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## RESEARCH ARTICLE

### UPSURGE IN DOMESTIC SEWAGE GENERATION - A GROWING URBAN ENVIRONMENTAL MANAGEMENT CRISIS IN PORT HARCOURT, NIGERIA

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#### ABSTRACT

This study examined contemporary urban environmental management crises with focus on increasing rates of domestic sewage generation in Port Harcourt. It adopted the use of cross – sectional research design where both primary and secondary data were used. The primary data were generated through the use of field observations, oral interviews and 5005 copies of questionnaire administered in ten stratified randomly selected areas. Ten research assistants were used for data collection in each zone. Six research questions and six specific objectives guided the study. The data was analyzed using descriptive statistics. Findings revealed high rate of sewage generation in the city which is spatially defined in line with population densities of the various segments of the city. Three principal sites are used for indiscriminate sewage disposal activities– mostly into creeks at Iwofe (Mini-kpiti)–Rumuolumeni; Amadi-Ama Creek; and into burrow-pits at Igbo– Etche area. The indiscriminate disposal of sewage in the urban environment is causing serious social and environmental challenges such as pollution of water resources, soil and food crops; environmental foul odours and eye-scores; spread of pathogens which cause sicknesses and sudden deaths. The authors concluded by recommending proper treatment of sewage before evacuation, enactment and implementation of good laws, immediate closure of all illegal dump sites and designation of well supervised and coordinated disposal sites.

#### INTRODUCTION

An urban centre is basically characterized with elements of modernity. In other words, the urban geographic space must be seen to display distinct features such as well coordinated and planned layouts; availability of workable and effective amenities evenly distributed; clean and safe environment; effective and equitable utilization of limited resources; have a population of over 20,000 persons with a demographic composition of more literate working class engaged mainly in secondary activities; presence of peace and security, and effective legal and administrative systems anchored on the principles of a just, free and egalitarian society; where there is respect for human rights and the rule of law. In addition, an urban centre is where sound environmental sanitation principles are observed (Ukpere, 2017). Anything short of this definition is an aberration and indication of a crisis – laden centre that does not possess the qualities of an urban centre. This is the emerging picture of most Nigerian and indeed African urban centres including the capital cities which are presumably supposed to be ‘heaven-on-earth’ for its inhabitants, who flocked into these urban centres for some ‘perceived golden opportunities’. From Port Harcourt, Lagos and Kano (Nigeria) to Dakar (Senegal), Nouakchott

(Mauritania), Casablanca (Morocco), Yaounde (Cameroun), Khartoum (N. Sudan), Addis Ababa (Ethiopia), Kampala (Uganda), Dar es Salaam (Tanzania), Pretoria and Cape Town (South Africa); the story is almost the same. They are characterized with a mirage of problems – poorly planned layouts, poor drainage system and flooding at the slightest rainfall, noisy environments, insecurity and lawlessness, ineffectiveness in general environmental sanitation, (wastes management) housing inadequacies and rising number of informal settlements (slums, ghettos), rising populations, and the lack of effective administrative and judicial systems. There is increased awareness of the need for sustainable environmental practices. However, issues of domestic sewage generation and the increasing social and environmental problem associated with indiscriminate disposal of untreated sewage into water bodies and lowlands within the fringes of the urban centres have received little attention. Available literatures point to the fact that environmental sustainability is the hallmark of every development on space. Unfortunately, in most Nigerian urban centres, little or nothing is been done in ensuring that the environment is well protected against any act of abuse or misused arising from man’s inept land use activities. Thus, our environment is often polluted with far reaching consequences on our health and other components of the environment. Urgent attention is therefore needed in order to halt this space of environmental despoliation and degradation. Encouragement in research and development is

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one sure way of addressing these problems. This paper examined one of such urban environmental management crises – increase in domestic sewage generation in our urban centres and the environmental and social effects of indiscriminate disposal activities, using Port Harcourt – the presumed ‘Garden City’ in South-South Nigeria, as a case study. The rational questions to ask are: where does the future of our urban centres lie? Shall we continue to desecrate, decimate and degrade our water resources and open lands? Shall the environment continue to suffer because of our inept actions and negligence?

This study is therefore posed to address the following research questions:

1. Which area of Port Harcourt generates the highest volume of sewage?
2. Is there any spatial variation in the volume of sewage generated in Port Harcourt?
3. Where exactly are the sewage disposal points in Port Harcourt?
4. What are the main reasons for the rise in domestic sewage generation in Port Harcourt?
5. What are the social and environmental problems associated with this rise in domestic sewage generation cum indiscriminate disposal activities in Port Harcourt?
6. What are the immediate and long term solutions to the problem?

#### **Aim and objectives of the study**

The basic aim of this study is to examine contemporary urban environmental management crisis with focus on increase in domestic sewage generation and the effects of indiscriminate disposal activities in our urban centres using Port Harcourt-Nigeria as a case study. The mission of the authors, apart from proffering solutions, is to communicate to the public, the dangers associated with the rise in domestic sewage generation in our urban centers. To achieve this aim, the following specific objectives were pursued. To:

1. Ascertain which area(s) of Port Harcourt generates the highest volume of sewage.
2. Determine if there is any spatial variation in the volume of sewage generated.
3. Find out the exact sewage disposal points in Port Harcourt and its environs.
4. Ascertain the main reasons for the rise in domestic sewage generation in Port Harcourt.
5. Find out the social and environmental problems associated with this rise in domestic sewage generation cum effects of indiscriminate disposal activities in Port Harcourt.
6. Examine the immediate and long term solutions to the problem.

#### **Literature Review**

The urban environment is most time presumably perceived to be ‘heaven-on-earth’ kind of place, with well planned layouts, beautiful green gardens/parks and serene surroundings. A place where the principles of environmental sanitation and protection is upheld strictly; an egalitarian society where there is respect for the rule of law, human rights, equity and justice in the distribution of resources and social services provision.

When there is a negation or reverse of this picture of the urban centre, then there is a crisis. A crisis – laden urban centre can only promote anarchy and chaos, increase in social tension. A society in shambles can only produce lesser fair attitudes which can lead to the negligence and abuse of simple environmental laws or principles. And this can cause a major doom on the residents of such environment (Adegoke, 1989; Ukpere, 2017). In his study on the impact of waste dumps on land use and property values in Port Harcourt, (Ukpere, 2015) opined that the contemporary challenges posed by rise in population and corresponding increase in productive activities and waste generation in our urban centers has led to high level of ineffectiveness in environmental management. Again, the inability of countries (especially in the Developing World) to properly manage their wastes is pushing the world to major environmental management crisis especially in the urban centres where it is observed that, refuse and sewage disposal activities is posing serious threat to our continued survival in our environments. Also, the inability of Governments to provide quality social services to their people has led to poor access to basic sanitation, forcing the people to use poorly – built pit latrines and on-the-slot defecations (OSD). Thus, sewage and other wastes are often being indiscriminately disposed in the environment leading to environmental fouls odours and contamination of drinking water sources. This problem has led to poor access to safe water supply and the emergence of water borne diseases which now kill more than 1.8 million people annually across the globe (especially children below five years) (WHO-UNICEF, 2010; Arokoyu and Ukpere, 2014). Several theories and debates have been postulated by scholars at international conferences and programmes on the need for sustainable environmental practices on our paths to development. Some of these theories and debates include: the application of the ecology principle in development issues; the doctrine of universal well – being which attracted much discourse through the well coordinated activities of notable men like Gandhi, Nyerere and Castro who fueled heated debates for more than twenty (20) years on the presumed benefits of the ‘universal well-being thesis’. Others are the ‘eco-development thesis’ of Ignacy Sachs; and the expressive report published by the Club of Rome in 1972 titled the limits to growth (Rist, 1996).

Major UN – conferences and programmes with focus on the environment include the Agenda 21 which was launched in Rio de Janeiro; the Aalborg Charter that was set forth at the Copenhagen Conference of 1994; the Third International Urban Forum in Vancouver in 2006; and the popular S- DEV Geneva 05 Programme which consisted of ten (10) conferences, thirty-eight (38) workshops and one hundred and thirty-nine (139) exhibitions that brought together, over 2,400 delegates and participants from seventy (70) countries across the globe. Other UN Conferences include the Convention on International Trade in Endangered Animal and Plant Species (CITES) that was signed by 21 Western Countries in 1973 in Washington DC, the 1994 UN – Conference in Spain, to Combat Desertification (UNCCD), the 1972 UN – Conference on Human Environment in Stockholm (Sweden), which gave birth to the creation of UNEP; the 1992 UN World Environmental Conference in Rio de Janeiro (Brazil) popularly known as ‘Earth Summit’ on Environment and Development; and the 1997 UN – Conference on Climate Change in Kyoto (Japan) popularly known as the Kyoto Protocol. Since then, there have been series of follow – up conferences and programmes almost on annual basis with

focus to addressing contemporary global environmental challenges.

## MATERIALS AND METHODS

This study applied the cross-sectional research design where both primary and secondary sources of data were used. The main (primary) data used for the study were generated through the use of field surveys/observations, oral interviews and semi-structured questionnaire (A-for residents; B-for sewage companies/ truck drivers) administered on 5005 randomly selected residents in ten (10) stratified selected areas. Ten research assistants were used for data collection in each zone, between the hours of 6am to 6pm daily for three weeks in May/June 2016. Six research questions and six specific objectives guided the study. The data was analyzed using descriptive statistics (simple percentage). The population of the study is made up of all the residents of the various segments of Port Harcourt. The entire city was classified into (10) zones (segments). Thus, these ten zones constitute the sample of the study.

## RESULT AND DISCUSSION

### Urban Environmental Sustenance and Livability - The Concerns and the Journey so Far!

Bearing in mind of the importance of a safe and healthy urban environment as a very crucial social welfare facility and public asset, nations and governments across the globe have continued to intensify their efforts towards maintaining a balance between development initiatives and environmental safety. This is based on the primary principle of urban governance that, maintaining a clean, healthy and safe environment will help to reduce the risk and burden that is associated with any negligence in environmental safety and public health. That is, trying to reduce the burden of retributive justice due to environmental failures in our urban centres. It is common knowledge that the vision of everyone coming into the urban area is not to contract any disease that may lead to his/her incapacitation or sudden death rather, he/she hopes to explore opportunities that will boost his/her socio-economic status and then contribute to national development.

This 'development' must be pursued in pari-passu with environmental safety and protection. That is to say, environmental protection and conservation must be a desideratum in our attempts to achieve development. This is based on the simple geographic truism that man's continual survival and comfortable living in any environment (such as the urban centre) is dependent upon the various roles and level of commitment of its inhabitants (the urbanites) to environmental protection, safety and sustainability. And this is a function of the people's culture, level of technology, availability of resources, level of education and awareness, policy and the right political – will to make proactive decisions for the benefit of all. The cost of managing the urban environment is on the increase and this is telling on the Municipal authorities. In some cases, municipal authorities do not even have the right political – will and legal framework neither is there any well – coordinated organizational architecture for the management of sewage. In most Nigerian cities (e.g. Port Harcourt), more emphasis is tilted towards urban solid waste management.

This is primarily due to the fact that these wastes are easily seen littering our environments especially blocking major roads, with offensive odours on passers-by; hence their quick evacuation. Again, it is beyond mere evacuation rather, the main concern is where these wastes are disposed and in what manner. This is where the problem lies (Adegoke, 1989; Ukpere, 2017). Often time, dumpsites are illegally acquired; wrongfully sited and poorly managed hence they end up constituting more challenge in the receiving environment such as the contamination of ground water sources and spread of water – related diseases which causes sudden deaths (Salami, Iroge and Egila, 2001; Ukpere, 2005; Ukpere and Edoghotu, 2015). The problem of effectively managing the rising volume of sewage generation in our urban centres is cumbersome. This increase in sewage generation is directly proportional to the size of the population in any location. Thus, the higher the population, the higher the amount of wastes generated. Untreated sewage can be contagious because of the presence of great number of pathogens. Yet, these wastes are being disposed indiscriminately on a daily basis without recourse to environmental laws and principles.

### The Nature of Domestic Sewage in Port Harcourt

Domestic sewage in Port Harcourt occurs in molten, semi-solids and liquid form and contains a wide range of dissolved and suspended impurities that are organic or inorganic in nature, coming from kitchens, toilet flushes, baths and laundry washes. They are intermittently evacuated from septic tanks or sucker-ways. They are composed of human faeces, urine, vomits, spits, kitchen washes, soaps and detergents. Often time, domestic sewage in Port Harcourt is never treated before evacuation. The indiscriminate disposal of untreated sewage poses serious concern such as the exacerbation of ecological damages, health risks and economic losses. Sewage is normally rich in phosphates and nitrates hence, if well treated can be turned into organic fertilizer that can be used in farms. However, it is evidently clear that untreated sewage can cause the growth and transmission of pathogens which may result to the outbreak and spread of faeco-oral and diarrheal diseases and other water-related illnesses which some time leads to sudden deaths. It contaminates and pollutes both surface and ground water sources, and can also provide breeding sites for flies, mosquitoes and other insects and rodents which may carry infections. Hence, the urgent need for sustainable environmental practices in order to protect Port Harcourt urban environment (Arokoyu and Ukpere 2014; Ukpere, 2017).

**Sample Analysis of the Main Constituents of Sewage in Port Harcourt:** Physicochemical and microbial analysis of samples of domestic sewage was carried out in the laboratory and the result showed a  $p^H$  of 6.5 – 7.0 and temperature ranging between 27.6 – 28.5 °C. Some of the chemical substances contained in the sewage includes sulphates ( $SO_4^{2-}$ ), chloride (Cl<sup>-</sup>), and phosphate ( $PO_4^{3-}$ ), nitrates ( $NO_3^-$ ). Others are urea  $CO(NH_2)_2$ , ammonia ( $NH_3$ ), potassium carbonate ( $K_2CO_3$ ) and potassium permanganate of potash used in soap making. The main microbial organisms present in sewage are *E. Coli*, *Coli-Form*, *Typhi-spp*, *vibro* – cholera and salmonella.

**Environmental Conservation and Protection: the Need for Effective Management of Domestic Sewage in Port Harcourt:** Environmental conservation, preservation or protection is simply the careful use of land, air, water, forests, minerals and other natural resources in our environments so that they are not

destroyed by thoughtless or selfish actions and inactions. It is the planned use of the environment at the different levels (local, sub-regional, regional, national, world-wide scales) using all available and most suitable mechanisms including planning, foresight and cooperation that man can muster in achieving this goal.

The need for environmental conservation is based on four main objectives namely:

1. The need to conserve and preserve wildlife, natural resources and natural beauty;
2. The need to maintain a balance between nature and the delicate spatial interactions and relationships between millions of living organisms (including man) on earth, and the use of natural resources whether renewable or non-renewable;
3. The need to maintain good quality of life of mankind through leisure, good working conditions, attractive buildings, clean beaches, parks and gardens;
4. The need to halt and if possible, reverse the course and progress of science and technology, and return to the 'old simple and easy life style'.

Resources conservation is very important for everyone both present and future generations. This prompted the United Nations in the 1950s to establish the International Union for the Conservation of Nature and Natural Resources (IUCN). The IUCN came up with three steps at preserving nature – through captive breeding of endangered species; through the establishment of nature reserves such as game reserves; and instituting legal protection/restriction. It is imperative to state here that the conservation and protection of the environment is an injunction given to humanity by God. The Almighty God commanded in the Holy Bible in Genesis 1:28 "Be fruitful, and multiply, and replenish the earth". That is to say, while man reaps the riches of the earth, he must be careful not to damage the earth. Rather, he must nourish (replenish) and protect it from all forms of pollution and degradation. Unfortunately, man has not really kept this aspect of the command. Most of man's actions and inactions have resulted to degradation and depletion of the earth (e.g. deforestation and biodiversity loss, use of chemicals in fishing, mass hunting of animals, etc.). Man's interactions with his environment have been lopsided and this is continually manifested in the various anthropogenic activities going on in the various geographic spaces. These activities have been very inimical rather than economically beneficial to the sustainability of the environment (Ukpere, 2015; Ukpere, 2017).

The entire environment is in a state of flux as contaminants and pollutants are constantly being released into the environment either directly or indirectly. The Port Harcourt environment is indeed in serious crisis; and 'has been crying for help'. While some care to listen to her yearnings, others seem not to care and are not even bothered. The truth remains that whatever game man plays with his environment, he will always be on the receiving side. This implies that the doctrine of retributive justice and or 'cause and effect' must definitely take its course (Salami *et al.*, 2001; Ukpere, 2005; Ukpere, 2014). In order to avert the consequences of urban environmental management crisis, there is urgent need to promote clean, safe and healthy urban environment. Domestic sewage and indeed every other waste, must be properly treated, evacuated and disposed. Development initiatives must be

carried out in strict compliance to lay down environmental laws. Environmental sanitation must therefore be the guiding principle to every decision as regard to the use of land for any desired purpose. There are three to four basic techniques that can be employed in the management of urban sewage. These are primary, secondary, tertiary and low-cost treatments. The first three are advanced modern techniques commonly used in the developed world; whereas, the low-cost technique is more pronounced in the less developed world, where due to the problem of low technology, trucks and 'night-soil-men' are used to evacuate sewage from the septic tanks and suckers.

**Primary Treatment:** Primary treatment is normally the first stage in urban sewage treatment procedures. Under here, large solids are physically separated from the waste stream through a metal grating. A moving screen then filters out much smaller items while a brief residence in a grit tank allows sand and gravel to settle. The waste stream then moves to the primary sedimentation tanks where suspended organic matter settle to the bottom as sludge. The effluent is not safe yet because of the presence of pathogens hence, cannot be discharge into water ways or on the ground (Cunningham, Cunningham and Saige, 2005).

**Secondary Treatment:** The secondary treatment involves the biological degradation of sewage by certain bacteria and other micro-organisms that act on the effluent from primary treatment that flows into a trickling filter bed (made up of perforated pipes and plastic sheets), an aeration tank, or a sewage lagoon. Aeration tanks are sometimes called 'activated sludge process', through which effluents from primary treatment stage is pumped into a tank and mixed with bacteria – rich slurry in order to enhance decomposition.

**Tertiary Treatment:** This stage removes plant nutrients basically nitrates and phosphates, from the secondary effluents. At this stage, the waste water does not contain pathogens and organic material nevertheless, it contains high level of inorganic nutrients (nitrates and phosphates) thus, when discharged into surface waters, and these nutrients automatically stimulate the growth of algae and eutrophication. Hence, these nutrients must be removed in order to protect water quality. To do this, the effluent should be passed through wetland or lagoon where these nutrients can easily be used – up by plants,

**Low – Cost Waste Treatment:** Due to the fact that the three earlier discussed strategies are very expensive and beyond the rich of many African Municipal Authorities, the adoption of the low-cost waste treatment approach will be helpful in the treatment of effluent sewerage. The effluent sewerage system is a hybrid between a traditional septic tank and a full sewer system, where a tank near each home collects and digests solids just like a septic system. In some cases, effluent is pumped out to a central treatment plant where it exists. Alternatively, effluent is pumped out into motorized sewage trucks or are collected by 'night-soil-men', and disposed into wetlands, ponds or marshes where bacteria and fungi help to digest the solids. As the effluents flows through the creeks, it is filtered and cleansed by aquatic plants and micro organisms. It is important to note here that, although, the use of 'night-soil-men' to evacuate sewage in our urban centres has long been diminished in most places, there are some spots where they are still being used, especially around ghetto areas that

**Table 1. Residents' Perception to Areas of Highest Sewage Generation in Port Harcourt**

S/N	Segments/Area	Classification (population density)	No. of Respondents	%
1.	D/Line Area–Ohamini bloc	Medium density area	518	10.35
2.	Diobu I, II, III Area	High density area	614	12.27
3.	G. R. A. Phases I, II and III	Low density area	511	10.21
4.	Rumueme, RumuepirikomRumuolumeni axis,	Medium density area	402	8.03
5.	Mile IV, Rumuokwuta, Rumuola, Nkpolu – Rumuigbo and Rumuokoro Bloc	High density area Medium density area	574 450	11.47 8.99
6.	Ozuoba–Choba, Aluu, Rumuekini/Rumuosi, axis			
7.	Rumuodumaya, Rukpokwu, Eneka, Rumuodara, Elioizu and Elimgbu areas	High density area	580	11.59
8.	Ogbonnabali, Amadi – Flats, Trans – Amadi, Oginigba, Abuloma, Marine Base	Medium density area	419	8.37
9.	Rumuobiakani, Woji, Elekahia, Elelenwo and Rumuomasi axis	Medium density area	428	8.55
10.	Township, Old G. R. A/Forces Avenue, Bundu&Borokiri Total	Medium density area	509 5005	10.17 100

Source: Authors' Field Work, 2017-2018

**Table 2. Spatial Pattern of Sewage Generation in Port Harcourt**

Segments/zones	Classification (population density)	No. of trucks seen evacuating sewage	Approx. volume of sewage in 000 (liters)	%
1	M	55	550	6.68
2	H	105	1050	12.74
3	M	31	310	3.76
4	M	79	790	9.59
5	H	124	1240	15.05
6	M	87	870	10.56
7	H	121	1210	14.68
8	M	80	800	9.71
9	M	81	810	9.83
10	M	61	610	7.40
Total		824	8,240	100

Source: Authors' Field Work, 2017-2018

NB: Volumetric analysis was based on the average capacity of the trucks which is 10,000 litres multiplied by the number of trips made by the trucks.

Some of the areas lack access to natural streams and use of sewage disposal trucks. It becomes obvious that the use of 'night-soil-men' is inevitable. The low – cost method is not a safe technique because of the danger of disposing raw sewage into the water bodies. This is the scenario in Port Harcourt and other urban centres in Nigeria. This is not environment friendly method and should be discountenance with. Rather, the use of bio-clean septic granules should be encouraged. Bio-clean septic granule is a special bacterial agent prepared in the laboratory to enhance faster and odourless decomposition process of sewage right in the septic tank or sucker-way.

**Pattern of Sewage Generation in Port Harcourt:** The primary factor responsible for the increase in the volume of sewage in Port Harcourt is associated with the high influx of people into the city. In association with this rise in the city's population is a corresponding increase in food consumption and wastes generation. Investigations revealed that the highest volume of waste (both solid and sewage is generated within the corridors of the moderate to densely (highly) populated areas of the city. That is, the spatial variation in volume of sewage in the city reflects the population distribution pattern. Areas of high population density (high population concentration) exhibits high rate of sewage generation as reflected in Tables 1, 2 and 4. These areas of high population density contribute over 35% of the total volume of domestic sewage generated in Port Harcourt. Specifically, these areas include Diobu areas, Rumuodamaya – Rukpokwu, Eneka, Elioizu, Rumuodara and Elimgbu; and the Mile IV, Rumuokwuta, Rumuola, Nkpolu – Rumuigbo and Rumuokoro axis. Others are the Choba – Ozuoba and Elioparanwo bloc and Rumuobiakani – Rumuogba – Woji area. During the period under review, eight million,

two hundred and forty thousand (8,240,000.00) litres of sewage were generated and evacuated in the city, while 824 trips were made by the various sewage disposal trucks. This translate into 2,746,666.67 litres per week and 392, 380.985 litres of sewage per day, and 275 trips by week or about 40 trips per. From Table 1 above, majority of the respondents [i.e. 1768 (35.32%)] out of the 5005 opined that the areas of Port Harcourt that generates the highest volume of sewage are the high population density areas (i.e. locations 2, 5 and 7). From Table 2 above, the areas of high population density records the highest volume of sewage evacuated in Port Harcourt.

**Splash Points of Sewage Disposal Activities in Port Harcourt:** There are several illegal sewage disposal points within and around Port Harcourt. Some sewage disposal companies discharge their wastes indiscriminately mostly in the night into main drains along the high ways or into low lands and water bodies. These criminal activities go on uncheck and no one knows exactly the number of such points. However, there are few well-established or known disposal points. These were the ones visited. The operations in these areas are carried out daily both day and night. They are however, not approved by government. From Table 3, majority of the residents of the various areas testified that the sewage evacuated from their areas are never treated and are merely dump into nearby water bodies, burrow-pits and wet-lands. There are three primary areas of sewage disposal activities.

**Functional Reasons for the Rise in Domestic Sewage Generation in Port Harcourt:** The principal factor responsible for the increase in sewage generation in Port Harcourt is

upsurge in the city’s population. There is high influx of people into the city for certain reasons on a daily basis;

1. This increase in the city’s population has a multiplier effect – increase in the demand and consumption of food, etc.
2. Increase in population has led to increase in laundry and restaurant businesses which also generate sewage. This is further explained by the respondents as shown in the Table 5 below.

biogas. If there is adequate technology, perhaps there would hardly been any disposal point; also a lot of jobs would be created.

5. It can cause serious economic loss and wastages. Pollution of water bodies can lead to the dead and extinction of Flora and Fauna. Again, clean-up of polluted site such as rivers and creeks involved lots of money, time and expertise.
6. The challenge of poor supervision and coordination of disposal activities.

**Table 3. Possible Sewage Disposal Points**

Zones	Possible Disposal Points
1.	Creeks at Iwofe, Mgbuosimini& Eagle Island
2.	Creeks at Iwofe, Mgbuosimini& Eagle Island
3.	Burrow-pits, swamps, creeks
4.	Woji creek, Igbo-Etche Burrow-pits
5.	Water bodies around Choba, Iwofe, Rumuokparali
6.	Iwofe&Mgbuodohia creeks
7.	Iwofe&Amadi Creeks, Igbo-Etche Burrow-pits
8.	Amadi Creek and others
9.	Amadi Creek and several others
10.	Amadi Creek and several others

Source: Authors’ Field Work, 2017-2018

**Table 4. Main Sewage Disposal Points in Port Harcourt**

S/n	Place Location	GPS Coordinates	Approximate daily no. of trucks (Mon – Sat) Seen Discharging Wastes
1.	Back of IAUE off Eagle Cement Rd,Rumuolumeni	4° 48 <sup>1</sup> 6.4 <sup>0</sup> N and 6° 56 <sup>1</sup> 23.29 <sup>0</sup> E	45trucks counted(6am – 6pm)
2.	Amadi-Ama Area, into the Creek Igbo– Etche Area(into burrow-pit)	4° 47 <sup>1</sup> 50.5 <sup>0</sup> N and 7° 1 <sup>1</sup> 22.28 <sup>0</sup> E	31 trucks counted (6am-6pm)
3.		4° 57 <sup>1</sup> 24.22 <sup>0</sup> N and 7° 46 <sup>1</sup> 14 <sup>0</sup> E	34 trucks counted(6am– 6pm)

Source: Authors’ Field Work, 2017-2018

**Table 5. Reasons for the rise in sewage generation in Port Harcourt**

Suggested Causal Factors	Responses from the various zones										Total	%
	1	2	3	4	5	6	7	8	9	10		
1.Upsurge in city’s population	200	240	290	213	201	189	268	171	200	158	2130	42.56
2.Increase in food consumption	58	51	57	65	60	61	60	100	47	42	601	12.01
3.Rise in laundry and restaurants business	21	24	19	30	14	18	14	19	37	11	207	4.14
4.Lack of treatment before evacuation	100	135	201	98	120	91	122	100	190	104	1261	25.18
5.Lack of adequate technology to process and convert waste	51	111	43	35	62	100	95	73	75	68	713	14.25
6.Others	15	6	5	4	9	10	9	13	10	12	93	1.86
Grand Total	445	567	615	445	466	469	568	476	559	395	5005	100

Source: Authors’ Field Work, 2017-2018

**Social Problems Associated with Increase in Sewage Generation in Port Harcourt**

The main social challenges that are associated with rise in volume of sewage include:

1. Increase in population brings about increase in the quantity of food people demand and consume. Prompting increase in the use of sanitary facilities. This often forced septic tanks/sucker-ways to be filled-up easily thus, begging for urgent evacuation.
2. The problem of poor treatment and easily evacuating sewage without littering the environment; emission of offensive odours and discomfort on residents.
3. The vehicles and implements used for evacuations are near obsolete and often breakdown due to poor maintenance and high cost of spare parks.
4. The lack of adequate technology to process and convert this waste into resource like organic fertilizer and

7. The challenge of where exactly to dispose the wastes in environmentally friendly manner.
8. The rising cases of pollution of air, water, soil and food crops.
9. The challenge of where exactly to dispose these wastes?
10. Spread of water-related diseases and associated rising profile of deaths arising from waterborne diseases.
11. Spread of water-related diseases and associated rising profile of death cum the rising cost of managing waste disposal activities especially sewage, is affecting the finances of both the Rivers State Waste Management Authority (RIWAMA) and Obio/Akpor and Port Harcourt City Council Authorities (Obalga and Phalga

**Environmental and Health Effects of Indiscriminate Sewage Disposal Activities in Port Harcourt**

1. It leads to contamination and pollution of water, soil and food crops.

2. It causes offensive and irritating environmental foul odours which cause discomfort and sometimes respiratory disorders on residents
3. It causes serious health risks and sudden deaths through the spread of pathogenic organisms.
4. It can cause serious environmental degradation and depletion. That is, prolonged disposal in a place can cause the dead and extinction of certain species of fishes, sea animals and plants; and cause the environment to be useless.
5. Apart from promoting the growth and spread of pathogens which affect both man, fish and animals, the disposal of untreated sewage into the environment causes serious ecological damages such as eutrophication in water, reduction in dissolved oxygen due to over population of organisms; increase in phosphates and other chemical substances from soaps and detergents which are toxic to many fishes and animals including man.

environmental benefits can help to reduce unemployment and crime rate.

### Contributions of the Study

Apart from contributing to knowledge by adding to the volume of literature on urban environmental problems, this study has helped in providing baseline data on the subject matter in Port Harcourt. It shall also helped to inform, educate/enlighten and alert the residents of the various segments of Port Harcourt on the sharp rise in sewage generation and the consequences on the environment and health of the people and on the income of municipal authorities.

### Conclusion

The current spate of urban crises across the developing countries especially urban centres in Nigeria, call for urgent intervention by the various stakeholders – the government, the people, the academia, the organized private sector, professional bodies, and right groups. Although, there is spatial variation in the magnitude of occurrence of these crises across Nigeria, they are easily noticed or perceived in most urban centres. These crises include rising urban population, and shortage of basic amenities; housing inadequacies and increase in the development and spread of informal settlements (slums, ghettos); increase in urban noise; poorly planned physical layouts;rural-urban drift, shortage in social amenities, security challenges and increase in crime rate, poor drainage system and urban flooding increase in waste generation and environmental pollution. Of all these issues, urban environmental management crisis seem to be the most perturbing and frustrating challenge of contemporary African urban centres.

As in most African cities and urban centres experiencing population explosions, increase in rates of sewage generation in Port Harcourt is associated with rise in the city's population. The areas with high population concentration (density) generate more waste and sewage than the less populous areas of the city. Also, there are several illegal sewage disposal sites in Port Harcourt. There is also poor coordination and supervision of disposal activities. The indiscriminate disposal of domestic sewage into the environment (mostly into water bodies and open spaces) is causing lots of social and environmental problems such as offensive foul odours, eye sores, contamination and pollution of food crops and water resources with pathogens which causes the outbreak and spread of diseases/illness and sudden deaths. Curbing this social menace is the responsibility of all concerned. The best time to act is now!

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### Suggestions on how to curb the Menace

In order to foster and sustain a clean, safe and healthy urban environment so as to prevent urban environmental management crisis in Port Harcourt and other urban centres, both the government and the people need to be proactive and resolute in all attempts to protect, conserve or preserve the environment. Municipal authorities in Africa (especially those agencies charged with the responsibility of managing the environment) must rise up and face the contemporary realities in our urban centres. Government must be sincere and willing to demonstrate the right political will and energy to drive the sector. The following suggestions may help us:

- a) To reduce the high volume of sewage arising from increase in population, measures aimed at discouraging rural-urban drift should be adopted including improvement of the quality of life at the rural regions.
- b) Enactment and implementation of enabling laws to regulate the sector.
- c) Ensuring proper supervision and coordination of sewage disposal activities.
- d) Government's designation of certain secluded places for the disposal of properly treated sewage, with strict compliance to laid down rules.
- e) Arrest and prosecution of defaulters, including severe punishment.
- f) In order to accelerate decomposition process, and also to reduce the effects of foul odours, growth of pathogens and pollution of water, soil and food crops, bio-clean septic granules should be adopted and applied right into the sucker-way through the toilets and kitchen flush – systems. This is the most suitable environment friendly method to adopt.
- g) A special agency should be set-up to handle issues of solid wastes and sewage/sludge management rather than handling it under general environmental sanitation.
- h) Government and the organized private sector should help to establish special farms (e.g. greenbelts, rubber plantations, etc.) where the effluents from sucker-ways/septic tanks and designated disposal points, could be pumped out or connected to the farms to serve as fertilizer because of its high nitrates and phosphates contents. These farms apart from their direct

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