most cities, the distribution of these heaps is related to the poverty configuration; for, they are disproportionately located in the areas of high density and poor housing where there is little or no planning, with relatively poor access and lack city-authority operated refuse collection and disposal system Perhaps, this is environmental injustice at work.

In some of the cities, indiscriminate dumping of solid waste has aided flooding. Ibadan, where refuse-blocked gutters and refuse-filled natural drainage channels have exacerbated the flooding problem, is a good example. Between 1951 and 1980 there were seven major floods in Ibadan. These were in 9th/10th July, 1951, 16th/17th June, 1955, 16/17th August 1960, 27th/28th August, 1963 and 31st August, 1980 (Ayoade, 2006). These floods have been characterized by considerable loss of lives and damage/destruction of property. The more recent flood of 28th August, 2011 was also disastrous; with many Nigerian newspapers "celebrating" the incident with screaming headlines of melancholy. For instance the Vanguard of Monday, 29 August, 2011 reported: *"man loses father, four children in Ibadan flood".*

The disposal of faecal waste has also been a major environmental challenge in several Nigerian cities. In the colonial period till 1960s (and in some cases up to the 1970s), the pail system was predominant. This involved defecating in a pail located in a "small-house". The faeces is disposed of regularly at night by individuals in-charge, usually referred as "night-soil men". The deteriorating effect on the environment lied in the fact that the faeces is normally dumped in lakes, lagoons, rivers or buried. The implication is that such areas were usually not only unsightly but also posed obvious health hazard. The fact that this system, which was largely predominant in the poor housing districts, has been phased out (or relatively insignificant) implies a better city environment. However, the difference lies largely only in terms of the degree of pollution; for, in some urban centres the disposal system remains environment-threatening.

In the early 1980s, pit latrine and other methods such as pail, defecating in open spaces and in rivers/lagoons were still significant in many cities. For instance, about 67% of the households in Ibadan and as many as 95% in Benin City used pit latrines. The other methods were particularly significant in Abeokuta, Port Harcourt, Owerri and Enugu. The percentage for flush toilet was between as low as 0.6% in Sokoto and only 30% in Lagos (Federal Republic of Nigeria, 1981). There is no doubt

Table 1. Solid waste generation in some Nigerian cities.

Urban areas	Tonnes/year		
	1982	1985	1990
Aba	131,903	143,712	169,719
Gusau	44,488	48,471	57,243
Ibadan	350,823	382,224	440,956
Jos	99,871	111,905	134,272
Kaduna	257,837	280,295	324,084
Kano	319,935	348,580	402,133
Lagos	624,399	681,394	786,079
New Bussa	5,690	6,200	7,152
Onitsha	242,240	263,929	304,477
Osogbo	131,903	143,712	173,720
Port-Harcourt	210,934	229,821	265,129
Potiskum	15,434	16,816	19,399
Suleja	9,383	10,514	13,311
Uyo	12,508	13,628	15,721
Warri	67,477	75,607	91,396

Source: Ajayi and Ikporukpo (2005: 361).

Table 2. The nature and volume of wastes generated at Ayeye community, Ibadan.

Waste components	Number of households producing (% in parenthesis)	Amount produced per capita/day, kg	Mean generation rate per house per week, kg	Projected daily generation in the total community, kg (Column 3 x 13720)
Kitchen waste	100	0.331	16.24	4541.32
Paper	60(33.9)	0.05	3.05	686
Leaves	5(2.8)	0.08	4.86	1097.6
Iron	7(3.95)	0.043	2.671	1097.6
Aluminum	31(17.5)	0.017	1.077	233.24
Other metals	18(10.2)	0.016	1.006	219.52
Glass, white	22(12.4)	0.037	2.332	507.64
Glass, coloured	24(13.6)	0.02	1.238	274.4
Plastic/Nylon	49(27.6)	0.027	1.745	330.44
Rubber	28(15.8)	0.011	0.689	150.92
Textile	4(2.3)	0.007	0.45	96.04
Ash	1(0.6)	0.33	16.0	4527.6
Goat/sheep	28(15.8)	0.073	4.607	1001.56
Poultry	27(15.3)	0.11	6.778	1509.2
Total waste	-	1.074	47.853	16251.2

Source: Sridhar (2006: 345).

that flush toilet is now more widely available; in certain cases even in poor housing districts. While flush toilets are much more environmentally friendly, they also pose environmental challenges where evacuated faeces from septic tanks is disposed of indiscriminately. In most cases, the disposal is handled by unorganized private operators who dump the waste in nearby streams, lagoons or bury. Such locations are usually in the surrounding rural areas. In other words, rural areas bear most of the brunt of such environmental neglect. Table 4 shows the disposal methods in recent years. It is obvious that pit latrine is still significant in most of the cities. However, compared with the situation in the early 1980s, the significance of pit latrine has declined. For instance,

Table 3. Method of solid waste disposal in major Nigerian cities.

Cities	Percentage of Households using each Method					
	Collected by Agency	Buried by Household	Dumped by Household in Approved Site	Dumped by Household in Unapproved Site	Burnt by Household	Others
Aba	18.9	7.4	50.4	16.7	5.6	1.0
Abakaliki	9.8	13.0	26.9	28.6	20.0	1.7
Abeokuta	14.5	3.6	32.1	30.4	17.2	2.1
Ado-Ekiti	7.5	6.0	21.0	24.8	40.1	0.6
Akure	31.4	3.4	12.3	26.3	25.8	0.8
Awka	12.5	10.3	3.3	20.1	22.3	1.5
Bauchi	17.6	8.9	37.8	16.9	17.0	1.8
Benin	55.1	5.8	13.4	9.7	15.7	0.3
Birnin-Kebbi	27.7	12.8	29.8	15.2	11.6	2.9
Calabar	12.2	8.9	54.5	18.3	4.7	1.4
Damaturu	12.5	9.6	34.8	23.4	19.0	0.6
Dutse	23.3	11.9	31.3	13.4	9.8	0.9
Enugu	21.1	5.3	27.4	29.8	13.0	3.4
Gombe	20.0	7.0	42.5	25.3	4.4	0.7
Gusau	32.2	8.9	22.6	16.3	14.2	5.8
Ibadan	20.2	3.7	22.2	28.0	23.8	2.1
Ilorin	7.7	3.7	36.2	35.6	15.2	1.5
Jalingo	11.5	8.7	30.2	33.5	15.3	0.8
Jos	16.0	6.9	21.6	25.2	29.6	0.7
Kaduna	38.7	5.9	31.3	13.4	9.8	0.9
Kano	27.8	5.6	39.0	11.1	14.7	1.7
Katsina	30.8	8.9	42.3	11.1	5.5	1.2
Lafia	12.0	12.0	26.4	31.3	16.8	1.5
Lagos	57.2	2.4	22.5	10.8	5.9	1.2
Lokoja	7.9	4.3	26.1	43.1	18.3	0.3
Maiduguri	31.4	7.3	34.8	14.2	10.4	1.9
Makurdi	9.7	13.5	20.3	27.6	28.6	0.3
Onitsha	27.2	5.7	36.4	18.8	9.0	2.9
Osogbo	9.6	5.7	25.8	33.0	24.5	1.4
Owerri	24.2	3.4	45.3	14.2	10.7	2.2
Port-Harcourt	24.4	3.6	48.8	17.9	3.1	2.2
Sokoto	24.9	8.6	48.7	9.7	6.8	1.3
Umuahia	6.1	8.0	37.4	34.9	9.8	3.4
Uyo	7.8	16.6	41.3	18.8	14.5	0.8
Warri	26.8	5.5	21.6	34.8	8.0	3.3
Yola	20.2	6.2	38.9	17.0	16.5	1.3

Source: Computed by author from National Population Commission (2010) Population and Housing Census data.

whereas the percentage in Ibadan was 67, this declined to 50 while the decline in Benin is from 95% to as low as 39%. The use of flush toilets improved drastically in the recent years compared with the situation in the early 1980s. Be this as it may, the disposal of faecal waste remains to be a significant environmental challenge as Table 4 indicates. For instance, open defaecation (the use of nearby bush or beach in Table 4) is still common in many of the cities.

It is instructive that, as Table 5 shows, of more than 380 urban centres in the country, only six have sewage treatment plants which are limited to the premises of higher educational/research institutions and firms. Ibadan and Lagos, which have six and five respectively, have the largest number of plants while Ife and Zaria, with one each, have the smallest number. Of the sixteen plants,

Table 4. Method of faecal waste disposal in major Nigerian cities.

City	Percentage of households using each method						
	Water closet	Pit latrine	Bucket	Toilet in another dwelling	Public Toilet	Nearby bush or beach	Others
Aba	69.1	15.0	7.9	0.8	6.0	0.8	0.3
Abakaliki	21.7	49.3	5.0	1.2	8.8	13.5	0.6
Abeokuta	30.4	54.0	1.3	0.9	2.2	11.0	0.2
Ado-Ekiti	32.0	42.2	1.4	0.7	3.0	20.4	0.3
Akure	30.9	41.9	0.8	0.4	1.7	24.2	0.2
Akwa	29.9	46.1	5.0	0.8	8.0	10.1	0.1
Bauchi	13.6	69.3	2.2	2.2	6.9	5.6	0.2
Benin	55.8	38.7	2.9	0.5	0.9	1.0	0.2
Birnin-Kebbi	14.4	61.1	4.1	3.5	6.8	9.8	0.3
Calabar	46.7	45.9	2.7	0.4	2.6	1.6	0.1
Damaturu	19.0	55.6	4.1	1.7	4.8	14.2	0.4
Dutse	4.2	74.9	10.5	3.1	3.4	3.6	0.3
Enugu	54.6	21.4	2.0	1.1	10.5	10.1	0.3
Gombe	20.6	67.6	4.7	1.9	4.6	0.4	0.2
Gusau	9.9	55.3	11.4	4.2	14.2	3.8	1.3
Ibadan	33.6	50.1	2.9	0.8	2.8	9.3	0.5
Ilorin	24.3	36.9	4.0	1.3	8.4	24.6	0.5
Jalingo	16.8	61.6	2.1	1.4	5.5	12.4	0.2
Jos	25.4	52.3	0.9	0.7	2.8	17.7	0.3
Kaduna	36.5	54.8	1.7	1.1	4.3	1.2	0.4
Kano	22.1	64.1	6.2	2.8	3.8	0.4	0.6
Katsina	13.1	72.4	4.5	3.6	5.8	0.4	0.2
Lafia	6.3	62.2	2.7	2.2	9.5	16.8	0.3
Lagos	51.7	39.1	2.2	0.5	2.1	4.0	0.3
Lokoja	18.7	25.0	0.7	1.1	3.8	50.5	0.3
Maiduguri	22.3	60.7	7.5	1.8	5.8	1.4	0.6
Makurdi	36.8	34.8	1.4	1.1	2.5	23.2	0.2
Onitsha	62.1	6.5	26	1.0	3.7	0.5	0.1
Osogbo	34.2	34.3	2.8	1.1	6.6	20.7	0.3
Owerri	68.0	6.2	16.5	3.1	3.7	1.9	0.5
Port-Harcourt	52.1	9.7	3.6	1.9	23.5	7.7	0.8
Sokoto	18.7	66.4	4.1	2.9	6.5	0.9	0.5
Umuahia	38.1	56.1	1.1	0.4	2.1	2.0	0.2
Uyo	30.2	62.6	4.0	0.7	2.0	0.5	0.1
Warri	35.8	24.8	7.5	2.3	15.9	12.7	1.0
Yola	23.0	59.6	5.9	0.9	4.2	6.1	0.3

Source: Computed by author from National Population Commission (2010) Population and Housing Census data.

more than one third are not functional. This setting underlines the gravity of sewage disposal challenge and its environmental consequences.

Apart from solid waste and untreated sewage, effluent from industries and other urban land uses pollute surrounding resources. The creeks and lagoons of Lagos, Port Harcourt and Warri are very typical, being major centres of industries. Apart from the fact that surrounding water bodies are the natural “toilets” for many coastal cities, untreated faecal waste is regularly dumped in these channels.

Important as this element is, effluent from industries is by far environment-unfriendly. Untreated chemical and related waste is regularly discharged into water courses, particularly in the coastal cities. The coloration of lagoons and creeks of Lagos, Port Harcourt and Warri is an

Table 5. Sewage treatment plants in Nigeria.

Location	Type	Type of Wastewater treated	Current situation	Remarks
Ibadan				
University of Ibadan	- Primary treatment - Trickling Filters - Activated sludge process - Water hyacinth pond	Domestic Domestic Domestic (packages type, imported) Domestic	Non-functional since 1970s -Do- -Do- Faulty	-Quality of effluent not satisfactory
-Ibadan				
University College Hospital	-Primary, secondary and tertiary (together) - Trickling - Activated sludge plant - Chlorine treatment of the effluent	Domestic and hospital waste	Not functional since mid 1980s	-A good plant worked well, some students collected data, could not be repaired as the suppliers preferred a totally new plant
-International Institute of Tropical Agriculture -Nigerian Breweries -British American Tobacco Company -Nigerian Tobacco Company	Primary and Activated sludge; Aerobic bioreactor Activated sludge Activated sludge, packaged, very old	Domestic Industrial; Brewery waste (strong and organic) Industrial; Tobacco process wastes and domestic Industrial; partly domestic	Functional Functional Functional Non-functional for a long time	-Effluent recycled through lake -Quality of effluent is below expectations -Government is trying to rehabilitate
Lagos				
WEMABOD Agbara Estate 1004 Flats	-Aerated lagoon -Aerated lagoon (surface aerated) Activated sludge	Domestic and industrial mixed Domestic and industrial mixed Domestic from Estate	Non-functional for many years Functional Non-functional for years but recently rehabilitated	Government tried and gave up
Guinness Breweries Oko-ObaAbattoir	-Activated sludge (surface aerated), sludge being digested for methane recovery and electricity generated; -Oxidation ditch	-Industrial (Brewery) and partly domestic -Livestock waste	-Functional -Non-functional -Faulty design	-Electricity is in the industry
Abuja				
WUPA Mini-sewage treatment plants	-Primary and Activated sludge with methane recovery and sludge drying and utilization -there are 11 of them with aeration systems	- Domestic and also includes fecal sludge from septic tanks and toilets -Domestic from residential areas	Working at 30% design capacity, -Not functional -Faulty designs and need for sewage pumping	-Under funding; -sewers not fully connected
Warri				
SPDC	-Primary -Activated sludge	Domestic	Functional	Mostly used for SPDC housing estates
Ife				

Table 5. Contd.

OAU	Waste StabilizationPonds	Domestic from University campus	Partially functional	Poor management
Zaria				
ABU	Waste stabilization ponds	Domestic from University campus	Partially functional	Poor management

Source: Communication from Professor M.K.C. Sridhar Department of Community Medicine, Niger Delta University, Wilberforce, Island, October, 2011.

obvious evidence. Aside from such intentional discharge, with little or no penalties, largely unintentional spillage of chemicals including oil has largely affected the environment of the coastal cities. Table 6 indicates such spills in the early 2000s. Apart from an incident in 2003 involving spill of chemicals in Lagos (Tin Can Island), all incidents have been in oil terminals. Given the nature of tides and currents, such spills have effects beyond the immediate port areas (Ikporukpo, 2008). Most of these terminals are at an incipient stage of urbanization which is facilitated by the oil industry.

Table 7 depicts the situation in one inland city, Owerri. Virtually, values of all chemical parameters increased over time, indicating an increase in the pollution of the river. The concentration of such constituents as nitrates, magnesium and iron, even for groundwater in the area, exceeds World Health Organisation (WHO) limits. Although, the deteriorating situation is largely due to urbanization processes, nutrients from surrounding farms also contribute to the situation. The existence of the nearby land-fill dumpsite at Avu complicates the situation (Ibe and Njemanze, 1999).

Air pollution results from industrial production activities and the large number of automobiles crawling each day between residences and various activity centres. The smoke emitted from various factories especially in the centres of industrial concentration in Lagos, Port Harcourt and Kano is evident. The pollution through automobile exhaust emission is no doubt increasing as the traffic hold-up situation in cities such as Lagos, Abuja and Port Harcourt worsens. A study in Ibadan in the mid 1970s provides evidence of the impact of urbanization. This study (Oluwande, 1977) indicated that whereas pollution levels in the city were higher than WHO long-limits, those in the surrounding countryside were not as high.

There is no doubt that with increasing urbanization, noise pollution has been growing. Apart from the industries, the growing number of electricity generators, commercial motor cycles and several individuals in commercial thorough-fares advertising products using loudspeakers constitute serious noise pollution. For instance, studies in Ibadan (Farai, 2006) indicated that noise levels vary between 70 and 120 decibels, well over an acceptable level of not more than 65 decibels.

The preceding analysis in this section has shown that in varying degrees, pollution due to urbanization is not abating. One common explanation for the observed acute environmental deterioration consequent on urbanization in the country is the fact that the cities are old, unplanned and, generally speaking, predate the introduction of modern transport systems (see for instance, Mabogunje, 1974, 1990). Does this therefore imply that new cities in the country will generally function more environment-friendly? This issue is addressed in the next section through case studies of the new cities of Abuja and Yenagoa.

CASE STUDY OF ABUJA AND YENAGOA

As a prelude to an analysis of the environmental impact of the two new cities, the circumstances of their emergence are discussed below.

Abuja is the country's new capital while Yenagoa is the capital of one of the states, Bayelsa (Figure 1). Abuja was proclaimed the capital of the country on February 3, 1976 although it was only on December 12, 1991 that it formally attained the status. Before then, Lagos located on the western coast (Figure 1) was the capital. The decision to move the capital from Lagos to Abuja was informed mainly by the realization that the former was too congested with a low liveability status and its non-central location. The choice of this location for the new capital city was informed by its centrality and the fact that there was no town there, apart from villages, and had extensive largely uninhabited tracts of land.

Similarly, Yenagoa before becoming a State capital with the creation of Bayelsa on October 1, 1996, was made up of about twenty villages, each with a population of a few hundred to a few thousand. These included mainly Yenigue, Akenfa,

Table 6. Port area pollution incidents in Nigeria (2001-2004).

S/N	Port/Terminal	Type of Incidence	Product/Cargo	Date
1	Brass	Oil Leakage	Brass light crude oil	18/08/2001
2	Bonny Offshore	Oil leakage from Hose from Buoy	Bonny light crude oil	4/11/2001
3	Bonny Offshore	Oil leakage from Propeller	Bonny light crude oil	24/11/2001
4	Qua Iboe	Oil Leakage	Qua Iboe light crude Oil	26/11/2001
5	Bonny Offshore	Oil leakage from Hose line	Bonny light crude oil	28/11/2001
6.	Tin Can Island	Oil spillage from Ruptured pipeline	AGO	5/6/2002
7.	Bonny	Oil Leakage from SBM No.1	Bonny light crude oil	31/10/2002
8.	Forcados	200 x 100 metres of spillage	Forcados Blend crude oil	28/12/2002
9.	Qua Iboe	Oil Spillage	Qua Iboe light crude oil	25/2/2003
10.	Forcados	50 x 50 meters of spillage	Forcados Blend crude oil	14/3/2003
11.	Brass	Oil spillage	Light crude	18/7/2003
12.	Tin Can	Spillage of chemicals	Suspended Ammonia (Not Radioactive)	28/8/2003
13.	Escravos	30 x 20 metres spillage	Light crude	9/9/2003
14.	Escravos	Oil Spillage	Light crude	27/9/2003
15.	Escravos	Oil Spillage	Light crude	19/4/2004
16.	Qua Iboe	Oil Spillage	Light crude	11/7/2004
17.	Escravos	1, 000 sqmetres of spillage	Light crude	30/7/2004
18.	Qua Iboe	100 x 100 sqmetres of spillage	Qua Iboe light crude oil	18/9/2004
19.	Forcados	Light leakage	Forcados Blend crude oil	10/10/2004

Source: Ikporukpo (2008: 209).

Table 7. Chemical parameters of Otamiri River, Owerri (1984 – 1997).

Parameter	Period				
	May 1984	May 1985	May 1986	May 1987	May 1997
	(mg L^{-1})				
Sodium ion (Na^{+})	6.31	6.38	6.42	6.50	6.61
Magnesium ion(Ng^{2+})	3.31	3.35	3.42	3.45	9.17
Calcium ion Ca^{2+})	2.34	2.38	2.40	2.43	4.85
Iron ion (Fe^{2+})	0.05	0.07	0.08	0.08	0.30
Bicarbonate ion (HCO_3)	11.50	11.53	11.58	11.84	15.51
Nitrate ion ($N0_3$)	8.41	8.81	8.45	8.80	50.1
Sulphate(SO_4^{2-})	2.60	2.80	3.07	3.02	5.31
Total Dissolved Solid (TDS)	50.00	50.60	53.00	55.00	60.2
Hydrogen ion (pH)	5.10	5.20	5.30	5.500	6.4

Source: Ibe and Njemanze (1999: 342).

Agudama, Akimpai, Ede-Epie, Etegue, Okutukutu, Opolo, Biogbolo, Yenizuegene, Kpansia, Yenizue-Epie, Okaka, Ekeki, Amarata, Onupa, Ovum, Swali, Azikoro and Yenagoa. These were separated by farmlands, forests and swamps. The most prominent among them was Yenagoa. Apart from Yenagoa, thatch-roof houses were predominant in the settlements. Indeed, in some of them, this was the only house type. Until the 1980s when a gas-powered electricity facility was provided in the nearby Kolo Creek (Imirigi), none had electricity supply and the sources of water for drinking and other purposes were wells and the river/streams. Farming and fishing were the predominant occupations. Before the construction of the East-West Road, linking Warri and Port Harcourt through Ughelli, Patani, Imbiama and Ahoada, in the mid-1970s, water transport was the only link with the nearest city, Port Harcourt. Given the fact that the area was not densely settled and had relatively insignificant number of

Figure 1. Nigeria's major cities.
Source: Author.

brick/cement block buildings, there was ample opportunity to build a well-planned environment-friendly city.

One obvious impact of the emergence of the two cities was destruction of the forest ecosystem as the built environment replaced the natural. This lost "bio-infrastructure", as it is sometimes christened (Roberts and Odonoghue, 2013), reduced ability of the areas to adapt to climate change and its consequences. This is largely because of the potentials of the forest ecosystem to lower greenhouse gas emission, to remove air pollutants and improve air quality. The area affected in Abuja is by far much more than that of Yenagoa, given the disparity in the sizes of the two cities. While the areal extent of Abuja is about 25,498 ha (about 255 km^2), about 32.6% of which is open space and green areas (Ago, 2001), Yenagoa's is only about 7,850 ha – about 78 km^2 (Bayelsa State, 2004). Similarly, in the 2006 population census, the latest in the country, whereas Abuja had a population of 776,298, Yenagoa's was only 266,008.

While in case of Abuja, mitigation measures were introduced, these were absent in Yenagoa. The Abuja master plan (1979) which guided the development of the city provided for areas of protected natural vegetation, parks, residential gardens, landscaping of roads and parks within residential area (Falade, 2001). The result is evident from the availability of green areas in Abuja (Figure 2) and virtual absence in Yenagoa (Figure 3). Indeed, there are currently 94 parks/gardens in Abuja; the largest being the Millennium Park and the National

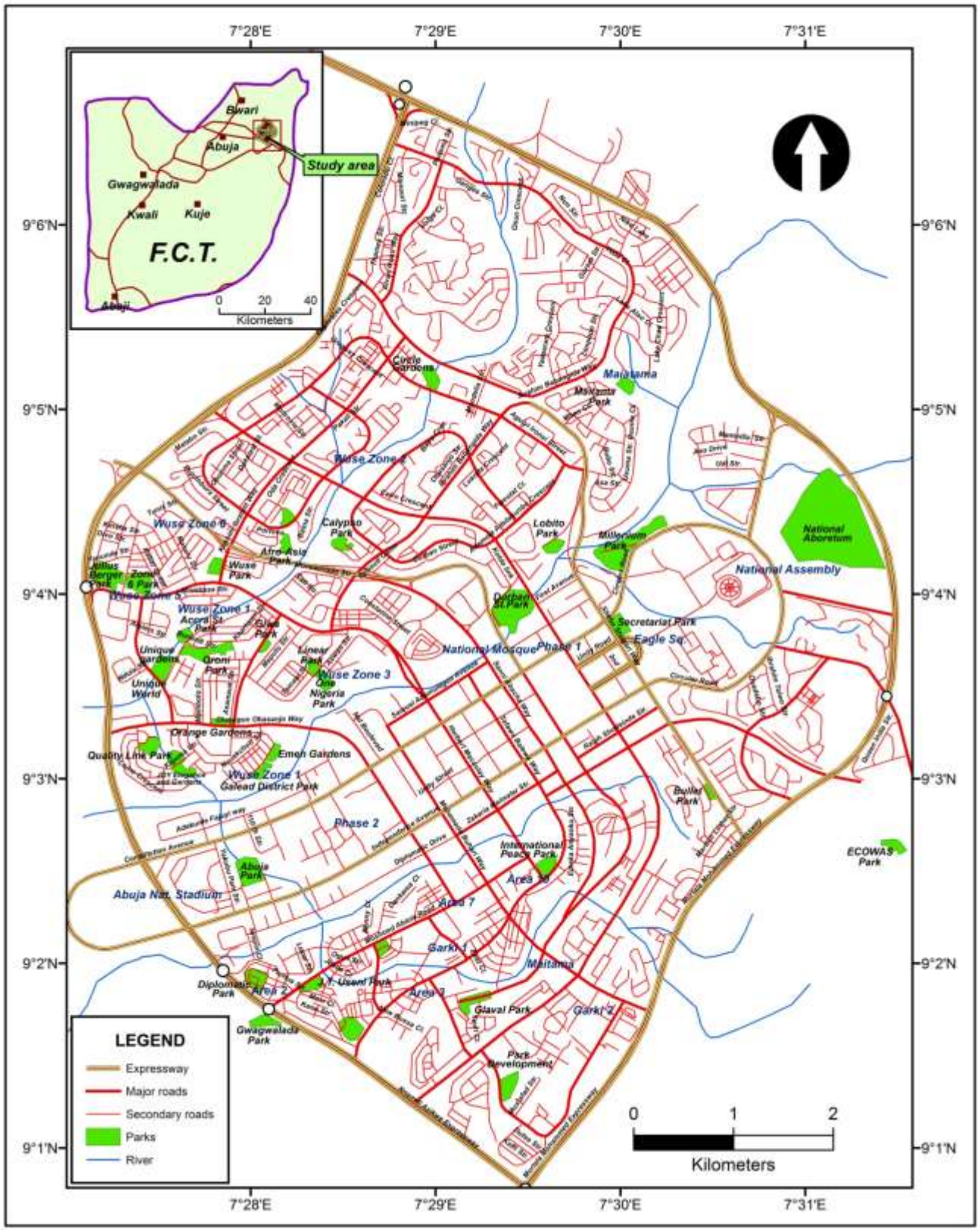

Figure 2. The major parks of Abuja.
Source: Author.

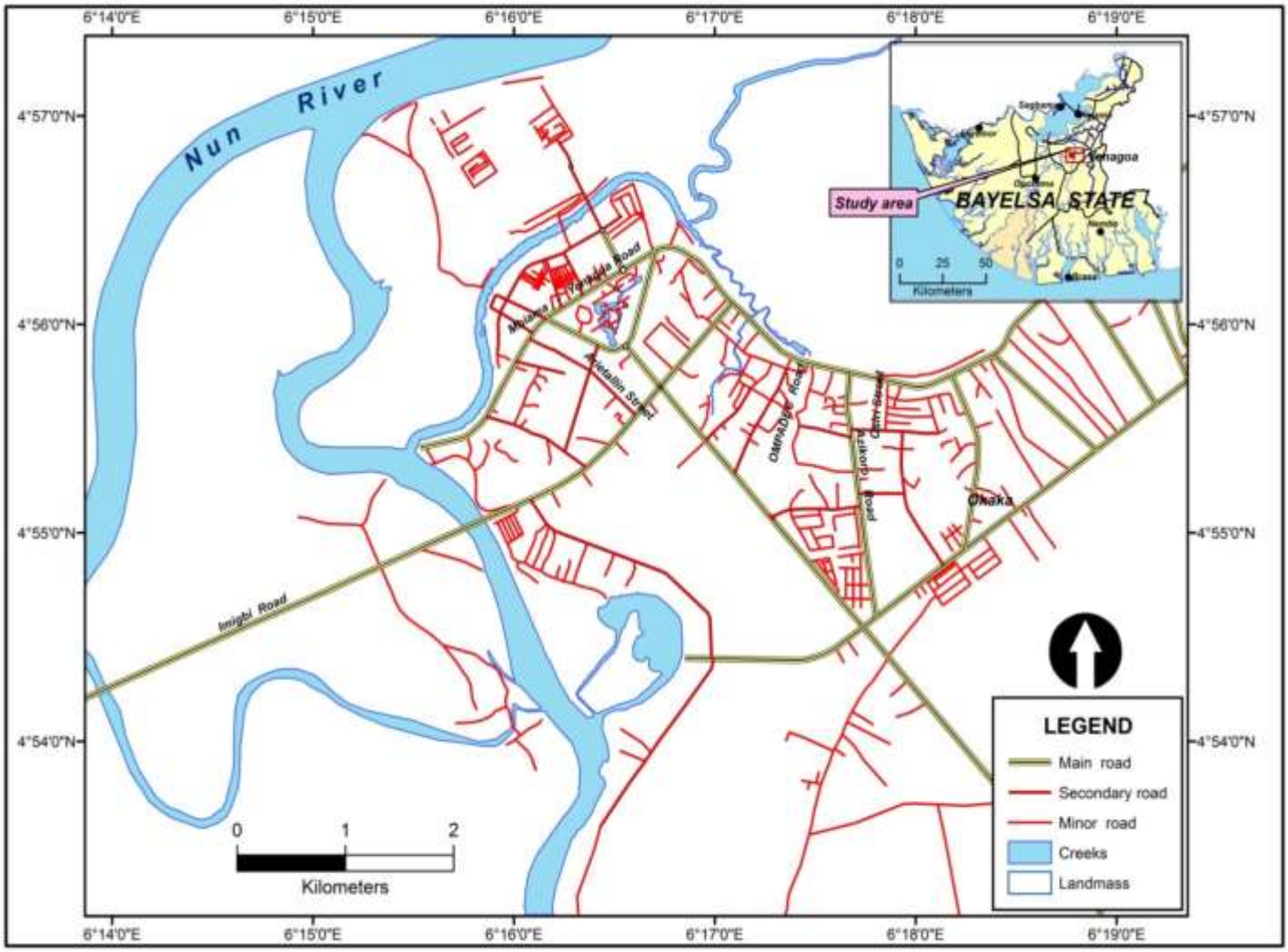

Figure 3. The structure of Yenagoa.
Source: Author.

Arboretum.

There is also a contrast between the two cities in solid waste pollution and its consequences. The Abuja Environmental Protection Board, the source of data on Abuja, does not have data on solid waste generated in the city but for the entire Federal Capital Territory which includes the city and several satellite towns. Data are available on an annual basis from 2000 to 2011. About 41,400 tonnes were generated in 2000. This increased to about 47,660 tonnes in 2005 and drastically to about 253,970 tonnes in 2010 but decreased slightly to about 245,962 in 2011. Given the disparity in development, including purchasing power, between the privileged city and the disadvantaged satellite towns, it is likely that at least half of the volume may have been generated in the city.

The city has well-developed facilities for handling solid (and even liquid) waste. For instance, in 2010, there were 3,000 recycling bins and 862 mechanical litter pickers, whereas there were none in the satellite towns. The city has a Central Waste Management Site located in the Idu Industrial layout outside the city. The entire area covers 504 ha, although only part of it, the 98 ha Gousa dumpsite has been developed. In 2011, there were 56 compacting trucks and 2 street sweepers servicing the city. In 2011, the solid waste management in the city was managed through a public-private partnership arrangement involving 18 companies. Thus, while Abuja is the cleanest city in the country, the satellite towns, such as Nyanya, Karu and Lugbe, characterized by scattered heaps of solid waste, are among the dirtiest towns in the country. The setting seems to be that the city

is clean at the expense of the satellite towns.

In case of Yenagoa, information obtained from the Ministry of Environment in early October, 2011 indicated that about 36,960 tonnes of refuse were generated annually. Part of the refuse is collected by government-registered private contractors who collect from designated locations and dispose in an open dumping site about 5 km west of the city along the road linking Wilberforce Island where the Niger Delta University is located. As Plate 1 shows, refuse is simply dumped along the side of the road, often spilling into the road. The situation is complicated by scavengers (Plate 1) who collect recyclable items, such as plastic bottles, glass bottles and aluminum cans, for sale in cities such as Port Harcourt and Aba. The stench from this dump is monumental and hence the site is common christened "furupa" literally meaning "smelling out" in ijo the vernacular of the state.

The environmental hazard the dump is to the rural areas is obvious. A number of small settlements are close to the site; some of them only a few meters away. Indeed, because of the rapid uncontrolled growth of Yenagoa along this western axis, the outskirts of the city are only about a kilometer from the site. It is also remarkable that an oil production facility where individuals work daily, is just opposite.

About 10 truck-loads each about 10 tonnes are dumped daily (Sridhar, 2006, 2011). This implies that less than 19,000 tonnes of the nearly 37,000 tons generated in the city are handled. In other words, only about 51% of the solid waste is evacuated. The remaining waste is usually disposed of through such unconventional means as dumping in the river and in open spaces. An official of the Ministry of Environment in a communication to the author in early October, 2011, indicated that the solid waste disposal system is limited by the lack of access to some streets consequent on poor planning, lack of funds and public enlightenment and shortage of well-trained Environmental Health Officers.

In terms of sewage pollution, as shown in Table 5, while Abuja has a sewage treatment plant, there is none in Yenagoa. What is particularly critical is that, although, all the houses in Abuja have water-closet toilet system, there are several unconventional forms of excreta disposal, with considerable polluting impact in Yenagoa.

As a Ministry of Environment official declared to the author:

Many houses do not have any toilet at all because of the attitude of landlords… Even those using flush-toilet systems, the problem is that of lack of access roads to facilitate evacuation of septic tanks or the exorbitant cost of hiring private sewage trucks . . . As a result of these difficulties, indiscriminate defecation and dumping or evacuation of sewage within the neighborhood is a common practice.

This is apparent from Figure 4 depicting the type of toilet facility used by a sample of individuals in two residential areas, Amarata and Azikoro, in Yenagoa. Although, in Amarata open field and pour flush toilet are of about equal importance and the most significant, open field is by far the most significant in the case of Azikoro. Water closet toilet is next to open field in Azikoro and is third in Amarata. Though the river is significant in Amarata, it is of no significance in Azikoro. The fact that there is no approved site for disposing sewage from septic tanks, resulting in indiscriminate dumping according to an official of the Ministry of Environment, complicates the pollution challenge.

The toilet facilities available, shown in Figure 4, point to an obvious source of pollution to surface water resources. The fact that pipe-borne water is in short supply complicates the setting. According to the Ministry of Water Resources (in a communication to the author in October, 2011), the installed water supply capacity in the city is 23,007 m^3/day. However, only about 20% of this capacity is currently available. Thus, water shortage is characteristic and hence water vending is common. In both sewage disposal/standard toilet availability and water availability, in the new emerging residential areas occupied by the very high income group, where personal boreholes are the rule, the environmental challenge is not as critical. Be this as it may, the fact that in a predominantly large part of the city, these challenges exist is beyond doubt.

Generally speaking, air pollution in Abuja is usually monitored and addressed where need be, by the Air Quality Monitoring Unit of the Abuja Environmental Protection Board. For instance, in 2011 there were monitoring activities in the Idu Industrial, Utako District, Wuse II, Mabushi, Central Area and Apo. The result showed that all parameters were within permissible levels. The fact that this is an administrative city with little or no industrialization may be responsible Yenagoa is also yet to industrialize and therefore does not have polluting industries. However, the indiscriminate use of motor cycles for public transport, no doubt, has implication for both air and noise pollution. Similarly, traffic jams, characteristic of cities such as Abuja, Lagos and Port Harcourt, are absent and hence pollution from automobiles is relatively minimal. However, noise pollution from those advertising their products is common in the commercial areas of both cities.

Conclusion

The analysis shows that the impact urbanization has on the environment is controversial. The basic issue is not whether or not urbanization impacts the environment; for, there is definitely an impact. The controversy is one of proportionality; that is, whether the impact of a given

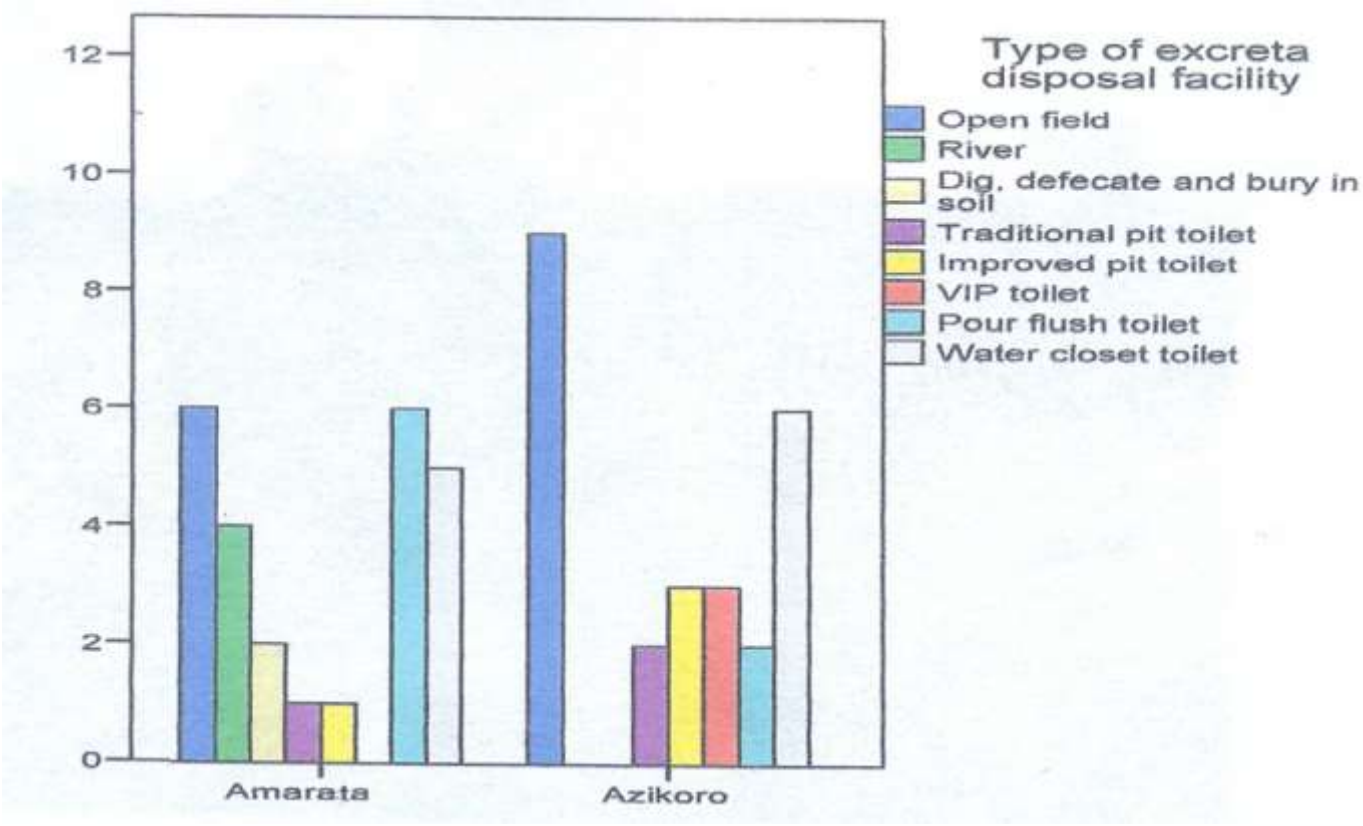

Figure 4. Types of toilets in use in Yenagoa.
Source: Author.

individual is less where a large number of people live in the same place (that is, in an urban area) or where few people live in the same place (that is, in a rural setting).

In spite of the fact that urbanization, in certain respects, may dampen environmental deterioration, the setting in Nigeria seems to have been mainly one of facilitation, although there are no data to investigate further the issue of proportionality. It is possible that, following the Kuznets Curve conceptualization, this may be related to the country's low level of development and the consequent orientation that development rather than environmental concern is more worth pursuing.

However, as the analysis of the two new cities of Abuja and Yenagoa has shown, there are considerable variations in the impact cities could have on the environment. Several factors may be responsible for such variation. In case of Abuja and Yenagoa the difference is mainly because of the fact that development of Abuja was guided by an environment-friendly master plan while Yenagoa developed spontaneous without a master plan or even a perspective plan. A master plan was developed only in 2004; eight years after Yenagoa emerged as a state capital with consequent rapid development. Related to this factor is the fact that a body responsible for environmental management emerged early in Abuja but not in Yenagoa.

The country now has well-stated policy and guidelines to address the environmental impact of the urbanization process. These include:

i) The National Policy on the Environment of 1989; revised in 1992
ii) The National water and Sanitation Policy
iii) The National Environmental Sanitation Policy of 2005
iv) The National Environmental Health Practice Regulation of 2007
v) The National Noise Standards and Control Regulation 2009.

The National Policy on the Environment has components on waste management and noise pollution. For instance, it emphasized that "priority should be given to the monitoring of the quality of industrial effluents as well as the variety of solid and liquid wastes". In the area of noise and air pollution, the emphasis is on establishment and monitoring of specific standards. All other policies that

Plate 1. Yenagoa's solid waste dump.
Source: Author.

have emerged since then focus on the establishment and implementation of standards.

However, in spite of the existence of an enabling framework for environmentally sustainable urbanization, it is apparent that the urbanization process in Nigeria is still characterized by increasing environmental challenge. There is no doubt that there are isolated attempts, such as in the city of Lagos, to limit the environmental impact. In spite of the postulates of the environmental Kuznet Curve, urbanization even at the developmental stage of Nigeria need not be environment –unfriendly. There is no doubt that the political will by government is required to provide an enabling environment for private sector participation in implementation of policies and programmes.

CONFLICT OF INTERESTS

The author has not declared any conflict of interests.

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