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MANAGING FLOOD DISASTERS IN NIGERIA THROUGH PHYSICAL PLANNING APPROACH

Kingsley C. Ogboi, Samson Fadare,
Lekwa Ezutah and Catherine E. Uloko

Abstract

With the current challenges of climate change many cities are experiencing consistent annual flooding, causing huge damages and losses. This paper highlights the role of physical planning in the prevention and management of flood disasters in Nigeria. It explores the institutional arrangements for flood management, planning measures that have been undertaken to reduce flood risks, and possible ways to enhance the application of physical planning in flood risks reduction and management. Although the potency of physical planning in mitigating flood risks is well recognized, its effectiveness is often reduced by some impediments. Lack of plans and poor enforcement make disaster preparedness, response and recovery inadequate, hence resilience and sustainability is weak. This is not unconnected to the fact that there are inadequate policies to support and guide development in that direction. These missing pieces within the physical planning strategies bedevil its efficacy in flood management. It suggests that physical planning can become an effective tool for reducing urban flood risks if the DRR framework is properly integrated into it. This requires reorientation of the existing planning framework to place planning at the centre of flood reduction and management. Effective application of planning in flood disaster management requires the promotion of inclusion of disaster mitigation measures in all settlement planning. It can be comprehensive, integrating both preventive (preparation of plans) and curative measures (recovery), covering such measure as relocating existing developments or directing new developments away from hazard locations and preserving the natural environment. There is need for Nigerian cities to have clear policies and guidelines to promote resilient urban development.

Keywords: disasters, flood, hazards, planning, resilience

1.0 Introduction

Policy options and overall framework that prescribe how disasters should be handled globally have gone through a series of evolutionary stages. Today, a number policy frameworks exist to attest to the fact that governments have made concerted efforts to reduce the catastrophic effects of disasters on citizens. Most developing countries have recorded disasters in terms of number, scale and trend especially in the last two decades. In response to

this problem, the world has developed a number of policies and frameworks for disaster risk reduction and management. Being a member of the global community and a signatory to these frameworks, Nigeria developed series of mechanisms for disaster risk management including review of the National Urban Development Policy periodically to incorporate and domesticate whatever new approaches and tools are introduced at the global level (Federal Ministry

of Lands, Housing and Urban Development, 2012). This is to set the country on the same page with the rest of the global community and ensure sustainable urban development in the country.

In Nigeria, over 50% of the population live in urban areas with the expectation of better quality of life. These urban centres have experienced various types of shock and stress arising from disasters. The various disasters in urban areas include flooding, fire inferno, landslide, diseases and building collapse with physical, social, environmental and health implications. These types of disaster have created serious devastation on urban areas of Nigeria, claiming a lot of lives and destroying properties annually. The responses from the government of Nigeria over the years have been reactionary. In order to manage the stresses and shocks arising from these disasters and promote resilience, the Federal Government created the National Emergency Management Agency (NEMA) and Ministry of Humanitarian Affairs, Disaster Management and Social Responsibility with a view to addressing the challenges of persons and communities negatively affected by natural and man-made disasters. The ministry and agency are expected to be responsible for the management of settlement stress and shock through systematic observation and analysis of disasters to improve measures relating to prevention, mitigation, prepared-

ness, emergency response and recovery. This will allow for better targeting of the people in the areas perceived of being at risk for purposes of early warning and response.,

The main type of disaster in Nigeria is flooding. Flooding has a high recurrent frequency, approximately every 10 years (UN-Habitat, 2013). As recorded by UN-Water (2011) flood has caused about half of disasters worldwide, and 84% disaster deaths in the world. A number of studies have been carried out in the urban areas in Nigeria and they linked the flood problems to poor or lack of planning (Aderogba, 2012; Enaruvbe and Yesuf, 2012; Nkwunonwo, 2016). As the country is experiencing a growing rate of urbanization, it means that the urban areas will experience population increase at a higher rate for the next decade. As the population increases, this increases the risks of man-made urban disasters and the number of potentially affected lives through such disasters. The growing population is adding pressure on the available infrastructure in the cities. These areas are also experiencing uncontrolled physical development and emergence of slums and squatter settlements along with associated social problems such as crime and diseases. With the current challenges of climate change many of the cities are experiencing consistent annual flooding, submerging several houses and valuables. This has given more reasons for disaster preparedness and urban resilience.

It is therefore necessary for Nigerian cities to be resilient and to develop sustainably to accommodate the imminent population growth and urban disaster risk. Researches show the importance of land use planning as a tool for flood risks reduction and urban resilience enhancement (Bloch, 2013; Sarah, 2015). Some studies were done on African cities (Satterthwaite, 2016). Manda (2014) and they provide an insight into how urban planning can lead to reduction of flood risks. But not many researches have been done on Nigeria to determine how much it can reduce flood risks. This paper therefore, highlights the role of physical planning in the prevention and management of flood disasters in Nigeria. It explores the institutional arrangements in planning for floods, planning measures that have been undertaken to reduce flood risks, and possible ways to enhance the application of physical planning in flood risks reduction and management.

2.0 Methodology

This study is based on data collection from secondary data. The data were collected through desktop review of literature and from agencies involved in disaster risk management in Nigeria. These include recorded flood width, depth, frequency and durations for cities and towns in Southern Nigeria as well as extant interventions by the various agencies. Others are the policies and laws on DRM in Nigeria.

3.0 Overview of Relevant Global Policy Frameworks

In response to the challenge of disasters, the world met severally between 1994 and 2015 to discuss how to strengthen the sustainability of development by managing disasters and climate risks. The outcome of these gatherings are the Yokohama Strategy and Plan of Action for a Safer World in 1994 (UNISDR, 1994); the Hyogo Framework for Action, 2005-2015 (UNISDR, 2005); and the Sendai Framework for Disaster Risk Reduction, 2015-2030 (UNISDR, 2015b).

The Sendai Framework for Disaster Risk Reduction (2015-2030) was a major agreement of the post-2015 development agenda, with seven targets and four priorities for action. It was endorsed by the UN General assembly following the 2015 Third UN World conference on Disaster Risk Reduction (WCDRR). It is a call for action in the next fifteen years to make the world a safer place and reduce the risk of natural and man-made disasters.

Specifically the seven targets of the Sendai Framework are as follows:

- a. Substantial reduction in disaster mortality
- b. Reduction in the number of affected people
- c. Reduction in direct economic losses
- d. Reduction in damage to critical infrastructure and disruption of basic services.
- e. Enhancement of cooperation in developing cities

- f. Substantial increase in the national and local disaster risk reduction strategies by 2020
- g. Increase in multi-hazard early warning systems, disaster information and assessments.

The four priorities are as follows:

- (1) Understanding disaster risk
- (2) Strengthening disaster risk governance to manage disaster risk
- (3) Invest in disaster risk reduction for resilience.
- (4) Enhance disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

This framework therefore, is a call that emphasizes disaster prevention and reduction. It also supports the climate change agenda and Sustainable Development Goals (SDG). Before the Sendai Framework were the Yokohama Strategy and Plan of Action for a Safer World in 1994 and the Hyogo Framework for Action 2005-2015. They were designed specifically to achieve substantial reduction of disaster risks and losses in lives, livelihoods and health. It emphasizes preventing new and emerging risks and reducing existing risks. The 2030 Agenda on Sustainable Development on the other hand is a commitment to eradicate poverty and achieve sustainable development globally by 2030, ensuring that no one is left behind (O'Connor and Bouye, 2019).

Adopted in 2015, it has seventeen goals and Goal number 11 seeks to make cities inclusive, safe, resilient and sustainable, with the number of people living within cities projected to rise to 5 billion people by 2030. It declares that it is important to see to the efficiency of urban planning and management practices so that cities can cope with the challenges brought by urbanization.

One of the greatest challenges of urbanization is climate change and for this the world met in Paris in 2015 to discuss the possible ways to reduce global greenhouse gas emission. The Paris agreement addressed the issues of mitigation, adaptation and finance for greenhouse-gas emissions. The Goal of the Paris agreement is to reduce the global average temperature to the pre-industrial levels. Sustainable Development Goal (SDG) number thirteen (13) also advocates for actions to tackle climate change and its impacts.

The African Union (AU) also came up with the Agenda which aims at a peaceful, integrated and prosperous African continent by 2063 (African Union, 2013). Agenda 2063 seeks to meet the commitments of African nations on the SDGs, climate change and disaster risk reduction. Goal number 7 of the Agenda 2063 is on pursuing environmentally sustainable and climate resilient economies and communities. It also adopted the Africa Programme of Action (PoA) for Disaster Risk Reduction.

Similarly, the New Urban Agenda (2017) document recognized “ that urban centres worldwide, especially in developing countries, often have characteristics that make them and their inhabitants especially vulnerable to the adverse impacts of climate change and other natural and human made hazards(Section 64 of the Quito Implementation Plan for the New Urban Agenda). In section 65, the Agenda committed itself to facilitating the sustainable management of natural resources in cities and human settlements in a manner that protects and improves the urban ecosystem and environmental service; and promote disaster risk reduction and management, by supporting the development of disaster risk reduction strategies and periodic assessment of disaster risks caused by natural and human made hazards, including standards for risk levels.

The concept of resilience has emerged recently to reinforce cities' capacity to withstand disasters. Resilience is the capacity to recover quickly from difficulties or adjust easily to undesirable changes. The World Bank Group (2015) conceives resilience as the capacity of individuals, communities, institutions, businesses and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience. It is the ability of a system, community or society exposed to hazards to resist, absorb, accommodate and recover from the effects of the hazard in a timely and

efficient manner, including through the preservation and restoration of its essential basic structures and functions. Urban resilience is the ability of any urban system, with its residents, to maintain continuity through all shocks and stresses, while positively adapting and transforming towards sustainability. Therefore, a resilient city is one that assesses, plans and acts to prepare for and respond to hazards. It is a positive concept that cities strive to attain and the key to any successful resilience and sustainability is planning. Some experiences and projects on urban resilience recognised the relevance of physical planning in urban disaster risk management (ActionAid, 2016; ICLEI, 2018; Strutz, 2018; World Bank Group, 2017)

4.0 Flood Disasters in Nigeria

In the last few decades, Nigeria has witnessed a plethora of disasters including fire inferno, epidemics, oil spillage, flooding etc). Among these forms of disaster, floods have become the most common in the country. Nigeria has experienced series of flood disasters in the past five decades and the trends and intensity as well as the effects are increasing. Flooding manifests in urban areas with poor drainage, and settlements located in low-lying flood plains and river banks. Figure 1 shows the extreme flood zones in Nigeria indicating that flooding is associated with the river basin systems in the country. The most affected are the settlements along the

major rivers in the country such as the Niger, Benue, Cross River, Ebonyi and Imo rivers etc. By their locations, they are highly vulnerable to flooding. Studies also showed that the flooding arises from intensive rainfall particularly in the Southern part of the country (Aderogba, 2012; National Emergency Management Agency, NEMA, 2013; Atedhor, Odjugo and Uriri, 2011).

Action Aid (2006) identified four types of urban flooding as follows:

- (a) Localized flooding- occurring severally in a year due to no drainage or blocked drains
- (b) Small streams in urban areas rise quickly after heavy rain, but often pass through small culverts under roads
- (c) Major rivers flowing through urban areas and overflowing the banks
- (d) Raining season flooding in coastal cities and lowland appearing as flood plains

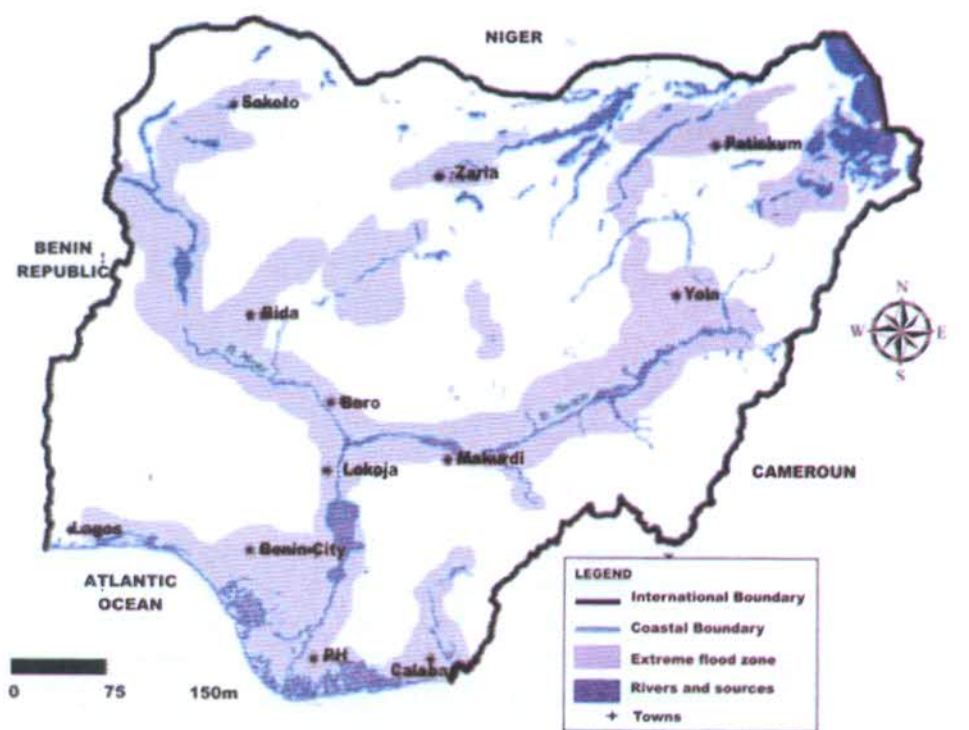


Figure 1: Spatial Distribution of Areas Affected by Extreme Floods in Nigeria in 2012

Source: Nkwunonwo (2016)

Table 1 shows the observed flood width, depth, frequency and durations for some cities and towns in Southern Nigeria in 2012 as provided by Aderogba (2012). Among the cities, Lagos had the highest values of 747.00m for mean width, 11.88m for depth/height and 10 times for frequency of occurrence per annum and 25 days for flood duration. This is followed by Ibadan with values of 521.45m for mean width, 9.20m for depth/height, 3 times for frequency of occurrence per annum and 7 days for flood duration. This indicates that most Nigerian cities are prone to flood occurrences.

Table 2: Observed flood width, depth, frequency and durations for cities and towns in Southern Nigeria

| Location | Mean Width (meters) | Highest Experienced Height (meters) | Mean Frequency (Per Annum) | Mean Longest Durations (days) |
|---------------|---------------------|-------------------------------------|----------------------------|-------------------------------|
| Asaba | 125.00 | 7.88 | 6 | 10 |
| Abeokuta | 115.05 | 7.32 | 6 | 8 |
| Aba | 235.00 | 7.54 | 5 | 15 |
| Ibadan | 521.45 | 9.20 | 3 | 7 |
| Owerri | 124.04 | 8.21 | 5 | 7 |
| Warri | 221.25 | 7.28 | 6 | 16 |
| Benin City | 198.00 | 8.90 | 8 | 12 |
| Enugu | 147.72 | 7.35 | 5 | 6 |
| Lagos | 747.00 | 11.88 | 10 | 25 |
| Port-Harcourt | 121.21 | 8.12 | 4 | 18 |
| Ondo | 124.75 | 7.80 | 8 | 11 |
| Ogbomosho | 118.00 | 9.55 | 3 | 12 |
| Osogbo | 111.00 | 9.73 | 8 | 13 |
| Onitsha | 128.00 | 7.65 | 4 | 4 |
| Calabar | 213.00 | 7.53 | 8 | 11 |

Source: Aderogba (2012).

Floods affect the urban population in various ways with some negative impacts such as temporary displacement of people from their homes, loss of farmland and agricultural products, damage to homes and businesses in the natural flood plains of rivers or where water flow is clogged due to poor drainage. The most devastating experience was the 2012 floods. In 2012, the

country experienced the worst flood disaster in 40 years with the economic losses amounting to an approximated N2.5trillion. NEMA (2013) reported that the 2012 floods that wreaked havoc on many parts of Nigeria between August and December affected over 7 million people, displaced about 2.3 million people, killed 363 persons and destroyed/damaged 597,476 houses

in 34 states, 256 Local Government Areas and 3,870 communities across the country.

According to NEMA (2013), the damages cut across personal property, public infrastructure and private businesses/ enterprises. Affected personal property include furniture, bed, houses, roofs, walls, fences and books. Public infrastructure and facilities damaged include school buildings, electricity poles, hospitals and roads. Many businesses were shut down. The total value of physical and durable assets destroyed by the 2012 floods in the country was estimated to be about N1.48 trillion, or its equivalent of US\$9.5 billion (NEMA, 2013). The total value of losses across all sectors of the economy was estimated at N1.1 trillion, equivalent to US\$7.3 billion. The combined value of the damages and losses was N2.6 trillion or US\$16.9 billion. The total impact on real GDP growth was estimated at 1.4 percent (N570 billion, in nominal terms).

In 2015 floods affected 11 states in Nigeria, with 100,420 people displaced and 53 people dead. In 2016, no fewer than 100 people died and 9,000 houses were completely destroyed. In 2017, 27 states were affected and 90 people died. In 2018, windstorm wrecked havoc on 321 houses and rendered 5,000 people homeless in North and South Ukelle in Yala Local Government Area of Cross River State. Also in 2018, some 363 people were reported killed, while 2.1million people were displaced and a loss of over 7million

worth of farmland products were destroyed in 30 out of the 36 states of the federation.

The cities and towns on the bank of River Niger and Benue are the most vulnerable as they lie in the flood plains. Urban flooding in Nigeria is attributed to overflowing of river banks, topography and poor infiltration, poor drainage network/ connectivity, building on water channels, dumping of wastes, climatic variability and sometimes the release of water from Ladgo Dam in Cameroun (NEMA, 2013). Floods are also caused by changes in land use and waterways; urbanization, concretization of streets and constriction of natural river channels. Particularly in the urban areas flooding is attributed to high intensity of rainfall, lack of sufficient drainage provision, illegal and unplanned developments, poor awareness of residents as well as dumping of refuse and solid wastes in open channel drainage systems (Odufuwa, 2012). It is therefore an issue that needs a comprehensive plan to manage.

Some of the impacts of climate-induced flooding on the built environment in Nigeria as identified by Akeh and Mshelia (2016) are:

- a. Erosion of urban beaches and inundation of coastal lands which affect adversely coastal communities as well as the cost of managing the problem.
- b. Increase in surface runoffs in the urban areas as more buildings, roads, infra-

structure and other paved areas are provided in the built environment leading to very large volumes of surface water that have overwhelmed the capacity of existing drainage systems.

- c. Destruction of buildings and other infrastructures in urban areas due to heavy rains and flooding.
- d. Water pollution and damage to sewers and sewage system leading to disease outbreak and contamination.
- e. Inadequate water supply for urban residents arising from the contamination and pollution.
- f. Cities and parts of cities not planned or developed without mitigation measures are becoming high risk areas and vulnerable for people who live.
- g. Many urban residents are forced to evacuate their homes as a result of excessive flooding and damage to their houses, thus resulting in huge financial pressure on government in coping with humanitarian services and emergencies.
- h. Cities without organized space for evacuation during emergency such as slums often experience disasters.
- i. Shortage of facilities including water and high burden on available ones in areas less vulnerable to floods.

- j. impact negatively on various urban land uses including recreational, industrial and agricultural land.

5.0 Extant Interventions by Cities and the Government

Nigeria has formulated some policies and laws as well as domesticated the global frameworks for disaster management. The major law formulated for the management of disasters is the Act establishing the National Emergency Management Agency called the National Emergency Management Agency Act of 2007. In addition to the NEMA Act are various policy documents which include the following:

- i) The National Disaster Management Framework
- ii) Search and Rescue and Epidemic Evacuation Plan
- ii) The National Contingency Plan for Nigeria
- iv) Lake Nyos Disaster Response Plan
- v) National Disaster Response Plan
- vi) Armed Forces of Nigeria Pandemic Contingency Plan
- vii) Military Assistance to Civil Authorities Disaster Contingency Plan.
- viii) National Urban Development Policy which has witnessed reviews in 2012 and 2019.

People affected by floods have tried in various ways to mitigate the impact and these include raising house foundation, use of sand bags and construction of temporary

bridges. The Government has also adopted some measures to mitigate the impact of flooding. The measures taken by the State and Local Governments include: jingles to inform people living along floodplains to relocate in order to avert being affected, relocation of residents affected by flood to safer areas as a temporary measure to cushion the hardship they were exposed to as a result of the flood disaster.

Over the years, the Federal Government has taken various steps to combat the challenges of flood disasters. Specifically, the government and other stakeholders have been active in the following areas:

- (1) Establishment of institutional framework coordinated by National Emergency Management Agencies (NEMA).
- (2) Using the media to send out early warning signals to communities that are vulnerable to flood disasters.
- (3) Formulation of a disaster response plans.
- (4) Setting up and supporting Disaster Management Centre in Universities to conduct researches. Six federal universities in the country (in each geo-political zone) have disaster management centres.
- (5) Collaboration among various agencies and stakeholders, for example in 2012, NEMA worked actively with federal and state agencies such as Nigeria Police, Nigerian Air

force, NIMET, Nigeria Security and Civil Defense Corps, Red Cross, and State Ministries.

- (6) Humanitarian services through provision of relief materials.
- (7) The Federal Government launched Nig. SAT II whose principal function is to monitor and inform appropriate authorities of impending disasters.
- (8) Creation of temporary camps to accommodate internally displaced persons.
- (9) Conduct of studies on city vulnerability and preparation of urban resilience and sustainability plans, for example the urban resilience and sustainability plans for Asaba and Makurdi in 2019 by the Federal Ministry of Works and Housing (Federal Ministry of Works and Housing 2020a, 2020b).

6.0 Physical Planning and Flood Disaster Risk Management

Some studies have shown that physical planning is a viable tool for flood risks reduction (Ran and Nedovic-Budic, 2016; Amoako, 2016; WMO and GWP, 2007). A study by Manda (2014) in particular assessed the effectiveness of physical planning in reducing urban disasters. Meanwhile, some scholars observed that physical planning as a tool for mitigating flood risks can have some limitations. Gondwe, Manda and Kamlomo (2017) noted that land use planning failed to eliminate flood risk thus it continues

to affect some cities. This is because planning framework has not been fully integrated into the flood risk management approach in such cities (Ran and Nedovic-Budic, 2016).

However, Land use planning regulates the physical space and provide guides to future activities (Ran and Nedovic-Budic, 2016). It has the potential to reduce the exposure of people to hazards in their living environments (Galderisi and Menoni, 2015, Amoako, 2016) by allocating specific spaces to specific uses. Physical planning is increasingly becoming an indispensable tool for disaster reduction and management, because it presents a veritable opportunity to facilitate and regulate the use of space through which the impact, exposure and destruction caused by natural hazards and human-induced threats can be minimized. Globally, planners collaborate with other stakeholders to provide multi-stakeholder participation in the DRR mechanism leading to coordination, analysis and advice on areas of priority among a multiplicity of organizations and individuals working at various levels of governance.

Flooding is often created and exacerbated by human activities such as the provision of riverside infrastructure (dams, and lands) (Olanrewaju and Fadairo, 2003); and by poor development practice including flood plain and riverside development, encroachment into waterways and dredging which may cause changes in the hydrological

balance of water-ways involved (Nolan and Marron, 1995). It through planning that such developments can be controlled to avoid the adverse effects.

For example, the Indian government, realizing the critical role of urban planning in disaster management, commissioned in 2012 the preparation of a toolkit for Urban Planning for Disaster Risk Reduction (UPDRR) and for building resilient cities with special reference to earthquake, landslide, floods and tsunamis (National Institute of Disaster Management, 2012). The report was put together by a multidisciplinary team consisting of, among others, regional planners, urban planners, structural engineers, social scientists and economists; and it became a very important step in the direction of safe and secured urban communities and resilient cities in India.

The key roles of urban planning in DRR as identified by the report are as follows:

- a. Assessment of urban settlements to know their level of resilience.
- b. Preparation of urban development sustainability and resilience plans, and supervision of the implementation of the plans.

Through the assessment, the level of vulnerability is determined and development plans can be produced to foster resilience. Physical planning ensures also the following:

1. Citizen and civic society participation at all levels so

- that awareness and buy-in is created on decisions taken and plans made, and their rationale.
2. Protection of ecosystem by ensuring robust and well-organized green spaces which serve as urban flood water capture.
 3. Application and enforcement of realistic risk compliant building regulations and land use planning principles.
 4. Identification of safe land for low income citizens and up-grading of informal settlements.
 5. Transportation land use plan is comprehensive to take care of a drainage system that is properly aligned with the relief and topography.
 6. Industrial land use is properly planned to ensure that technological disasters are avoided by their proper location at a safe distance from areas of population concentration.
 7. Developing agricultural and recreational land uses in area that are otherwise prone to disaster. With such alternative land uses the disaster prone areas become useful places. Green belts creation is also a land use planning tool for converting disaster prone areas to useful land.
 8. Zoning to ensure that dense settlement and infrastructure are not located in flood disaster prone zones.
 9. Proper building plan approval to ensure that areas disaster prone are avoided.
 10. Disaster preparedness plan including early warning system and quick response
 11. Building a database that includes information on the following:
 - a) Mapping to determine the extent and location of flooded or flood prone-areas.
 - b) Depth and duration of flood.
 - c) Velocity of water flow.
 - d) Frequency and timing of occurrence.
 - e) Rainfall volumes and intensities.
 - f) Natural and man-made obstructions to flows and flood-control structures. Historical records of frequency, locate characteristics and impact of past events.
 - g) Meteorological data, rainfall records and monitoring.
 - h) Topographic mapping & height contouring around coast lines, river systems and catchment areas, geomorphological mapping and sequential inundation stages mapping. Pati et al (2014) suggested flood hazard zonation mapping and planning of the watershed
 - I) Estimates of capacity of hydrological system and catchment areas.

7.0 Weaknesses to Physical Planning in Flood Disasters Prevention

Ran and Nedovic-Budic (2016) observed that although the potency of land use planning in mitigating flood risks is well recognized, its effectiveness can be reduced by some impediments. The New Urban Agenda and the SDG number 11 advocate for the development of resilient cities and communities. However the plethora of flood disasters in Nigeria since 2012 has left physical planning overwhelmed with more problems than solutions. The biggest challenge in Nigeria is that physical planning is at its lowest ebb with most settlements lacking physical plans. This hampers the role of physical planning in preventing the menace of flood disasters in the country. There is no functional institutional framework that links planning to disaster risk reduction and management. Emergency management agencies have not fully engaged physical planning tools in their emergency planning stage, thus their responses usually fall short of the global best practices.

In few cities where master plans exist, the implementation agencies have very poor staffing, thus implementation is difficult. This has given rise to abuse of land uses in the towns and cities; and to some extent responsible for the vulnerabilities of residents. The cities have a complete absence of well-developed comprehensive approach to disaster mitigation. There is no proper integration and coordination among the agencies involved in managing

disasters. The lack of physical planning and poor enforcement makes disaster preparedness, response and recovery inadequate, hence resilience and sustainability is weak.

Some cities that have plans are characterized by some degrees of land-use zoning and development of new urban layout designs, but DRR principles are highly deficient in such plans and designs. Such increasing urban spatial expansion and new physical development projects without DRR principles, are compounding the challenges, thus there is no promotion of resilience in the cities. This might not be unconnected to the fact that there is no existing policy to support and guide development in that direction. These missing pieces within the land use planning strategies bedevil its efficacy in flood management. Therefore, the cities and their key stakeholders have a long way to go in terms of measuring up with global best practices in urban resilience and sustainability

On the other hand the existing practise of DRM is encumbered by the following challenges:

1. Inability of government and other critical stakeholders to fully comply with the policy frameworks
2. Poor implementation of the National Emergency Response Plan.
3. Poor intergovernmental co-ordination and collaboration.
4. Other related issues such as dearth of rescue equipment.
5. Poor record keeping which

leads to poor execution or recovery.

6. Poor management of Internally Displace Persons (IDP) camps and secondary displacement of pupils from schools used as IDP camps.

These weaknesses in Nigeria affect performance (Essoh, and Abutu, 2018), thus lead to recurrence and accumulation of flood risks.

8.0 Strengthening Physical Planning in Flood Disasters Reduction and Management

Physical planning, construction and building codes are part of the preventive package for disaster management (Gencer, 2013). It is suggested that physical planning can become an effective tool for reducing urban flood risks if the DRR framework is properly integrated into it (Gondwe, Manda and Kamlomo, 2017). This requires reorientation of the existing planning framework so that planning will be at the centre of flood reduction and management. For Nigeria, lesson can be learnt from the Indian design. The scenario in Nigeria may show some peculiarity, but with regards to physical planning involvement in DRR, the approaches can be flexible to fit into the situation. It can be comprehensive, integrating both preventive (preparation of plans) and curative measures (recovery), covering such measure as relocating existing developments or directing new developments away from known hazard locations, maintaining features of the natural environment (open space management).

To ensure effective disaster reduction and management, physical planning must be at the forefront. The key planning tools and measures should include the following:

1. Preparing urban Master Plans that integrate disaster management plans and strategies
2. Revising the Master Plans where available to build in DRM and DRR strategies
3. Regularizing and planning informal settlements based on DRR principles and concepts
4. Developing local plan to tackle hazards at local level, and creating comprehensive residential layouts fully serviced with infrastructure
5. Addressing the hazards in floodplains through relocation of the inhabitants and evacuation land uses and activities at the bank of river.
6. Creation of drainage infrastructure along the roads and maintaining existing drainages.
7. Use of modern facilities and improved institutional capacity particularly spatial planning and GIS, and risk information systems on flood hazards and a mechanism for early warning.

There is need for cities to have clear policies and guidelines for practitioners to promote a more resilient urban development.

9. Conclusion

The response of Nigeria to disaster issues, especially flooding which has become a perennial occurrence since 2012 is rather inadequate because the government reacts to such issues by carrying out curative strategies (such as the designation of public schools as areas accommodate IDPs and relief materials). There is indeed the need for a more proactive approach to disaster management in Nigeria. This paper calls for a paradigm shift. A shift from over-concentration of critical resources on curative measures to preventive measures. Urban planning is basically a preventive measure and it can go a long way in improving the resilience of settlements. It can also reduce the vulnerability of the urban communities. The role of urban planning in ensuring a drastic reduction in the effects of disaster on settlements can therefore not be underestimated.

Effective application of urban planning in flood disaster management requires the promotion of inclusion of disaster mitigation measures in all settlement planning. Urban planning requires annual assessments of disaster risks and management by all levels of government; strengthening the capacity of existing planning agencies at all levels, communities and the private sector for prevention, preparedness, response and recovery activities of disaster management and ensuring that building code

mitigation measures are fully complied with during project implementation.

References

- Action Aid, (2006). Climate change, urban flooding and the rights of the urban poor in Africa: Key findings from six African cities. *A Report of ActionAid International*, October.
- ActionAid, (2016). *Strengthening Urban Resilience in African Cities: Understanding and Addressing Urban Risk*. ActionAid.
- Aderogba, K.A. (2012). Qualitative studies of recent flood and sustainable growth and development of cities and towns in Nigeria. *International Journal of Academic Research in Economics and Management Science*, 1(3), 1-25.
- African Union (2013) Agenda 2063: The Africa We Want. <https://au.int/en/agenda2063/overview> accessed on 7 September
- Akeh, G.I. & Mshelia A.D. (2016) Climate Change and Urban Flooding: Implications for Nigeria's Built Environment. *MOJ Ecology & Environmental Science* 1 (1) : 00003.DOI:10.15406/mojes.2016.01.00003
- Amoako, C. (2016). Brutal presence or convenient absence. The role of the state in politics of flooding in informal Accra,

- Ghana. *Geoforum*, 77, 5-16.
<http://journals.sagepub.com/doi/abs/10.1177/0042098016686526>
- Atedhor, G.O., Odjugo, P.A. & Uriri, A. (2011). Changing rainfall and anthropogenic-induced flooding: Impacts and adaptation strategies in Benin City, Nigeria. *Journal of Geography and Regional Planning*, 4(1), 42-52.
- Bloch, R., (2013). Integrating Flood Risk Management and Land Use Planning. *ICLEI FORUM*, Bonn
- Enaruvbe G.O. & Yesuf G.U. (2012) Spatial Analysis of Flood Disaster in Delta State, Nigeria, *Ifè Research Publications in Geography*. 11(1), 52-58.
- Essoh, G.E. & Abutu, P.O. (2018). Managing National Emergencies in Nigeria: Prospects and Challenges. *Journal of Good Governance and Sustainable Development in Africa* (JGGSDA) 4(1). Accessed on 18-06-2019 from <http://www.rcmss.com/index.php/ijpamr;www.academix.org>.
- Federal Government of Nigeria (2013) *NIGERIA - Post-Disaster Needs Assessment: 2012 Floods*. Abuja: National Emergency Management Agency/World Bank, June.
- Federal Ministry of Lands, Housing and Urban Development (2012). *National Urban Development Policy*. Abuja. (Federal Ministry of Works and Housing 2020a, 2020b).
- Galderisi, A & Menoni, S.(2015) Improving the role of land use planning for reducing existing and future risks. *The State of DRR at Local Level. A 2015 report on patterns of disaster risk reduction actions at local level*. International Institute of Social Studies. ISS Working paperseries/ General series, Vol. 619, pp. 1-25
- Gencer, E.A (2013). The interplay between urban development, vulnerability and risk management. A case study of the Istanbul Metropolitan Area. *Springer Briefs in Environment, Security, Development and Peace*.
- Gondwe, J., Manda, M. & Kamlomo, D. (2017). Discriminatory land use planning and flood risk management in Karonga Town, Malawi. *Journal of Human Sciences*, 14(4), 3343- 3355. doi:10.14687/jhs.v14i4.4706
- ICLEI, (2018). *Resilient Cities Report 2018: Tracking Local Progress on the Resilience Targets ofSDG 11*. ICLEI World Secreteriat, Resilient Cities Team. Bonn: ICLEI.
- Manda, M. (2014). 'Where there is no local government: addressing disaster risk reduction in a small town in Malawi,' *Environment and Urbanisation*, 26(2), 586-599.
- National Institute of Disaster Management (2012) *Toolkit for Urban Planning in Disaster*

- Management*. New Delhi: DDF Consultants Pvt. Ltd.
- Nigerian Emergency Management Agency (NEMA), (2013). *Nigeria Post-Disaster Needs Assessment, 2012 Floods*. National Emergency Management Agency. Abuja: Government Press.
- Nkwunonwo, U.C. (2016) A Review of Flooding and Flood Risk Reduction in Nigeria. *Global Journal of Human – Social Science: B Geography, Environmental Science and Disaster Management*, 16 (2) 22–42.
- Nolan, B. & Maron, R. (1995). History, Causes and significance of changes in the Channel geometry of Redwood Creek, North western California, 1936 to 1982. United States Geological Survey Professional, Paper 1454N, USA.
- O'Connor, D. & Bouye, M. (2019). Synergies between the 2030 Agenda and Paris Agreement: an Overview. *Climate and SDGs Synergy Conference* 1-3 April in Copenhagen, available online at www.UNDESA.org. 18-06-2019
- Odufuwa, B., Adedeji, O.H., Oladesu, J.O. & Bongwa, A. (2012) Floods of Fury in Nigerian Cities *Journal of Sustainable Development*; Vol. 5, No. 7; 69-78
- Olanrewaju, D. & Fadairo, G. (2003). Flooding as an induced environmental problem: A case study of Ala River in Akure, Nigeria. *Journal of Nigerian Institute of Town Planners*, XVI, 85-96.
- UNISDR, (1994). Yokohama Strategy and Plan of Action for a Safer World: Guidelines for Natural Disaster Prevention, Preparedness and Mitigation. World Conference on Natural Disaster Reduction, Yokohama, Japan. 23-27, May, 1994.
- UNISDR. (2005) *Hyogo Framework for Action 2005-2015: Building Resilience of Nations and Communities to Disasters*. Retrieved on 9th August 2010 from www.unisdr.org.
- UNISDR. (2015a). *Assessment Report on Main streaming and Implementing Disaster Risk Reduction Measures in Nigeria* retrieved from www.Uneca.org on 17-06-2019
- UNISDR, (2015b). *Sendai Framework for Disaster Risk Reduction 2015-2030*. Geneva: Switzerland www.unisdr.org
- UNISDR, (2015c). *Making Development Sustainable: The future of Disaster Risk Management. Global Assessment Report on Disaster Risk Reduction*. Geneva: Switzerland: United Nations Office for Disaster Risks Reduction (UNISDR).
- Pati, R.C., Franco D.T., Alcantara,

- A.J., Pacardo E.P. & Resurreccion, A.N. (2014) Vulnerability to Flooding of the Towns of Mabitac and Santa Maria, Laguna, Philippines. *Journal of Environmental Science and Management*, 17(2): 17-28
- Ran, J. & Nedovic-Budic, Z. (2016). Integrating spatial planning and flood risk management. A new conceptual framework spatially integrating policy infrastructure. *Computers, Environment and Urban Systems*, 57, 68-79.
- Sarah, A. (2015). Urban Flood Response Planning: Building Urban Resilience in Calgary and Toronto. Paper 1774.
- Satterthwaite, D. (2016). Background Paper: Small and intermediate urban centres in sub-Saharan Africa. *Urban ARK Working Paper No 6*, IIED, London.
- Strutz, B. (2018). With a Green Makeover, Philadelphia is Tackling Its Stormwater Problem. Retrieved from Yale Environment 360: <https://e360.yale.edu/features/with-a-green-makeover-philadelphia-tackles-its-stormwater-problem>
- UN Water, (2010). Climate Change Adaptation: The Pivotal Role of Water. *Policy Brief*. Retrieved October, 20, 2011, from http://www.unwater.org/downloads/unw_ccpol_web.pdf
- World Bank Group, (2015). *City Strength Diagnostic: Methodological Guidebook*. Washington, D.C.: World Bank. Retrieved from <https://openknowledge.worldbank.org/handle/10986/22470?locale-attribute=fr>
- World Bank Group, (2017). *Enhancing Urban Resilience in the Greater Accra Metropolitan Area*. Washington DC: World Bank Group.
- WMO & GWP, (2007). The role of land use planning in flood management: A tool for integrated flood management associated programme for flood management, document No. 12, Version 1.

**DISABILITY AND ACCESSIBLE INFRASTRUCTURE
IN URBAN PUBLIC INSTITUTIONS:
A PERSPECTIVE ON STUDENTS
OF BENUE STATE UNIVERSITY, MAKURDI**

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Abstract

Recent studies have advocated the need for all-inclusive designs to ensure that urban infrastructure, facilities and services are accessible to all because of the realization that the focus of the built environment is hinged on inclusive design. Social exclusion of people with disabilities in public institutions such as schools cannot be overemphasized. Benue State University, Makurdi, has a significant population of students with disabilities who consequently experience peculiar challenges. Availability of facilities accessible to these special students has not been explored. Therefore, this study examines the availability and accessibility of facilities to students with disabilities in Benue State University. Twenty seven (27) students were identified and classified under 8 major disability categories to determine the peculiarity and occurrence of specific disability types in the institution. Their perception on accessibility of facilities, associated challenges faced and adaptability measures were sought through focus group discussions and questionnaire administration using purposive sampling method. A simplified Disabled Access Audit (DDA) was done using the DDA checklist to ascertain availability of accessible facilities. The study revealed that while efforts at providing accessible infrastructure and facilities were evident, a lot more had to be put in place to meet the needs of disabled students in compliance with standards such as the DDA checklist requirements. It was recommended that with due consideration to recently adopted Disability laws, key areas within the institution be reviewed for re-modification to better accommodate people with disabilities while sensitization and awareness campaigns can also be organized to enlighten the university community on disability and inclusiveness.

Key words: Disability, Accessibility, infrastructure, Access Audit, Benue State University,

1.0 Introduction

A balanced city is one whose attention is sensitive to the needs of every individual irrespective of age, gender, medical limitations, socio-economic status and cultural values, while integrating the servicing of these needs into a sustainably cohesive system. Due to the

undeniable realization that “the focus of the built environment lies at the heart of inclusive design” (Knight & Bichard, 2011, 2), 20th century planners in their numerous works and research have increasingly advocated the need for all-inclusive planning designs to ensure that urban infrastructure,

facilities and services are accessible to all.

People living with one form of disability or the other constitute 15% of the world's population (World Health Organization, 2011, 29), which is indicative that disability exerts a significant global presence since no single urban area in the world can stand out as not having a substantial percentage of its population living with disability. This, as noted by Nyamweno and Ayonga (2009, 9), sees people with disability suffering from physical, economic and social exclusion with the most cases experienced in developing countries. Given that they constitute a great proportion of the poor, Venter et al (2002, 28) further point out that it is critical that specific measures be taken to reduce the societal discrimination and isolation that persons with disabilities continue to face if internationally agreed targets on reducing poverty are to be reached.

Social exclusion of people with disabilities in public institutions such as schools cannot be over-emphasized. So is the consequent short and long-term effects it has on them. This precipitates the need for public awareness and studies that pay attention to their needs and seek effective ways of including and integrating their needs into urban society. Benue State University, Makurdi as a public institution is no exception from having a significant population of people, especially

students living with disabilities and the challenges they face in adapting to normal lifestyles given their handicaps. These challenges are further compounded by inadequate interrogation into how they cope, what attempts have been made towards ensuring that their needs have been considerably catered for, in the provision of facilities and infrastructure; and ensuring an equitably convenient and safe environment, devoid of discrimination. It is on this premise that this paper sought to examine the institutional availability and accessibility of facilities to students with disabilities, using Benue State University, Makurdi as a case study.

2.0 Literature Review

Disability has been defined in comparative terms and up till 1980, the term "handicap" was used. However for the sake of distinction, three classifications of deficiency, handicap and disability were outlined. Deficiency was defined as any loss in the body or functions of a person physically and mentally. Disability was defined as any restrictions in activities done by normal people meanwhile, handicap is related to privations a person experiences as a result of disorders and disabilities. Therefore, handicap reflects one's adaptation and interaction towards his/her environment (Mahmoudi & Fanaei, 2010, 1217).

The World Health Organization (WHO) defined disability as any

restriction or lack (resulting from impairment) of ability to perform and activity in the manner or within the range considered normal for a human being (Mahmoudi & Fanaei, 2010, 1217). Disability as an evolving concept results from the interaction between persons with impairments and attitudinal environmental barriers that hinder full and effective participation in society on an equal basis with others (Nyamweno & Ayonga, 2009, 4; United Nations, 2006). Venter *et al* (2002, 4) further averred that disability is both a cause and consequence of poverty. In developing countries, where discriminatory social attitudes persist and welfare safety nets frequently underperform, people with disabilities are overwhelmingly poor.

The Cambridge Dictionary (2019) defined infrastructure generally, as the basic systems and services, such as transport and power supplies, that a country or organization uses in order to work effectively. It also defined the term 'facility' as a place, especially including buildings, where a particular activity happens. Merriam-Webster Dictionary (2019) further defined infrastructure as resources such as personnel, buildings or equipment required for an activity. It also defines facility to be something that makes an action, operation or course of conduct easier - usually used in plural.

Accessibility can be viewed in terms of the simplicity to which a product, service or property is conveniently available and reasonably usable to an individual. This generally cuts across a wide scope of reference. Nyamweno and Ayonga (2009, 4) put it as the ease and convenience with which a property can be entered by customers, tenants and other users. This puts more emphasis on access via automobile. They go further to include building design and modifications that enable people with physical disabilities to enter and move within the building.

Accessibility is often used to focus on people with disabilities and their right of access to entities, often through the use of assistive technology. Some definitions refer to access-based individual rights, laws and regulations. Products or services designed to meet these regulations are often termed 'Easy Access' or 'Accessible' (Disabled World, 2019). Furthermore, accessibility goes beyond its reference to facilities and amenities to assist people with disabilities or 'wheelchair accessible', to include braille signage, wheelchair ramps, elevators, audio signals at pedestrian crossings, walkway contours and website design (Disabled World, 2019).

One important strategy for measuring accessibility level is the Access Audit, Disability Discrimination Act Audit also known as the

Disabled Access Audit. This is an assessment of a building, an environment or a service against best-practices to benchmark its accessibility to disabled people (Jones, 2016). It is an important tool to identify barriers and can help to improve accessibility for people with disabilities and the basis for an access improvement plan or strategy (National Disability Authority, 2014). An audit is carried out for several reasons such as legislation and to gather data on buildings for comparison analysis. It is carried out to check compliance with certain standards and regulations, company policy on equal opportunities and enhances public relations/company image. It also promotes conservation by use of historic buildings. In carrying out an access audit, the following features will be identified:

1. the current accessibility of the building/property/site;
2. areas for improvement (e.g. no accessible car spaces in the car park or inaccessible water closets as a result of incorrect location of the ground floor)
3. Good/bad practice in relation to facilities management that an organization has in place;
4. Positive accessibility features such as counter loop at reception, good use of lighting and colour throughout, building, signage (National Disability Authority, 2014).

3.0 The Study Area

The area for this study is Benue State University, Makurdi. Benue State University was established by the Benue State Government Edict No.1 of 1991 and academic activities commenced during the 1992/1993 session with four faculties. The University occupies an area of about 6km² and it is bounded by the Benue River to the North, the Benue State University Teaching Hospital to the east, Makurdi-Gboko road to the south and farmland that stretches to Benue Links Park to the west (figure 1). The University consists of the eastern and western campuses (Gyuse et al, 2017, 10). Benue State University presently consists of 8 faculties and 30 departments.



Figure 1: Google Imagery of Benue State University
Source: Google Map (2019)

4.0 Methodology

The number of undergraduate and postgraduate students in each department for the 2018/2019 session was obtained by research assistants to ascertain the total student population. Each class/ level in every department was visited to check for students with disabilities, identified and recorded. Students with disabilities were subsequently identified to form the target frame. Focus group discussions were held due to the controlled size of the target population (27 in number, which constituted the total population of disabled students discovered at the time of gathering the data) and the peculiarity/sensitive nature of information required from them. All the 27 students were administered questionnaire to get information about their perception on availability of public infrastructure and strategies adopted to cope with the challenges faced in the environment.

Other sources of information included the University Information Unit, the ICT directorate, and departmental and faculty offices to confirm the population of students including those with disabilities as at the time of the research. This was to ensure that as many students with disabilities as possible were captured by the research assistants. However, most departments had no proper records of students with disabilities. The study relied on the manual class-by-class census of students with disabilities in each department.

A simplified Disabled Access Audit (DDA audit) checklist was applied in the areas of circulation, street furniture, transportation, parking, special building and recreational facilities. This was used to determine the extent to which facilities and infrastructure had been made accessible to students with disabilities within the institution.

This was done by observing and documenting what facilities were available in each department. Presentation of data was descriptive and inferential.

5.0 Finding from Study

As at the time of the study, registration process for newly admitted students and returning

students was still on-going so the student population based on information from the departments retrieved by research assistants and the ICT directorate was estimated at 25,000. Out of this estimated population, 27 students were identified to have various forms of disability within and across the various departments (see table 1).

Table 1: Categories of Students with Disabilities by Department in Benue State University

| S/No | Code | Condition | Male | Female | Department |
|------|-------|--------------------------|------|--------|-----------------------------|
| 1 | UL | Upper limb disabled | 1 | 0 | History |
| 2 | LLD | Lower Limb disabled | 2 | 0 | Urban and Regional Planning |
| | | | 2 | 0 | Law |
| | | | 1 | 0 | Mathematics and Computer |
| | | | 1 | 0 | Sociology |
| | | | 1 | 1 | Language and Linguistic |
| | | | 1 | 0 | Economics |
| | | | 0 | 1 | Educational Foundations |
| 3 | AL | Albinism | 0 | 1 | Sociology |
| | | | 0 | 1 | Religion and Philosophy |
| | | | 1 | 0 | Psychology |
| 4 | PA | Paraplegic | 1 | 0 | Educational Foundations |
| | | | 1 | 0 | Curriculum and Teaching |
| 5 | HD | Hearing impaired | 1 | 0 | English |
| | | | 1 | 0 | History |
| 6 | VI | Visually impaired | 0 | 1 | Urban and Regional Planning |
| | | | 1 | 0 | Law |
| | | | 1 | 0 | Sociology |
| | | | 1 | 0 | Medicine and Surgery |
| | | | 3 | 0 | Language and Linguistic |
| 7 | PD | Psychological disability | 1 | 0 | Chemistry, |
| | | | 1 | 0 | Urban and Regional Planning |
| | Total | | 22 | 5 | |

The nature of disabilities identified within this population was classified under 8 major categories, with students that have lower limb disabilities and visual impairments constituting the highest number (figure 2). Students with either upper or lower limb disabilities included amputees and deformities while the visual and hearing disabilities included both partially and fully blind and deaf students.

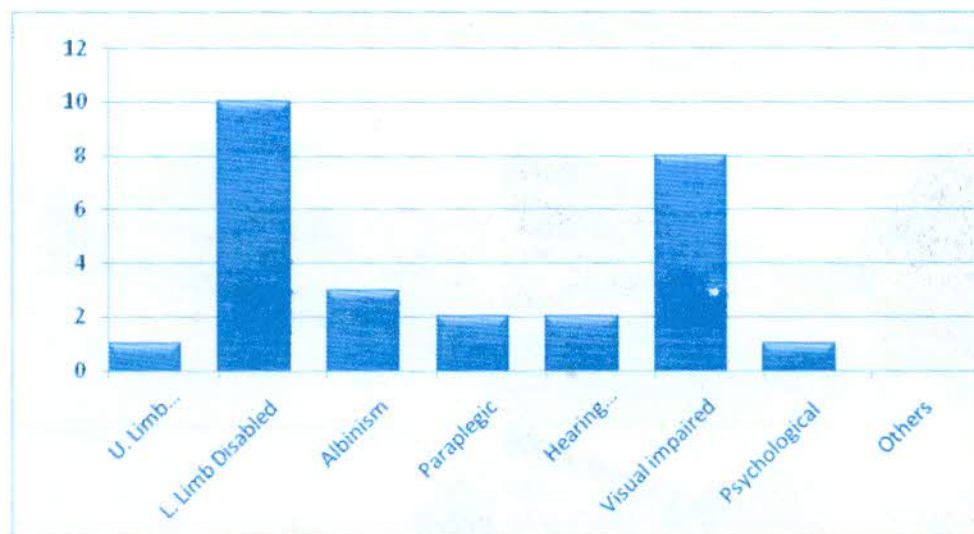


Figure 2: Occurrence of Disabilities within Benue State University by Categories

Source: Author's field study (2019)

5.1 Students' Perception on Accessibility of facilities and infrastructure and Adaptability

Responses from the students during the interviews indicated a considerable inadequacy of accessible facilities and infrastructure within the university, which are agreeably inadequate or absent in some instances. Further interrogation revealed the challenges faced as a result of such inadequacies. The responses were further grouped into students with visual impairment and albinism in one group and lower limb-disabled and Paraplegics in the other. This was because these two sub-groups evidently faced the most challenges out of the 8 categories and shared similar experiences in their challenges.

The Visually Impaired and Albinism-related disabilities - Students with visual impairment were fairly satisfied with the brightness of the lighting within the classrooms but felt the lighting situation could be improved upon in terms of brighter bulbs or more lighting points and quicker response to maintenance (replacement of dead bulbs and repair of lighting points). This would reduce the situation of poorly lit rooms especially at night, which

results in their eyes being strained especially when they needed to read. Students with albinism-related visual problems also reported the same challenge but were more affected by outdoor exposure to the sun's brightness and intensity as well. The sun's rays left visibly unpleasant sunburns on their skin which they felt embarrassed about. This was compounded by the inadequacy of trees with shade at strategic locations such as being lined up along both sides of the streets and or pedestrian walkways especially along the route from the western to the eastern campus which is the longest pedestrian stretch among others (Plate 1).

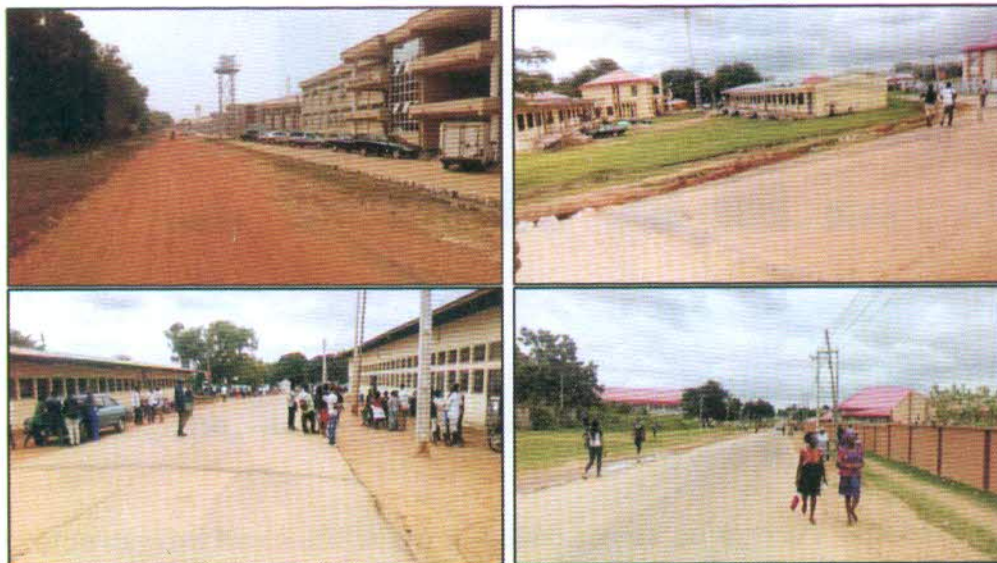


Plate 1: Lack of shaded trees for pedestrians along several major routes

Source: Author's field survey (2019)

The Lower limb disabled and Paraplegics - Students with lower limb deformities/ disabilities had a lot of challenges especially that of smooth mobility along pedestrian routes, which for most parts of the campus were either not clearly defined or totally absent and as such were forced to walk along vehicular paths or along grassy routes. They also complained about difficulty in mobility such as not being able to move quickly enough to attend lectures on time especially when exiting a lecture to meet up another in the other campus. They faced more serious vulnerability by getting least attention in cases of rapid evacuations to safety during emergency scenarios such as fires and crises.

When asked to enumerate their challenges, respondents who particularly used wheelchairs or crutches (lower limb deformities, amputees and paraplegics) first expressed difficulty gaining access to or using public convenience facilities. The facilities were either not available or where

available, they were locked permanently or undergoing repair or were not in usable condition. But obviously, they were found to be very small and not conducive enough for these students to comfortably navigate and relieve themselves (Plate 2).



Plate 2: Convenience facilities not accessible or convenient for disabled users

Source: Author's field survey (2019)

Secondly they had challenges of mobility in terms of easily transiting from the eastern to the western campus and vice versa via transit vehicles due to the added inconvenience of their wheelchairs or crutches, thus, leaving them with the dilemma of having to wheel themselves manually to their destinations (often under extreme weather conditions). It was gathered that the inter-campus buses that transport students between the two campuses have ceased operations for over a year. Even basic tasks such as getting easy access to classrooms or some offices using a wheelchair was quite daunting due to physical barriers such as steep steps and the absence of a wheel ramp into such classrooms (Plate 3).



Plate 3: Wheelchair left at the base of steps due to steepness of steps

Source: Author's field study (2019)

5.3 Effects and Adaptive Strategies of Students with Disabilities

Visually impaired students reported that they use corrective eye glasses or sun shades to protect their vision, while the students with Albinism also take extra measures by avoiding exposure to sunlight for long periods and use umbrellas when they can. Students with lower limb disabilities and paraplegics, in the instance of absence of convenience facilities or not being within proximate reach, are propelled to find 'convenient', private and secure spots within nearby bushes or open spaces to defecate or urinate. Because of the nature of their dependency, they are assisted by friends, classmates or random good Samaritans. While they seek assistance from others, their privacy is sometimes being invaded which creates a feeling of shame and low self-esteem. They desired professionally trained technical assistants at strategic locations and

better designed public convenience facilities that were tailored to accommodate their needs.

Where passages are inaccessible to wheelchair users, friends, classmates or random good Samaritans assist in carrying them to their destinations otherwise, they limit their movement all together except when it is very important or necessary. This ultimately affects their level of productivity as students and puts them at a disadvantage with other students. The resultant effects as mentioned by the respondents include feelings of alienation and depression. When asked to enumerate preferred needs to be provided or improved upon, accessible public convenience was top on the list followed by provision of more special ramps and then provision of adequate natural and artificial shade within and between the two campuses. Improved signage and human assistance were the least in priority (figure 3).

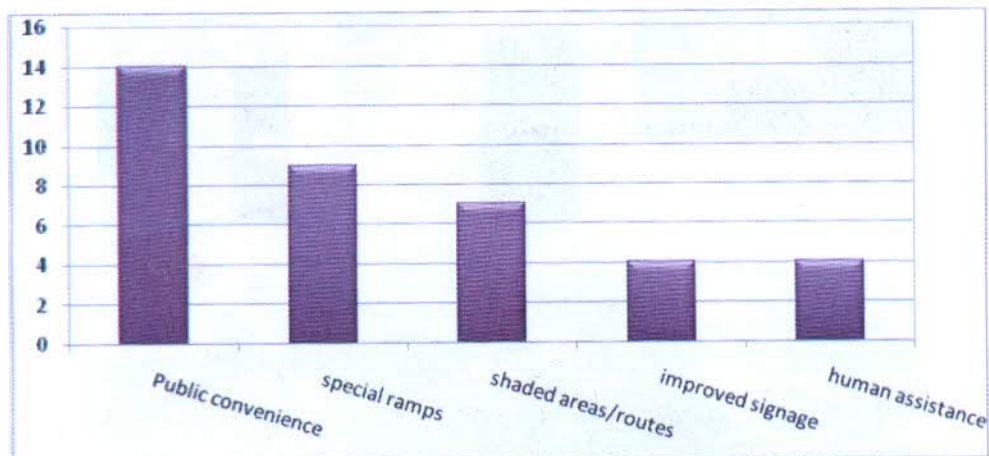


Figure 3: Respondents' Preferred Needs in order of Priority

Source: Author's field study (2019)

In order to determine the institution's level of compliancy with the requirements of a simplified Disabled Access (DDA) audit, a checklist was generated and areas where accessible facilities and infrastructure were identified and noted down to provide a summary checklist. This was applied in the areas of circulation/street furniture, transportation, parking, special buildings and recreational facilities (table 2).

Table 2: Simplified Disabled Access Audit (DDA) checklist of accessible facilities

| | Component | Availability | Remarks / location |
|----------|--|--------------|---|
| 1 | Curriculum / street furniture | | |
| | Special side walk for wheel chair | N / A | |
| | Street signage | N / A | |
| | Pedestrian crossing | IA | |
| 2 | Transportation | | |
| | Vehicle lift for disabled | IA | |
| | Special ramps for wheel chairs | N / A | |
| | Bus stops with special audio/visual aids | N / A | |
| 3 | Parking | | |
| | Special parking area | N / A | |
| | Audio and visual signage/aid | N / A | |
| 4 | Special building facilities | | |
| | Special rail / wheel chair ramp | IA | Law, Urban and Regional Planning, Library, Education Trust Fund block |
| | Special public convenience | | |
| | Modified toilets for disabled persons | | |
| 5 | Recreation / sport facilities | | |
| | Special sporting facilities | N / A | |
| | Special sport activities | N / A | |
| 6 | Others | | |
| | Learning assistive devices | N / A | |
| | Trained assisting personnel | N / A | |
| | Special health services | IA | University Clinic, Psychology department |
| | Natural landscaping elements (vegetation especially sun blocks) | IA | Across the whole campus |

AA – Adequately available, **IA** =Inadequately available, **NA** = Not available

The checklist seemed to validate the result of responses by the students on the status of accessibility within the campus. It showed some level of consideration for students with disabilities in some of the departments such as provision of wheelchair ramps for easy mobility, and shaded corridors as illustrated in Plate 4. However, there was still a substantial evidence of inadequate provision of accessible facilities, infrastructure and services that are sensitive to the needs of students living with disabilities. This had inadvertently driven the students into isolation and spurred them into taking adaptive steps to tackle their challenges.



Plate 4: Accessible facilities (ramp and shaded corridors) in some departments

Source: Author's field work (2019)

6.0 Discussion

It was observed from the findings of the study that the population of students with disabilities compared with the total student population seemed quite insignificant, nonetheless, the presence of these disabled students and future admission of students with disabilities into the university still necessitates the provision of attendant facilities. It also revealed that current facilities or infrastructure in most parts of the institution lack proper design considerations to fully accommodate students with disabilities. This puts negative psychological and sociological pressure on them as they constitute a very small minority. These students sometimes tend to withdraw from social interactions

and activities to avoid stigmatization or alienation. Their small numbers discourage their will to constitute a social network or support group to effectively deal with their common peculiarities. Besides the need to provide accessible infrastructure, disability awareness should be initiated through training workshops by and for the institution. It should be sustained for better sensitization, empathy and to form a habit of inclusion towards people with disabilities as suggested by Shigri (2018).

The study acknowledges the Discrimination against Persons with Disabilities (Prohibition) Act, 2018 which was signed by President Muhammadu Buhari and was meant to focus on social justice for persons with disability. The Act seeks to

criminalize discrimination against persons with disabilities. It directs that all public buildings and structures must be accessible to persons living with disabilities while new plans of public structures shall be scrutinized by relevant authorities to conform to the building code in providing accessible facilities. The Act also ensures considerations for people with disabilities by public transportation service providers to cover seaports, railways and airport facilities. In all situations they are to be given first consideration in queues and emergencies to ensure their safety and protection taking their peculiar vulnerability into consideration. They are also to be provided access to social services such as educational assistive devices, trained personnel and special facilities, rights and privileges to include health care services. All these also come with punishment in the case of contravention (Akinwale, 2019; Iroanusi, 2019).

7.0 Conclusion

The study examined the institutional availability and accessibility of facilities to students with disabilities, using Benue State University, Makurdi as a case study. It is recommended that a DDA audit of the built environment be undertaken as a strategy to improve accessibility and to provide the basis for an access improvement plan or strategy as proposed by the National Disability Authority (NDA, 2014).

This would be useful for the acquisition of data on buildings for comparison or analysis in order to ascertain compliance with specified standards and regulations. The inclusion of this procedure to the process of the already signed Disability bill would add value to the overall exercise and terms governing the bill.

In order to meet the immediate needs of the students within the university, key areas in departments that require architectural modifications can be reviewed to make them more accessible to the disabled. This is to include special wheelchair ramps, better access to convenience facilities and planting of trees for shade at strategic locations. Special assistants could be employed or trained to cater for students with special needs, audio assistive devices and proper signage facilities should be provided. Artificial lighting in classrooms should be improved upon. Sensitization workshops and awareness campaigns should be organized to create awareness of the challenges faced by people with disabilities with the aim of giving them a better sense of inclusion.

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References

- Akinwale, Y. (2019). *Six key things you must know about Disability Act. 2018*, <https://www.icirnigeria.org/six-key-things-you-must-know-about-disability-act-2018/> (Accessed January 24, 2019)
- Cambridge Dictionary (2019). *Infrastructure*, <https://dictionary.cambridge.org/dictionary/english/infrastructure> (Accessed July 13, 2019)
- Disabled World (2019). *Accessibility News and Information*, <https://www.disabled-world.com/disability/accessibility/> (Accessed August 22, 2019)
- Gyuse, T., Alaci, D., Ogwuche, J., Iorliam, S., Mngutyo, I., Kwaghsende, F., Adzande, P., Anule, P., Udoo, V. & Ajene, A. (2017). *Drainage Circulation, Parking and Landscape Plan*. Benue State University, Department of Urban and Regional Planning. Makurdi: Department of Urban and Regional Planning.
- Iroanusi, Q.E. (2019). *Ten things to know about Nigeria's new disability law*, <https://www.premiumtimesng.com/news/headlines/307494-ten-things-to-know-about-nigerias-new-disability-law.html> (Accessed January 23, 2019)
- Jones, E. (2016). *What is Access Audit?*, <https://www.evansjones.co.uk/services/access/access-audits.php> (Accessed July 13, 2019)
- Knight, G., & Bichard, J. (2011). *Publicly Accessible Toilets: An Inclusive Design Guide*. London: Helen Hamlyn Centre for Design, Royal College of Art, Kensington Gore.
- Mahmoudi, A & Fanaei, K. (2010). Revision of Urban Spaces to make it Accessible for Disabled People in order to achieve the aim of "City for All". In Schrenk M. Popovich V.V Zeile P (Ed.), *Real Corp 2010: Cities for Everyone: Liveable, Healthy, Prosperous*, (pp. 1217 - 1222). Vienna.
- Merriam-Webster. (2019). *Infrastructure*, <https://www.merriam-webster.com/dictionary/infrastructure>
- National Disability Authority. (2014). *Guidelines for Access Auditing of the Built Environment*, <http://nda.ie/Resources/Accessibility-toolkit/Make-your-buildings-more-accessible/Guidelines-for-Access-Auditing-of-the-Built-Environment.html> (Accessed July 13, 2019)
- National Population Commission. (2009). *National Population Commission Census Priority Table: Population Distribution by Sex and Class, Size of Household, State and Local Government Area Table*. Abuja: Federal Republic of Nigeria Official Gazette No.2.

- Nyamweno, I. N. & Ayonga, J. N. (2009). Disability and the Built Environment: Innovative Options for Promoting Accessibility in Addis Ababa City. *Journal of African Development Studies*, 2(2), 1 - 17.
- Shigri, N. (2018). *The Importance of Disability Awareness: Home and School*, <https://medium.com/arise-impact/the-importance-of-disability-awareness-home-and-school-ccad2276f349> (Accessed September 23, 2019)
- United Nations. (1994). *Standard Rules on the Equalization of Opportunities for Persons with Disabilities*. Department of Public Information.
- United Nations. (2006). *Convention on the Rights of Persons with Disabilities*, <http://www.un.org/disabilities>. www.ohchr.org (Accessed May 16, 2019)
- Venter, C., Savill, T., Rickert, T., Bogopane, H., Venkatesh, A., Camba, J., Mulikita, N., Khaula, C., Stone, J & Maunder, D. (2002). *Enhanced Accessibility for People with Disabilities Living in Urban Areas: Unpublished Project Report*. United Kingdom: Department for International Development.
- World Health Organization. (2011). *Disabilities and Rehabilitation: World Report on Disability*, http://www.who.int/disabilities/world_report/2011/en/ (Accessed May 9, 2019)

REDUCING ENVIRONMENTAL POLLUTION THROUGH SUSTAINABLE MANAGEMENT OF SINGLE-USE PLASTIC BAGS IN DEVELOPING COUNTRIES

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Abstract

Environmental effect of the use of plastic bags has become a subject of increasing concern in recent decades amongst environmentalists, governments, civil society groups and researchers across the globe. In the developing countries, single-use plastic products particularly bags tend to be the most dominant among plastic products and are being consumed at a high rate, with significant social, economic and environmental impacts. In spite of the fact that its cost of production is low, the poor disposal practices and related environmental costs are resulting in overwhelming challenges. This paper examines the challenge of single-use plastic bag in the developing economies and strategies for its containment. The observed environmental, economic and social impacts of plastic bags include litter, inability to decompose easily, threat to animals and clogging of drainage channels. The paper examined also the policy options for regulation of single-use plastic bags adopted by other countries. Suggested strategies for the countries in line with global best practices are imposing levies and bans, freewill reduction, public-private sector partnership, public awareness campaigns, adoption of affordable environmentally friendly alternatives and enforcement of policy and monitoring.

Keywords: Single-use plastic bags, pollution, regulation, policy, strategies

1.0 Introduction

Environmental concern resulting from the use of plastic bag in recent decades has become a subject of increasing concern amongst environmentalists, governments, individuals, civil society groups and researchers across the global north and south. With about 500 billion to one trillion single-use bags being consumed at the global level annually, plastic bag tends to be one of the most extensively used shopping bags across the universe (Plastic Bag Facts, 2010). Pollution associated with plastic bag use has become an environmental emergency not just in developed nations of the world, but also in developing economies. Plastic bag that are today increasingly used in enormous

quantity and varieties in industries, and by retailers and consumers. The eminence gained by plastic bag is attributed to its low-price, convenience, lightweight and incredible strength, and these characteristics have equally spurred its low cost production by manufacturing companies. Thus, it is perceived as one of the world's greatest industrial inventions and an indispensable facility for packaging, preserving and conveying varied items. Virtually all sectors of the economy make use of plastic bag in one form or the other. Its extensive demand has caused its production globally to explode, thereby outgrowing most products (Geyer *et al.*, 2017).

In spite of the fact that the cost of production tends to be low, the

environmental cost of production, the public social cost and poor disposal practices are resulting in overwhelming challenges. The prevalent use of single-use plastic grocery bags by millions of people arouses substantial environmental concerns long and short term negative impacts to solid waste management, resource consumption and marine environments as well as impacts ensuing from litter. All of these entail huge public resources to manage the environmental impacts, which has been challenging for policy makers and the waste management industry in several nations (AECOM Technical Services, 2010; BIO Intelligence Service, 2011; Synthia, 2014; GEF [Global Environment Facility], 2018). Generally, single-use plastic products particularly bags tend to be the most dominant among plastic products and are being consumed at an alarming rate, with significant social, economic and environmental impacts.

Studies show that while developed countries are making conscious efforts to control the production and use of plastic bags, the situation in the developing countries appears different. In the later the quantity produced and used is rising and an enormous amount of the plastic bags are not properly managed especially where waste management system is inadequate (UNEP [United Nations Environment Programme], 2009). Even with the increasing consciousness in contemporary times on the adverse impact of plastic bags on marine ecosystem and the environment at large, manufacturing

companies are still producing these bags in enormous quantity.

Plastic bags contribute to global and local litter problems that affect living organisms in the marine environment, occupy the much desired landfill space as waste, increase reliance on oil (Chaffee & Yaros, 2007) and degrade the environment in general. In reaction to this phenomenon and in the quest to go green, states and cities of most developing and developed countries have taken proactive steps single-use plastic bag ranging from levy imposition to banning of its use.

Emulating the global trend in containing plastic bags, individuals, civil society groups and non-governmental organisations in such countries have called on the government to take more stringent actions. This is because of the fact that the increasing consumption of single-use plastic bags has become a serious threat to the environment, human and animal lives, and it is placing huge costs to both the national and local governments. However, not much has so far been achieved by some governments and states as the plastic bags continue to litter streets and clog drainage channels, thereby resulting in flooding in towns and cities. Based on the foregoing, adoption of policy initiatives that are in line with best practices in the light of sustainable containment of plastic bags is necessary in the developing countries. This paper therefore, examines the challenge of single-use plastic bag in the developing economies and strategies for its containment.

2.0: Global Production and Management of Plastics

One of human's remarkable industrial inventions in contemporary world is plastic. The word 'plastic' is defined as "a resistant, lightweight, and hygienic synthetic polymer which may be synthesised from biomass raw materials and can be moulded in diverse ways as well as utilised in a wide range of applications" (UNEP, 2018). Plastic generally comprises five key elements: polyethylene terephthalate, polypropylene, polyvinyl chloride, polyethylene, and polystyrene (Andrady & Neal, 2009).

Though the emergence of plastic production could be said to have a long history, dating back to 1600 BC (Hosier *et al.*, 1999), its advent however, since the 1940s has been progressively widespread for consumers and industrial usage. The quantity of plastics produced annually continues to increase greatly, with the amount manufactured in the first epoch of the 21st century approaching the total produced during the entire century preceding. At present, a significant number of plastics are manufactured for various purposes annually (Thompson, *et al.*, 2009; Al-Salem, *et al.*, 2009).

As plastic become an indispensable material to humans' daily activities, its production has risen incredibly over time from 15 million tonnes in 1964 to 381 million tonnes in 2015. Figure 1 shows the global plastic production in the last

56 years, that is, from 1950 to 2015. This growth will continue, with a further doubling in production over the next 20 years (World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, 2016). About half of all plastics produced are essentially fashioned in such a way that they can only be used just once and then discarded. Plastics historically were typically manufactured in the United States and Europe. It has in recent times witnessed a shifted to Asia. The leading producer of plastics now is China with 28 percent of global production in 2015. The rest of Asia, including Japan, produces 21 percent; Latin America, 4 percent; Europe, 18 percent; USA, Canada and Mexico, 18 percent; and Middle East and Africa 7 percent (Plastic Europe, 2016).

Estimates revealed that 95 percent of plastic packaging worldwide is lost per annum after a brief first use, with a value of approximately 110-165 billion dollars (UNEP, 2018; Macintosh, *et al.*, 2018). Before the 1980s virtually all the plastics are lost into the environment. But from 1981 there has been a gradual reduction of the proportion of plastics that is discarded. As presented in table 1 and figure 2 the proportion of the plastics that was discarded into the environment reduced from 98.3 percent in 1981 to 55.0 percent in 2015 while the proportion incinerated increased from 1.7

percent to 25.5 percent respectively. The proportion recycled increased from 0.6 percent in 1988 to 19.5 percent in 2015. Though efforts are being made by some countries to reduce wastes from plastics through recycling and reuse, the quantity of

plastics not properly managed is increasing. Open incineration commonly practised in the developing countries has serious implication on the environment through gas emission into the atmosphere.

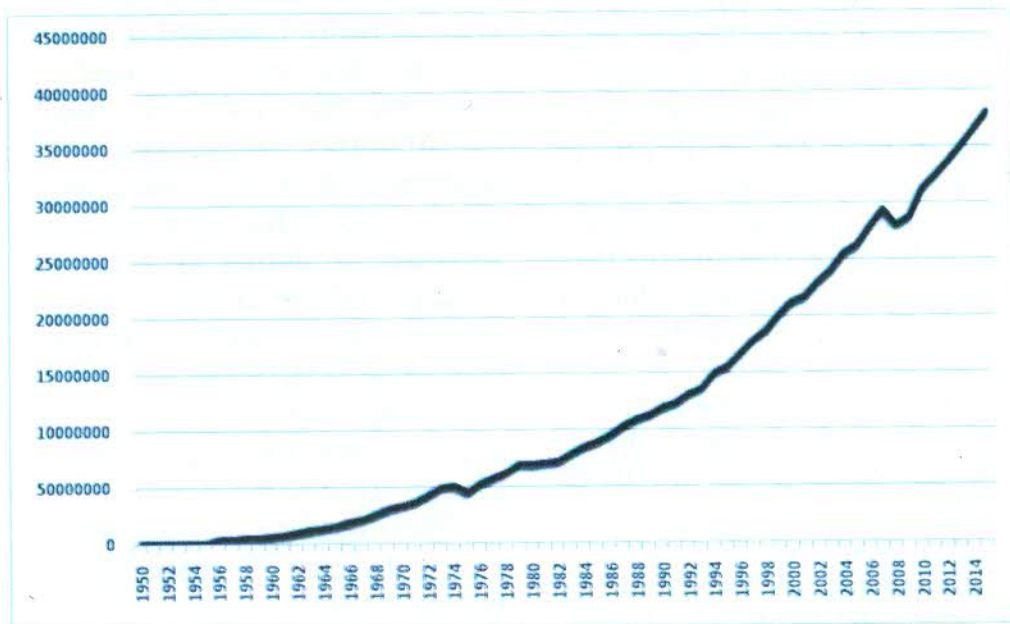


Figure1: Global plastics production (million tonnes) from 1950 to 2015

Table 1: Estimates of the proportion of global plastic waste discarded, recycled and incinerated

| Year | D i s c a r d e d | | | I n c i n e r a t e d | | | R e c y c l e d | | |
|------|-------------------|---|--|-----------------------|---|---|-----------------|---|---|
| 1980 | 0 | | | 0 | | | 0 | | 0 |
| 1981 | 9 | 8 | | 3 | 1 | | 7 | | 0 |
| 1982 | 9 | 7 | | 6 | 2 | | 4 | | 0 |
| 1983 | 9 | 6 | | 9 | 3 | | 1 | | 0 |
| 1984 | 9 | 6 | | 2 | 3 | | 8 | | 0 |
| 1985 | 9 | 5 | | 5 | 4 | | 5 | | 0 |
| 1986 | 9 | 4 | | 8 | 5 | | 2 | | 0 |
| 1987 | 9 | 4 | | 1 | 5 | | 9 | | 0 |
| 1988 | 9 | 2 | | 8 | 6 | | 6 | 0 | 6 |
| 1989 | 9 | 1 | | 4 | 7 | | 3 | 1 | 3 |
| 1990 | 9 | 0 | | 0 | 8 | | 0 | 2 | 0 |
| 1991 | 8 | 8 | | 6 | 8 | | 7 | 2 | 7 |
| 1992 | 8 | 7 | | 2 | 9 | | 4 | 3 | 4 |
| 1993 | 8 | 5 | | 8 | 1 | 0 | 1 | 4 | 1 |
| 1994 | 8 | 4 | | 4 | 1 | 0 | 8 | 4 | 8 |
| 1995 | 8 | 3 | | 0 | 1 | 1 | 5 | 5 | 5 |
| 1996 | 8 | 1 | | 6 | 1 | 2 | 2 | 6 | 2 |
| 1997 | 8 | 0 | | 2 | 1 | 2 | 9 | 6 | 9 |
| 1998 | 7 | 8 | | 8 | 1 | 3 | 6 | 7 | 6 |
| 1999 | 7 | 7 | | 4 | 1 | 4 | 3 | 8 | 5 |
| 2000 | 7 | 6 | | 0 | 1 | 5 | 0 | 9 | 0 |
| 2001 | 7 | 4 | | 6 | 1 | 5 | 7 | 9 | 7 |
| 2002 | 7 | 3 | | 2 | 1 | 6 | 4 | 1 | 4 |
| 2003 | 7 | 1 | | 8 | 1 | 7 | 1 | 1 | 1 |
| 2004 | 7 | 0 | | 4 | 1 | 7 | 8 | 1 | 8 |
| 2005 | 6 | 9 | | 0 | 1 | 8 | 5 | 1 | 5 |
| 2006 | 6 | 7 | | 6 | 1 | 9 | 2 | 1 | 3 |
| 2007 | 6 | 6 | | 2 | 1 | 9 | 9 | 1 | 3 |
| 2008 | 6 | 4 | | 8 | 2 | 0 | 6 | 1 | 4 |
| 2009 | 6 | 3 | | 4 | 2 | 1 | 3 | 1 | 5 |
| 2010 | 6 | 2 | | 0 | 2 | 2 | 0 | 1 | 6 |
| 2011 | 6 | 0 | | 6 | 2 | 2 | 7 | 1 | 6 |
| 2012 | 5 | 9 | | 2 | 2 | 3 | 4 | 1 | 7 |
| 2013 | 5 | 7 | | 8 | 2 | 4 | 1 | 1 | 8 |
| 2014 | 5 | 6 | | 4 | 2 | 4 | 8 | 1 | 8 |
| 2015 | 5 | 5 | | 0 | 2 | 5 | 5 | 1 | 9 |

Source: Geyer et al. (2017)

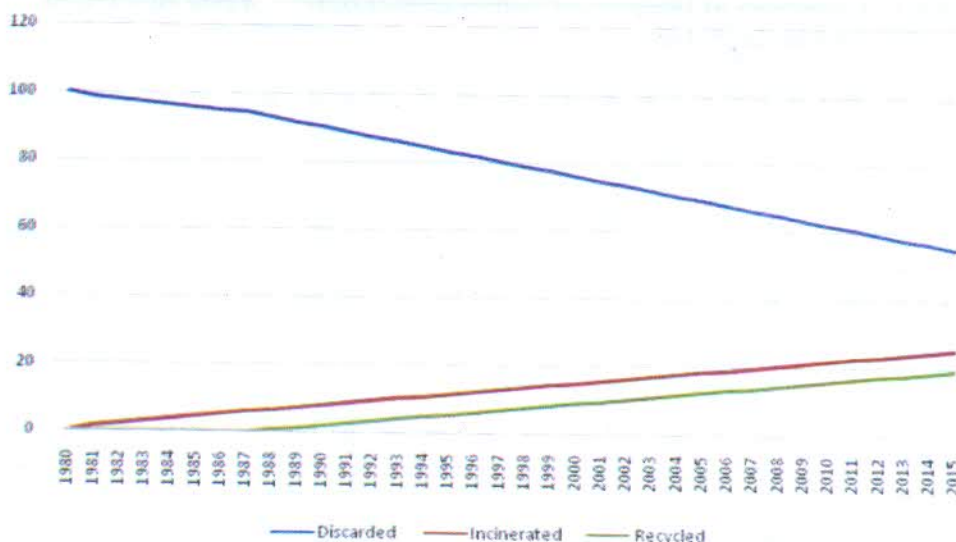


Figure 2: Estimates of the proportion of global plastic waste that is discarded, recycled and incinerated

3.0: The Issue of Single-Use Plastics Bags

According to Ślusarczyk & Kot (2018) as defined by the Directive (EU) 2015/720 of the European Parliament and of the Council “plastic bags shall mean grocery bags, with or without handle, made of plastic, which are supplied to customers at the point of sale of products”. They further asserted that amongst these bags, “it is possible to differentiate light plastic bags (plastic carrier bags of material thicknesses below 50 microns) and very light plastic bags (plastic carrier bags of material thicknesses below 15 microns, which are required for hygienic reasons or offered as basic packaging of food, when it helps prevent food waste)”.

The contribution of plastics to economic growth has been tremendous (Plastic Europe, 2016; UNEP, 2018). Ever since their widespread debut, the manufacture and development of plastics has

stretched dramatically. Its number of applications has equally risen significantly with plastics being used in a number of sectors – medicine, food and water provision, electronics, construction, clothing, household goods and transport (UNEP, 2018). Essentially, their present production pattern and use, on a linear model of 'take, make, use and dispose', have adverse human health impact. Thus, it is a major driver of natural resource depletion, waste generation, climate change and environmental degradation (Geyer *et al.*, 2017).

Due to their strength, low cost and hygienic nature, plastic bags are extensively used in carrying merchandises. In particular single-use grocery bags are popular due to their light weight relative to other types of plastic bags. Table 2 presents the types of plastic grocery bag based on weight as categorized by Ślusarczyk & Kot (2018). The plastic shopping bags consume less water

and energy to manufacture and they also produce less solid waste than paper bags, taking up a lesser amount of space in landfills. Nonetheless, some of those qualities that make them commercially prosperous also add to making them environmentally flawed (when managed badly) and very challenging in terms of recycling (UNEP, 2018). The vast majority of plastic bags used are discarded as wastes often times after a single use.

Table 2: Categories of plastic bags

| Types | Description | Weight (g) |
|------------------------------|---|------------|
| Single-use non-biodegradable | Thin-walled high weight plastic bags usually given out at super shops or retail shops. They are made of high density polythene (HDPE) often used for on shopping trip | 8.6 |
| Single-use biodegradable | Can be totally bio-based, or a starch-polymer blend. They can decompose under certain defined conditions | 8.9 |
| Multiple-use (Reusable) | Are made either from low density polythylene (LDPE) or polypropylene (PP) which is more durable. They are more expensive than single-use bags. | 88.3 |

Source: Ślusarczyk & Kot (2018)

4.0 Environmental, Economic and Social Impacts of Single-Use Plastic Bags

Plastic bags have unarguably brought quite a great number of societal benefits with highest per capita use taking place in developed nations of the world. Regrettably the stride of acceptance in most nations has not been harmonised by an appreciation of the economic, social and environmental damage being caused by inappropriate disposal of plastics (UNEP, 2018). The sturdiness and flexibility of plastic bags are presumed to be their major strength, which also happens to be their prime weakness (Camann, *et al.*, 2010). Essentially, a number of studies have recognised that irrespective of the beneficial impact of plastic bags, they have far-reaching detrimental impact on the environment. The detrimental impacts have been attributed to difficulty in eliminating it given the fact that it is not degradable in nature, but could only be photo-degraded

into smaller fragments. Studies reveal that after entry into the environment, they could take up to 1000 years to degrade and hence they pose a serious disposal challenge (Stevens, 2001; UNEP, 2005; Shaw & Sahni, 2014; Ślusarczyk & Kot, 2018).

It is evident that plastic bags in all its stages of life, from production to disposal, have adverse social and environmental impacts. The environment (air, soil and water) is affected directly in various ways, starting with the extraction and use of fossil fuels during the production process of plastic bags (Spivey, 2003). Another source of environmental pollution is in the incineration of plastic bag wastes. Emissions ensuing from this process are detrimental to the environment and human health. The conveyance of plastic bags from their source to places where they are put into use equally adds considerably to their environmental footprint (Synthia, 2014). Adverse effects are found in

the course of the use and instantaneous disposal of plastic bags, mainly in non-industrialized countries where waste management practices are not well-established. In these nations, plastic bags are usually found to be littered virtually in all places, thereby making the environment unpleasant (Gogte, 2009).

Most plastic bags are fated to stay in landfills or to become litter on the streets as a result of their lightweight and capability to bloat and drift with the wind (Gogte, 2009). In China for instance, the great quantity of plastic grocery bags littering the streets have been locally designated as 'white pollution' (Xing, 2009). Similarly, plastic bags have been christened as 'national flower' in South Africa, due to the fact that they are usually found littering the environment. The Irish on the other hand coined the term "witch's knickers" to describe the windblown plastic bags caught in vegetation (Ritch *et al.*, 2009; Shirley, 2009). Such pollution impacts negatively on the local people's livelihoods in terms of loss of agriculture and tourism potentials (Synthia, 2014). Non-renewable resources such as petroleum is used in their production, thus their breakdown takes more than a thousand years (Jakovcevic, 2014). Used plastic bags contribute to a significant extent to water, air and soil pollution, and all these pose substantial threat to human and animal lives (Zhu, 2006; Njeru, 2006; Ayalon *et al.*, 2009).

Worldwide, the effects of plastics on the environment are projected to cause natural capital losses of 40 billion US dollars

annually. The value of the damages in marine environment was projected to be 13 billion US dollars annually (Turpie, 2019).

Plastic materials in high concentrations, especially plastic shopping bags, have been found obstructing the stomachs and breathing passages of many animal species. In the ocean, plastic bags are mostly captivating to marine wildlife as they look like jellyfish, and are most time singested by fish, seabirds, dolphins, sharks, turtles among others who mistake them for food. The ingested plastic bag usually do not breakdown and can clog the intestinal tract of the animal ingesting it, thereby resulting in starvation or death of the animal. In the case of small animals, the effect is largely as a result of entanglement which may lead to suffocation, most especially when they cannot set themselves free (Department of Water and Environmental Regulation, 2017). There is increasing recognition that the poisonous compounds added during the production process of plastic bags transfer from the consumed plastic into the animals' tissues, ultimately entering the food chain for human beings as well. Studies have revealed the presence of microplastics in table salt as well as in tap and bottled water. Furthermore, plastics have been discovered in human stool and estimation indicates that about 50 percent of the population of the world may possibly be feeding on microplastics (UNEP, 2018a; Schwabl *et al.*, 2018).

In developing countries, the practice of illicit dumping of plastic bags usually occurs in the form of open burning, heightening the

emission of poisonous gases that comprises dioxins and furans. Recent studies have revealed that scattering of plastic bags on the environment can result to perceived 'welfare losses' allied for instance to pictorial disamenity of a park being polluted with litter. This however, escalates the indirect social costs of plastic pollution (UNEP, 2018). With the present situation in developing nations where solid waste management regulations is not well developed, plastic bag litter can exacerbate epidemics. Through the obstruction of drainage systems and making available breeding grounds for mosquitoes and other pests, plastic bags can increase the menace of transmission of vector-borne ailments such as malaria (Clapp & Swanston, 2009).

5.0 Plastic Bag Challenges in the Developing Countries: The Nigerian Case Study

The aforementioned situation is the typical scenario in cities and towns in most developing countries. It is common to find plastic bag litters on streets, lawns and open spaces. As plastic bags become part of the daily life of an average household in the developing countries, concerns at both local and national levels about the impact of plastic bag on human health and the ecosystems in general have been increasing rapidly in recent times. For instance, in Nigeria the rapid growth in population and urbanisation in recent decade have without doubt spurred the consumption of single-use plastic bags. According to GGRN [Going Green Recycling Nigeria] (2014), on an annual basis an estimated 50

billion plastic bags are used for various purposes in Nigeria. With the current trend in urbanisation and change in consumption pattern, the bulk of plastic bags produced and used annually will likely continue to rise over time.

In the 1960s and 1970s in Nigeria, cotton bags, raffia baskets, paper, glass bottles, calabash, terra cotta pots, amongst others were used for conveying and packaging varying forms of merchandise both at home and in marketplaces. But today, these conveyance utilities have disappeared over time almost totally from cities and villages. Plastic bags now serve as a better replacement for the aforementioned for the functions and its use is gaining momentum. The growing plastic bag waste especially from single-use plastic bag being generated in Nigeria in recent years is allied with a paradigm shift in the direction of more organised grocery shopping where market place for consumer products is characterised by well-designed plastic wrappings.

As a results of their hygienic nature, suitability for all purposes, low price, light weight, among other characteristics, the usage of single-use plastic bags by superstores, restaurants and retail shops is on the increase in most cities and towns in the country. The country has witnessed an explosion in the volume of plastic bag used for varying purposes by both large-scale and small-scale retail shopping outlets particularly in the area of packaging and conveyance of purchased products. With rise in income of the populace, the nature of shopping is equally experiencing a shift from roadside hawking and street retail to

department shops and chains of well organised hypermarkets. This phenomenon translates into possible rise in the demand for more plastic bags. This scenario is evident in the number of plastic bags taken home by most consumers who patronise shopping malls such as Shoprite, Games and Gabbs.

With increasing population growth and change in consumer behaviour, the demand for plastic bags will continue to rise without taking into account its accompanying negative impact on the environment. For most consumers, plastic bag tends to be a promising alternative for conveying and packaging varied items. Unfortunately, their use leaves adverse effect on the environment. The over reliance on plastic bags by various individuals with widely different economic and cultural background has a number of environmental challenges such as litters, ocean and river pollution, land degradation, among others.

Although, the proportion occupied by plastic bags as waste and litter streams on the environment may currently not be too enormous in volume, but they tend to have disparate effects on the ecosystem. This phenomenon could be attributed to lack of appropriate waste management infrastructure (Adane & Muleta, 2011). Poor awareness campaign and education, population growth, economic and political instability, amongst other factors have equally worsen the situation in most nations (Ruban, 2012), including Nigeria. As rightly asserted by Turpie, *et al.* (2019) acceleration of production of plastics as well as its

waste in the African sub-region is at present taking its toll on the general public, particularly the under-privileged. They further stated that across Africa, most cities and towns are already witnessing severe and recurrent flooding, which has hampered production and also resulting in heavy casualties, displacement and pandemics. With the effect in terms of drainage channel blockage, envisaging how these challenges will heighten with the expansion of plastic bag waste will not be a difficult task.

A number of cases of flooding resulting from drainage channels being blocked by plastic waste have been reported at various points in time and places in Nigeria. Plastic bags have the ability of clogging watercourses and can also aggravate natural catastrophes. Plate 1 and 2 show plastic wastes blocking urban rivers. For instance, the Ibadan flooding that resulted in the destruction of urban assets and loss of about 2000 lives was attributed to blockage of Ogumpu River channel partly by plastic waste. Similarly, in 1988 poor drainage channels ensuing from plastic bag litter obstructing drains contributed to the overwhelming deluges in Bangladesh, triggering a number of deaths as two-thirds of the nation was inundated (Ritch *et al.*, 2009). Most cities in Africa lack the financial resources to deal with this (Turpie, *et al.*, 2019). This is because the waste management system is still underdeveloped and public awareness about adverse impact of plastic waste is still low. Plastic bags in certain indigenous and peripheral urban settlements in

Nigeria have been adopted for a variety of uses given their waterproof nature, light weight and dependable medium for conveying things. However, these bags are even used for the disposal of faeces by people – a practice that has equally earned it colloquial nicknames like 'bullet', 'shotput' and 'flying toilet' (Ogwo, *et al.*, 2013). These practices contribute to environmental degradation.



Plate 1: Plastic wastes blocking Water Flow in Urban Waterway in Makurdi, Benue State



Plate 2: Plastics blocking Iyiabi River in Asaba, Delta State

6.0 Policy Options Adopted by Some Countries for Plastic Bag Waste Containmentment

Due to the environmental, social and economic effects of plastic bag usage, ranging from litter, inability to decompose within a short time, threat to wildlife to clogging of drainage channels, there is an increasing surge of awareness campaigns and policy initiatives by governments and individual organisations in both the global north and south. Around the world, a substantial number of policy initiatives have been employed at both national and local levels in recent decades in the light of reduction and sustainable use of single-use plastic grocery. The diverse policy instruments adopted by the governments include partial or total ban of plastic bags, use of economic tools such as taxes/levies, public-private agreement and the adoption of a combination of such measures.

Essentially, in Asia, a number of nations have made concerted efforts to regulate the production and use of plastic bags through the imposition of bans and levies. Bangladesh was the first country in Asia to impose a national ban on single-use plastic bags. Other countries that equally banned plastic bags at the national level include Mongolia, Israel, Sri Lanka and Bhutan. Nations that imposed local ban include Myanmar (Mandalay), Pakistan (Punjab, Sindh) and Philippines (Muntinlupa). While those that placed a combination of bans and levies at the local levels include Indonesia (Bandung), Malaysia (Penang State) and China.

In order to attain a sustainable decrease in the volume of single-use plastic bags consumed per capita in Europe by 2025, several nations (such as in Bulgaria, Croatia, Denmark, Estonia, Cyprus, Ireland, Greece and Portugal) have taken drastic actions at the national level. The measures were ban as in the case of France, a combination of levies and bans (in Belgium, Italy and Spain), and public-private agreement (as was adopted in Finland, Germany and Austria). Following the trend, imposition of bans and levies were equally implemented at the local level in some European states like Northern Ireland, Scotland, Wales, Wallonia, etc. Moreover, at the continental level Europe is paying attention to the challenge of management of plastics in its states. In this regard, the European Commission has developed the "European Strategy for Plastics in a Circular Economy" (2018-2030), with regards to reduction of avoidable production of single-use plastic waste (European Commission, 2013; UNEP, 2018).

In both South and Central America, there are also policy actions that have been instituted at the local and national levels by governments with regards to curtailing the consumption of single-use plastic bags. Plastic bag ban were initiated at the national level in countries such as Antigua and Barbuda, Belize, Guyana, Haiti, Panama, etc. While at the city level, ban is placed in Buenos Aires (Argentina), Mexico City (Mexico), Galapagos Islands (Ecuador), among others. In Colombia, it was a combination of ban/levy at the

national level. In Rio de Janeiro in Brazil levies were imposed on plastics.

For North America, these policies were employed generally at the local level. The bans on single-use plastic bags were in places like Leaf Rapids and Montreal in Canada, and in California and Washington, DC in USA. In the Oceania, similarly policies on the use of plastic bags were also constituted by governments. Ban on the use of single-use plastic bags was initiated at the national level by countries like Vanuatu, Palau, Papua New Guinea, etc. Fiji imposed levy on plastic bag use at the national level. While in Australia, the policy was a ban and the ban was at a local level in places like Coles Bay, Tasmania and Queensland.

Amongst the continents in the world, Africa has the highest number of nations that have introduced a complete ban on the manufacture and use of single-use plastic bags. This prevalent ban of single-use plastic

bag in the region is attributed rather to low recycling rates and waste collection that has made the problem of plastic waste more discernible. In addition, most African nations lack robust industrial base, hence very little quantities of plastic products are exported rather they are imported. As rightly highlighted by UNEP (2018), 58 percent of the 25 African nations where these bans have been initiated at the national level, have moved into execution between 2014 and 2017. Essentially, nations such as Cameroon, Eritrea, Ethiopia, Gambia, Kenya and Malawi instituted a plastic bag ban at the national level, while a local ban was imposed in countries like Somalia (Somaliland), Egypt (Hurghada) and Chad (N'Djamena). In Tunisia and Zimbabwe, a combination of ban and levy on single-use plastic bags was adopted, while Botswana initiated levy on single-use bags. Table 3 shows the countries in Africa with their varied curtailment policies on plastic bags.

Table 3: Nations of the Global South with Plastic Bag Policies

| African Countries | | | Other Countries of the Global South | | |
|-------------------|-------------------|---|-------------------------------------|---------------------------|---|
| Year | Country | Type of Policy | Year | Country | Type of Policy |
| 2003 | South Africa | tax | 1999 | Bhutan | ban |
| 2004 | Rwanda | ban (plastic bags banned from shops) | 2002 | Bangladesh | ban |
| 2005 | Eritrea | ban | 2002 | India | ban |
| 2005 | Somaliland | ban | 2005 | India | ban (including thicker bags) |
| 2006 | Tanzania | ban | 2005 | Bhutan | ban (reinforced due to ineffectiveness) |
| 2007 | Kenya | ban (manufacture and import) | 2008 | China | tax |
| 2007 | Kenya | tax 90n other bags) | 2008 | China | ban |
| 2007 | Uganda | ban (plastic bags < 30 nm) | 2009 | Macedonia | tax |
| 2007 | Uganda | tax (for bags > 39 nm) | 2010 | Mexico: Australia Capital | ban |
| 2007 | Botswana | tax | 2011 | Malaysia, state of Penang | tax |
| 2008 | Rwanda | ban (banned completely) | 2012 | Serbia | tax |
| 2010 | Gabon | ban | 2013 | Mauritania | ban |
| 2011 | Republic of Congo | ban | 2013 | Macedonia | ban |
| 2011 | Kenya | renewal ban (on manufacture and import for thicker bags, due to former ineffectiveness) | 2013 | Haiti | ban |
| 2011 | Kenya | tax (on other bags) | 2016 | Papua New Guinea | ban |

African Countries

| Year | Country | Type of Policy |
|------|---------------|---|
| 2011 | Ethiopia | ban (import and manufacture of single use plastic) |
| 2013 | Uganda | ban (including manufacturing and use of plastic bags) |
| 2013 | Niger | ban |
| 2014 | Cameroon | ban |
| 2014 | Ivory Coast | ban |
| 2015 | Gambia | ban |
| 2015 | Madagascar | ban |
| 2015 | Senegal | ban |
| 2015 | Malawi | ban |
| 2016 | Morocco | ban |
| 2016 | Mozambique | tax |
| 2016 | Guinea-Bissau | ban |
| 2017 | Kenya | ban (use, manufacture and importation of plastic bags) n.d. |
| 2017 | Benin | ban |

Other Countries of the Global South

| Year | Country | Type of Policy |
|------|---------------------|------------------------------|
| 2016 | Antigua and Barbuda | ban |
| 2016 | India | ban (including thicker bags) |
| 2016 | Nepal | ban |
| 2017 | Sri Lanka | ban |
| 2017 | Tunisia | ban |
| 2017 | Georgia | ban |
| 2017 | Colombia | tax |
| 2017 | Colombia | ban |
| 2017 | Moldova | ban |
| 2018 | Panama | ban |
| 2018 | Vanuatu | ban |
| n.d. | Sweden | tax |
| | Hungary | voluntary agreement |

Source: Adapted from Knoblauch, *et al.*, (2018)

7.0 Suggested Strategies for Regulation of Single-use Plastic Bags in Developing Countries

While encouraging imposition of tax on the retailers or manufacturers, public education and adopting buy-back policy, a number of cities and nations across the global north and south are focusing their attention off single-use plastic bags made from polyethylene to the use of more environmentally friendly bags made from materials such as compostable plastics, paper and cloth. In developing countries, environmental challenges resulting from the use of single-use plastic bags in recent epoch have become of increasing concern amongst individuals, scholars and civil society groups. Considering the global trend with respect to policies initiative on sustainable use of single-use plastic bags, it is very worrisome to note that in many countries, such initiative has not received adequate attention from the government both at the local and national levels. This is an aberration

considering the increasing awareness campaign around the world about the adverse effect of plastic bag waste on the environment. Regrettably, there are no indications that this issue will be squarely addressed soon by the governments. Taraba State in Nigeria, the government only recently made a proclamation on the banning of single-use plastic bag in the state in order to promote environmental cleanliness in Jalingo, its capital city. However, this much speculated ban in Taraba state is yet to be implemented. It is also pertinent to mention that the level of community sensitization and educational programmes geared towards fostering awareness as regards the underlying environmental challenges of plastic pollution is also encouraging.

It is therefore, important that urgent action be taken to avert impending environmental and human health challenges associated with the use of single-use plastic in the developing countries. In an effort

to curtail the use of single-use plastic bags in line with best practices in the world, a number of successful environmentally friendly strategies that have been applied in developed nations around the world can as well be employed in developing economies. The strategies considered useful in these countries are as follows:

i. Imposing Levies and Bans on Single-Use Plastic Bags

To date, the levies and bans on single-use plastic bags introduced at both the national and local level in a number of nations across the world have recorded high level of success in dramatic drop in the use of the bags. Levies and bans imposed on plastic bag production and use can be a significant stride in the light of driving towards a wide-ranging strategies aimed at reducing pollution as well as substituting single-use plastic bags with sustainable and eco-friendly alternatives. For instance, levies and bans as observed by Turpie *et al.* (2019) in Eritrea led to a substantial reduction in disease epidemic, general pollution, clogged drainage systems and loss of livestock. They further asserted that Rwanda has established an international reputation for cleanliness based on this same policy and the city of Kigali in 2008 was named by the UN-Habitat as the cleanest city in Africa.

ii. Freewill reduction and Social pressure

Compelling people to change from a particular practice that they

are already accustomed to within a short time frame is not an easy task to accomplish. But initiation of voluntary reduction approach can go a long way to give the people sufficient time to adjust their behavioural or consumption patterns as well as embrace environmentally friendly alternatives that will be made available in the market or designated points. Social pressure can as well arouse the interest of the consumers of plastic bags, the producers and governments. This could however, lead to a drastic reduction in plastic bag usage and pollution.

iii. Public-Private Sector Partnership

A properly coordinated public-private sector partnership agreement through appeals for early inputs, far-reaching preparedness crusades and policy dialogue will not only improve the extant waste management system and practices, but it will also create employment opportunities, as well as promote environmental consciousness among the people. Essentially, opposition from the public is likely to occur when a new policy is initiated by the government, hence care must be taken in identifying the key stakeholders that will be directly affected by the policy and their relative influence. Through comprehensive baseline study, evidence-based alternatives can equally serve as a backup for the policy and guarantee positive outcomes. Stakeholder groups that should be involved from inception include federal, state and local

governments, waste management authorities, trade and industry unions, plastic manufacturers, retailers, residents, non-governmental organisations and organized civil society groups. Through such arrangement, a significant reduction in the production and use of the bags can be accomplished, like in the case of Australia, Germany and Austria.

iv. Sustaining Adoption of Environmentally Friendly Alternatives Bags

Affordable environmentally friendly alternative bags that have improved or similar properties to single-use bags can help in reducing plastic pollution. In a situation whereby the government have chosen ban of plastic bags as the desired option, environmentally friendly alternatives must be made readily available for the public. Its unavailability may perhaps end up adversely impacting the under-privileged sector of the populace. Though, recycling has not received adequate attention from governments in Nigeria, assisting projects aimed at recycling single-use bags can arouse the establishment of micro-enterprises as well as transform prospective wastes into resources. Additionally, to earn the support of plastic bag producers and limit their possible resistance on policy initiatives, governments can give manufacturers enough time to acclimatise to the transition, as well as offer financial inducements to enable them key in. The adoption of environmentally friendly substitute bags that are affordable and with

recycling technology, may perhaps be made easier by offering economic incentives in the form of public-private partnership, research, development funds and tax discount.

v. Public Awareness Campaigns

Evidence revealed that opposition to policies on single-use plastic bags is expected to drop if consumers are conscious of the economic, social and environmental impacts of mismanaged single-use plastic bags. Public awareness can be carried out through diverse channels ranging from workshops in schools, wide-ranging multimedia consciousness raising crusades, informative programmes, exhibitions and giving out alternate varieties of reusable bags. It has been observed that awareness campaign at the local level is more effectual than that at national level. Public awareness campaigns according to UNEP (2018) requires a well drafted and concise missive explaining to a wide range of stakeholders why such policies are adopted. Awareness campaigns need to be introduced prior to the implementation of major policies such as levies and bans on plastic bags and ideally should continue to post execution so as to enable wider acceptance over the long term (UNEP, 2018). Additionally, consumers should be conscious of the fact that the easiest way to abate the environmental impacts of plastic bags is to reuse them as many times as possible (United Kingdom Environment Agency, 2011) and dispose them in an eco-friendly way.

vi. Enforcement of Policy and Monitoring

Sustaining government policy at the same time promoting good governance, enforcement and monitoring is very paramount. As part of the policy initiative process, it is important to ensure that the human resources, finance and essential skills required are put in place prior to when the policy takes effect. However, it is also important to explicitly define the responsibility of all the stakeholders including the federal, state and local governments. To ensure that the policy is being enforced according to plan, monitoring of the progress of implementation is necessary and adjustments should be made accordingly where necessary. Essentially, it is also important for the government to carry out a review of the policy instruments periodically.

References

- Adane, L. & Muleta, D. (2011). Survey on the usage of plastic bags, their disposal and adverse impacts on environment: a case study in Jimma City, south-western Ethiopia. *Journal of Toxicology and Environmental Health Sciences*, 3(8), 234-248.
- AECOM Technical Services (2010). Economic impact analysis: proposed ban on plastic carryout bags in Los Angeles County ordinance to be placed in title 12 of the Los Angeles County code. AECOM Technical Services.
- Andrady, A. & Neal, M. (2009). 'Applications and societal benefits of plastics'. *Philosophical Transactions of the Royal Society B* 364, 1977-1984.
- Ayalon, O., Goldrath, T., Rosenthal, G. & Grossman, M. (2009). Reduction of plastic carrier bag use: an analysis of alternatives in Israel, *Waste Management* 29, 2025 - 2032. <https://doi.org/10.1016/j.wasman.2009.02.016>
- Bio Intelligence Service, (2011). *Assessment of impacts of options to reduce the use of single-use plastic carrier bags*. Final report prepared for the European Commission-DG Environment.
- Camann, A., Dragsbaek, K., Krol, S. & Sandgren, J. (2010). *Properties, Recycling & Alternatives to PE Bags*. Worcester Polytechnic Institute, Retrieved from https://www.wpi.edu/Pubs/E-project/Available/E-project-030510-45034/unrestricted/Properties.Recycling_and_Alternatives_to_PE_Bags.pdf
- Chaffee, C. & Yaros, B. R. (2007). *Life cycle assessment for three types of grocery bags—recyclable plastic; compostable, biodegradable plastic; and recycled, recyclable paper*. Final report, Boustead Consulting and Associates Ltd.
- Clapp, J. & Swanston, L. (2009). Doing away with plastic shopping bags: international patterns of norm emergence and policy. *Environmental Politics*, 18(3), 315-332, <http://dx.doi.org/10.1080/09644010902823717>
- Department of Water and Environmental Regulation,

- (2017). *Implementing a lightweight single-use plastic bag ban in Western Australia. Discussion paper*. Retrieved from <http://www.dwer.wa.gov.au/>
- European Commission, (2013). *Commission staff working document impact assessment for a proposal for a directive of the European parliament and of the council amending directive 94/62/EC on packaging and packaging waste to reduce the consumption of lightweight plastic carrier bags*. Retrieved from <http://www.eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52013SC0444>
- GEF, (2018). *Plastics and the Circular Economy. 54th GEF Council Meeting June 24 – 26, 2018 Da Nang, Viet Nam*
- Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances*, 3(7).
- GGRN (2014). *Disposable bag reduction*. Retrieved from <http://goinggreenrecyclingnigeria.org/disposable-bag-reduction/>
- Gogte, M. (2009). Are plastic grocery bags sacking the environment? *International Journal for Quality Research*, 3(4), 363-375.
- Hosier, D., Burkett, S. and Tarkanian, M. (1999). Prehistoric polymers: rubber processing in ancient Mesoamerica. *Science* 284, 1988–1991.
- Jakovcevic, A., Steg, L., Mazzeo, N., Caballero, R., Franco, P., Putrino, N. & Favara, J. (2014). Charges for plastic bags: motivational and behavioural effects, *Journal of Environmental Psychology* 40, 372-380. <https://doi.org/10.1016/j.jenvp.2014.09.004>
- Knoblauch, D., Mederake L. & Stein, U. (2018). Developing countries in the lead—what drives the diffusion of plastic bag policies? *Sustainability*, 10, 1994, 1-24. doi:10.3390/su10061994
- Macintosh, A., Simpson, A. & Neeman, T. (2018). *Regulating plastic shopping bags in the Australian Capital Territory: plastic shopping bags ban Act 2010 options analysis*, Canberra: Australian National University, p 48
- Njeru, J. (2006). The urban political ecology of plastic bag waste problem in Nairobi, Kenya, *Geoforum* 37, 1046–1058. <https://doi.org/10.1016/j.geoforum.2006.03.003>
- Ogwo, P.A., Obasi, L.O., Okoroigwe, D.S. and Dibia, N.O. (2013). From plastic bag wastes to wealth: a case study of Abia State University, Nigeria. *Journal of Environmental Management and Safety*. 4 (1), 35–39.
- Plastic Bag Facts (2010). *Clean Up Australia*. Retrieved from www.cleanup.org.au/au/Campaigns/plastic-bag-facts.html
- Europe. (2016). *Plastics – the facts 2016: An analysis of European plastics production, demand and waste data*. Association of Plastics Manufacturers. Retrieved from <http://www.plasticseurope.org/plastics-industry/market-and-economics.aspx>

- Ritch, E., Brennan, C. & MacLeod, C. (2009). 'Plastic bag politics: modifying consumer behaviour for sustainable development'. *International Journal of Consumer Studies* 33, 168–174.
- Ruban, A. (2012). *Life Cycle Assessment of Plastic Bag Production*. Uppsala University, Retrieved from <http://www.diva-portal.org/smash/get/diva2:546648/FULLTEXT01.pdf> SANDEE
- Schwabl, P., Liebmann, B., Köppel, S., Königshofer, P., Bucsics, T., Trauner, M., & Reiberger, T. (2018). *Assessment of microplastics concentrations in human stool – Preliminary results of a prospective study, presented at the United European Gastroenterology Week 2018, Vienna*.
- Shaw, D. K. & Sahni, P. (2014). Plastic to oil. *Journal of Mechanical and Civil Engineering*. 46–48.
- Shirley, B. (July 3, 2009), *South Africa's plastic bags dubbed national flowers*". Engineering News. Retrieved from <http://www.engineeringnews.co.za/article/world-trends-in-reducing-plastic-bag-use>
- Ślusarczyk, B. & Kot, S. (2018). Solution for sustainable development: provisions limiting the consumption of disposable plastic carrier bags in Poland, *Journal of Security and Sustainability Issues* 7(3), 449–458.
<https://doi.org/10.9770/jssi>.
- Spivey, A. (2003). *Plastic Bags- Prolific Problems: Environmental Health Perspectives*. EBSCO Publishing 2003, 111(4)-A208
- Stevens, E. (2001). *Green Plastics: An Introduction to the New Science of Biodegradable Plastics*. Princeton, NJ: Princeton University Press.
- Synthia, I. J. (2014). Ban on plastic bags and the emergence of new varieties: a study of awareness on shopping bags and the possibility of behaviour change towards eco-friendly consumption. *Proceedings of the Australian Academy of Business and Social Sciences Conference 2014 (in partnership with The Journal of Developing Areas)*, 1-16.
- Turpie, J., Letley, G., Ng'oma, Y & Moore, K. (2019). *The case for banning single use plastics in Malawi. Report prepared for UNDP on behalf of the Government of Malawi by Anchor Environmental Consultants in collaboration with Lilongwe Wildlife Trust*. Anchor Environmental Consultants Report No. AEC/1836/1. 1-46
- UNEP, (2005). *Selection, Design and Implementation of Economic Instruments in the Solid Waste Management Sector in Kenya: the Case of Plastic Bags*. Nairobi: UNEP.
- UNEP, (2016). *Marine plastic debris and micro plastics: global lessons and research to inspire action and guide policy change*. Nairobi. Retrieved from <http://wedocs.unep.org/bitstream/handle/20.500.11822/7720/-Pdf>

- UNEP (2018a) *Beat Plastic Pollution*. Retrieved from <https://www.unenvironment.org/interactive/beat-plastic-pollution/>
- UNEP, (2018), *Single-use Plastics: A Roadmap for Sustainability*. Retrieved from https://wedocs.unep.org/bitstream/handle/20.500.11822/25496/singleUsePlastic_sustainability.pdf
- World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company (2016). *The new plastics economy — rethinking the future of plastics*, retrieved from <http://www.ellenmacarthurfoundation.org/publications>
- Xing, X. (2009). Study on the ban on free plastic bags in China. *Journal of Sustainable Development*, 2(1), 156-158.
- Zhu, Q. 2006. An Appraisal and Analysis of the Law of “Plastic-Bag Ban”. *Energy Procedia*, 5, 2 5 1 6 – 2 5 2 1 . <https://doi.org/10.1016/j.egypro.2011.03.432>

THE PLACE OF THE COMPACT CITY CONCEPT IN CREATING MORE LIVEABLE URBAN ENVIRONMENTS

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Abstract

In the recent times, there has been sprawling effects being experienced in most urban areas across the globe and this has become a source of worry. The worry has been due to the negative aspects of sprawl. From the social and economic view points, such aspects as longer journeys to work, shopping trips, more energy consumption, pollution, excessive land utilization and accidents constitute the negative aspects of urban sprawl. This study was carried out to investigate the negative aspects of urban sprawl with a view to exploring how the recent compact city concept can be employed as an antidote to that effect. The tenets of urban sprawl were explored from literature alongside the attendant problems. The compact city idea was also investigated to oversee the ability of its potentials to help curb sprawling in the urban environment. The study showed that urban sprawl is caused chiefly by the desire to keep away from urban problems. The problems bother on the overall liveability of the urban core. It was also generalized from literature that the sprawling activities lead to much use of commuters who go for one activity or the other in the urban centre. The sprawl leads to reduction in agricultural land and destruction of biodiversity and ecosystems. The compact city, if properly planned and executed, can lead to a more efficient use of resources in the urban area. It is therefore, suggested that the Compact City concept be adopted to restrict the sprawling activities as witnessed in the urban areas recently.

Keywords: sprawling effects, compact city, urban core, agricultural land, biodiversity.

1.0 Introduction

As reported by the United Nations Department of Economic and Social Affairs (UNDESA) (2012), the world's urban population will increase by about 2.7 billion by 2050. Logically, this would lead to increased need for urban infrastructure, particularly housing. Ideally, there has been evolution of diverse new trends to cope with the world's urban population problems, which bothers much on the overall liveability of the urban area. However, the recent sprawling being

experienced in most urban areas has become a source of worry. There have been some arguments among scholars on the negative aspects of urban sprawl. From the social and economic view points, such aspects as longer journeys to work, shopping trips, more energy consumption, pollution, excessive land utilization and accidents constitute the negative aspects of urban sprawl. Basically, a dispersed settlement, which is brought about by sprawling, relies much on car travel as a condition for accomplishing any activity in the

inner core of the city. This contributes to social segmentation. Inner cities, except for the largest and most successful metropolis with a prosperous, international central area, are victims of the exodus of people and jobs, and will increasingly develop as just one among several regional centres. For Dieleman and Wegener (2016), the inner-city housing areas will continue to become marginalized as the younger and more active segments of the population leave because of the rundown housing stock, traffic noise and lack of parking spaces, unless the total existing population is displaced by gentrification.

Studies of urban living around the world indicate that the liveability of an urban centre and/or any settlement is in close relationship with the physical form and the level of energy use. The physical form, on the other hand, includes but not limited to the dimensions and spatial distribution of buildings, streets, green areas and other social services. This is to say that urbanization or urban development needs to be guided if efficiency has to be achieved (Iyi and Ugwuanyi, 2014). One of such guides is to restrain dispersal of home, work and leisure facilities in a form of settlement called compact city. It is the 'Compact City' concept that this study is set to address. The study discusses a step-by-step manner of creating liveable city

environments with compactness of urban elements in mind.

The study is structured into five indistinct sections. Section one is on the general introduction where the global problems on population explosion in cities are expressed. Section two explores the definitions and concepts of urban sprawl and compact city. It also gives an account of the historical development, principles and practice of compact city. Section three deals with the relationship of city compactness to the practice of urban and regional planning, indicating the major areas of emphasis. Such areas include the perceivable issues that can be tackled with the compact city form, the city level agenda, the site level agenda, the needed design actions and the strategies for such actions. The fourth section is on the implications of compact city for urban and regional planning education, where the structure of anticipated programme of study is highlighted. Section five forms the concluding part and it stresses the need to show astuteness by city governments and higher learning institutions in matters of training and practice in the design principles of compact city.

2.0 Literature Review

2.1 Concept and Issues of Urban Sprawl

Brody (2013) describes sprawl as haphazard development spiralling outward from the urban centre. For Zuhkal, (2016), urban sprawl is seen

as transition zones with indefinite borders between rural and urban areas. These two definitions are where other definitions from a good number of authors lean. Urban sprawl, therefore, can be understood as the spreading out of population and activities from the core area to the suburb of urban centres. This has some adverse effects on the environment. Nowadays, according to Zuhkal (2016), every country uses land and its resources irresponsibly to meet the ever-growing demand for them.

Many factors such as population increase, socio-economic factors, technological development and development policies lead to urban sprawl. Urban sprawl appears as a major problem in recent urban planning activities because it occurs as a result of uncontrolled and unplanned growth (Zuhkal, 2016). The expansion of industrial areas, for example, has not only led to land degradation and soil pollution, but to habitat destructions. Natural environment is indiscriminately being destroyed and lost completely with little or no replacement (Zuhkal, 2016). This, in the long run, will have harmful impacts on human survival and other environmental issues.

According to Brody (2013) the environmental problems associated with urban sprawl are air pollution, water pollution, loss of environmentally sensitive areas, reduction in open spaces and increased flood risks. Air pollution can result from

automobile dependency, while water pollution can be caused in part by increased paved surfaces. Environmentally sensitive areas like agricultural lands and wildlife corridors may be lost completely to the sprawl. All these and a lot more can lead to overall reductions in quality of life.

2.2 Concepts of Compact City

Compact city is one of many new forms which are being evolved by city designers to address the multifarious problems that now face city dwellers in recent times. It is emerging as a new concept to reduce or to control the size of cities for their efficient functioning (Karteek, 2013). The Energy Sector Management Assistance Programme (ESMAP) (2014) defines compact city as a design approach that promotes relatively high residential density with mixed land uses. A good number of researchers on the compact city form lean more on these definitions and have described it as an antithesis of urban sprawl.

Compact city policies have often been designed primarily to reduce the use of private cars and to minimize the loss of open countryside (Kotharkar, Bahadure and Sarda, 2014). Through intensification of developments within the city, problems emanating from urban sprawl are often curbed. Arbury (2016) makes the definition more elaborate and describes compact city as a form deliberately

designed to achieve sustainable development within the city environment and to counteract the perceived negative social, economic and environmental impacts of urban sprawl. Basically, therefore, a compact city is taken to mean a relatively high-density, mixed-use city that is based on an efficient public transport system and dimensions that stimulate walking and cycling.

All the definitions and concepts revolve around the city form, the characteristics of the city space and the associated functions (Kaji, Kenegae, Ishibashi and Hara, 2003). The form is such that exhibit relatively dense settlement so as to achieve less dependence on automobiles. The space is characterized by mixed land use that functions to entrench social fairness and self-sufficiency of daily life.

2.3 Historical Development of Compact City

There is no consensus among researchers as to the historical account of the compact city concept in the literature of urban design. According to Arbury (2016), the concept was coined by American writers but has been used more, in recent years, by European and particularly British planners and academics. In North America, the concept was linked to the concept of smart growth, which was meant to create denser urban areas with greater mixture of land use and better public transport.

Rogers (2010) declares that the concept of compact city was developed in 1961 by Jane Jacobs, who in her book - *The Death and Life of Great American Cities* - provided a critique of modernist planning policies and advocated principles of mixed use. On the other hand, Kaji *et al.*, (2003) account that the concept came into being in the 1980's following the Brundtland Commission report on the sustainability imperatives of resource conservation and waste-minimization and the UNCED Agenda 21. The fundamental idea was that high densities of people and activities led to less available space per capita and, therefore, more land for such other activities as agriculture, transportation and other spaces. Ewing (2008) opines that the compact city form can facilitate mass transport and also lead to a reduction in travel distances and efficient use of land through high population densities, social cohesion and cultural development. In this way, there is overall economy in per capita cost of infrastructure provision and minor businesses by making a supportive threshold population available.

Arbury (2016), reports that compact city policies were implemented in the early to mid-1990s, in the UK and parts of Europe, when the policymakers moved ahead of academics in implementing new measures to improve the sustainability of their cities. This was in a way to tackle a somewhat

unusual situation which arose in the area at that time. Jacobs' (1961) work seems to be a force to reckon with in the compact city literature. Her popular advocate for the principles of mixed use was a notion that cut across the submissions of later writers.

2.4 Principles and Practice of Compact City

Compact city is one of the new urban planning concepts deduced to achieve sustainable development within the urban environment so as to counter the perceived negativities of urban sprawl. The overall aim is to build up a relatively high-density and a mixed-use city. The high density nature of the city culminates in efficient public transport systems and avenues to encourage walking and cycling within the city through intensification of developments within the city. In this way, many problems related to sprawl-type developments are eliminated.

Policies on compact city are often designed in such a way that the use of private cars is minimized while a strategy to increase open areas is created, especially at the countryside. Matsumoto (2012) outlined the following principles for designing a compact city:-

- a. Creation of diverse, compact, and mixed neighbourhoods.
- b. Everyday activity locations such as housing, work, schools, shops and other amenities, are all ideally within 19 minutes

walking distance of each other.

- c. To provide a pleasant, comfortable, interesting and safe environment for pedestrians, and to provide alternatives to car use, such as public, transit and cycling facilities.
- d. The idea emphasizes that urban activities should be located closer together to ensure better access to services and facilities via public transport, walking and cycling, and more efficient utility and infrastructure provision.
- e. Human scale factors are given greater emphasis from the viewpoint of achieving a better quality of life and, therefore, consideration of the effects of the local environment are key components in such planning.

Goodyear (2015) pointed out five city design measures that have proven effective in cities around the world, namely, keeping cities compact, reducing traffic speeds, creating streets for people, using data mapping techniques and then making public transportation safe, affordable and convenient. All these measures have the compact city design content.

Compact cities cut down the intensity of car travels by the inhabitants. This is as against the case with sprawl development which

leads to car travel increase. This is because in the design, short block lengths as well as concentrated housing and business districts are created to allow people to walk to and use public transit and reduce dependence on personal motor vehicles. Short block lengths reduce traffic speeds. Notably, the faster the drivers go, the more likely accidents might occur in urban areas.

In the compact city, not just environmental benefits can be gained from intensifying urban areas. Higher density settlements are argued to be more socially sustainable because local facilities and services can be maintained, due to high population densities, and therefore, accessibility to goods and services is more equitably distributed (Williams, 1999). High density urban living is seen as a prerequisite for vitality, vibrancy, cultural activities and social interaction. The rejuvenation of local economies, particularly in downtown areas neglected by urban decentralization and sprawl can be achieved through intensification (Williams, 1999).

In general, the compact city has six main characteristics which include shorter travel distances, less automobile dependency, more district-wide and local energy generation, optimum use of land resources and more opportunity for urban-rural linkage, more efficient public service delivery, and better access to a diversity of local services and jobs (Matsumoto, 2012). These characteristics of compact city are popular because of the associated environmental, social and economic benefits as shown in Table 1.

Table 1: Environmental, Social and Economic Benefits of Compact City

| S/N | Characteristics | Benefits | | |
|-----|--|--|---|---|
| | | Environmental | Social | Economic |
| 1 | Shorter travel distances | - Less CO ₂ emission. - Less pollution from automobile | - Greater accessibility due to cost | - Higher production due to shorter travel time for workers |
| 2 | Low automobile dependency | - Less CO ₂ emission. - Less pollution from automobile | - Lower transport costs. - Higher mobility for people - Improved human health | - Development of green jobs/ technologies |
| 3 | More district-wide and local green energy | - Less energy consumption for capitals - Less CO ₂ emission. | - Higher quality of life due to job opportunities. | - Development of green jobs/ technologies - More energy dependence |
| 4 | Optimum use of land resources and more opportunity for urban-rural linkage | - Conservation of farmlands and natural biodiversity - Fewer CO ₂ emissions due to | - Higher quality of life due to more recreational activities | - Rural Economic development (Rural agriculture and renewable energy) |
| 5 | More efficient public service delivery | - Greater responsiveness for environmental issues. | - Public service level for social welfare maintained by improved efficiency. | - Lower infrastructural investments and cost of maintenance. |
| 6 | Better access to a diversity of local services and jobs | - Greater responsiveness for environmental issues by the people | - Higher quality of life due to local services (shops, hospitals, etc.) | - Skilled labour force attracted by high quality of life - greater production due to |

Source: Adapted from Matsumoto (2012)

2.5 Compact City Practices in Europe

In the 1960s, the Netherlands' urban planning activities were highly influenced by the compact city idea

(Rogers, 2010). Cities expanded in large, top-down planned neighbourhoods through efficient use of scarce space available. This gave way for entirely new towns on

moderate distances from the main city. This was in order to keep the new towns influenced mainly by their capital and also to make them self-sustaining. The new towns were deliberately designed to be relatively dense and with very good connections to get to downtown by public transport or bicycle.

This reduced urban sprawl at the time as new neighbourhoods needed to be built, as an outer skin around existing settlements. This was in order to keep the rural landscape clean and cities dense and compact. All neighbourhoods were close to city centres, particularly in Dutch towns, a situation that enabled inhabitants to get around quickly and cheaply by bike. Getting out of town no longer involved driving through sprawled suburbs, thereby making it easy and popular to visit rural areas.

In Europe, based on the preparatory work of a Committee on Transport and Tourism in 2008, a call was made among other things for drawing up customized sustainable mobility plans and supporting measures for planning for cities of short distances. The Committee referred to the EU strategy to combat climate change and other environmental problems.

The compact city concept showed strong influence on planning policy in the UK during the Labour Governments of 1997–2010 (Rogers, 2010). In 1998, the UK Government issued Planning Policy Guidance on Housing which

introduced a minimum net residential density guideline of 30 dwellings per hectare. This was a follow-up to a report of a task force on Urban Renaissance. Over the succeeding years, this and other targets were substantially exceeded, with the average densities of 43 dwellings per hectare.

2.6 Critiques of Compact City

Where compact city policies had been implemented, follow-up studies began to indicate that the benefits as shown in Table 2.1 were not as rosy as they appear. A significant difference was found between the romantic, vibrant, traditional city and the reality of traffic congestion, poor environmental quality and town cramming of the compact ideology (Arbury, 2016). In other words, the city was something which many people wished to escape from, through suburbanization and rural living. Similarly, another critique is that compact cities may not help to reduce carbon dioxide emissions. This line of argument reduces the force of the main component of the compact city as environmentally friendly (Arbury, 2016). Breheny (1996), cited in Rogers (2010) makes a case that rests on four main points: the likelihood that compact cities will not deliver the environmental benefits claimed; the probable impossibility of halting urban decentralization; that some Greenfield developments are

inevitable even with compaction policies; and that higher urban densities are unlikely to bring about the high quality of life that the proponents promise. These arguments against decentralized development policies lead Breheny to conclude that a compromise should be reached that consists of various forms of decentralized concentration based around single cities or groups of towns.

2.0 Compact City and Urban and Regional Planning Practice

The place of the compact city idea in the practice of urban and regional planning cannot be overemphasized. The discourse on this is done alongside the nature, objectives, methodology, theory and practice of planning. The environment in which we live influences man and vice versa. There are various types of environment but in the field of urban and regional planning, five types stand out. These are physical, socio-cultural, demographic, economic and political environments (Iyi, Ezeilo and Ugwu, 2005). The first (physical) comprises the natural and built environments and which include such elements as land, vegetation, wildlife, different land uses and the associated physical character; water bodies, houses and appurtenances, neighbourhood facilities and services. Socio-cultural environment refers to the complexity of the social and cultural variables

which tend to influence people's perception of elements of other types of environment. Demographic environment relates to the trends and characteristics of the population of the society. Economic environment comprises the wealth base, such as employment, land tenure, revenue resource and technological processes. The political environment has to do with the platform for the practice of the science of control of public affairs, and it is this that determines the growth and welfare of the society. Based on these brief explanations of the environment types, it can be seen that physical environment is fundamental in the compact city development process.

Furthermore, the urban and regional planning practice has its major objective as ensuring harmonious relationships among the elements of the settlement. The compact city concept is one of the new approaches to achieving the foregoing. The operation of the concept and what planning is all about are in tandem. Wahab and Lasisi (2017) described planning as the art and science of taking decisions to influence the course of the future changes in a settlement or a region for the maximum benefit of the people living there. The compactness in the new concept creates spatial relationship among the residents. There is deliberate arrangement of facilities to ensure efficiency in the living conditions and wealth creation.

Methodology or the how of planning evolves out of the desire to overcome a problem that is noticed in any environment system. In other words, a problem is first considered and then desirable actions are systematically articulated in order to bring a change that is capable of overcoming the problem. In this instance, the actions taken constitute the plan. The stages undergone before arriving at the plan form the planning process. Differing stages are undergone to prioritize issues to be tackled using the compact city arrangement. Theories in planning tend to explain the economic, geographic and social phenomena which planners deal with. Examples include location theories and social systems theories. It is within these theories that proposals or strategies for dealing with present or expected problems are considered. These are espoused in the compact city concept as issues to be addressed. The issues to be addressed, on the other hand, give rise to the reasons for planning. Ideally, the reasons for planning the physical environment include (Omuta and Onokerhoraye, 1986):-

- a. To achieve a satisfactory relationship between people, work and environment.
- b. To ensure more judicious use of land and resources.
- c. To ensure orderliness in our environment.
- d. To promote public interest.
- e. To maximize opportunities for social interests.

In planning practice, the compact city designs culminate in a process in which these reasons are articulated and addressed. The social, economic and physical issues in our cities are analyzed, synthesized and planned for. This is followed by formulating strategies to achieve set goals and objectives for compact settlements. The major areas where planners explore as good platforms include, the perceived issues, the city level agenda, the site level agenda, the design actions and the design strategies (Karteek, 2013). That is, when a glaring issue is raised in a given city in relation to functionality, a broad objective is set at city level. This is followed by a more specific objective as to what is to be done where, and then design actions alongside available local potentials (see Table 2).

There are five key issues that can be tackled with compact city form, namely, developments that are not integrated with the natural systems, uneven pressures created by unstructured densities, non-integrated transport system, segregated and dispersed functions, and increased car dependency. Table 2 shows a summary of how these issues and other areas where the urban planners should explore can be systematically approached in the compact city design process.

Table 2: Perceived Issues and Design Strategies

| | Issues | City Level Agenda | Site Level Agenda | Design Actions | Design Strategies |
|---|--|--|--|--|---|
| 1 | Developments not integrated with the Natural systems | Developing the Approach towards environmentally sustainable future | Conserving the ecologically sensitive areas and processes | Creating low dense passive creation within ecological areas of the site | Using the natural systems as the structuring elements for the site |
| 2 | Uneven pressures created by unstructured densities | Formation of a dense and compact urban district | Creating dense neighbourhoods | Creating compact and dense delineated in suitable areas, conserving the natural resource system | Allocating appropriate densities at conserve land and resource |
| 3 | Non integrated transport system | Integrating the site with the city through public transport system | Encouraging public transit for daily activities | Encouraging the use of public transport through allocating public functions along the transit system | Linking mass transit system with the site through a public transport system |
| 4 | Segregated and dispersed functions | Creating mixed use environments | Creating a mix of IT based functions and the new housing facilities and institutions | Allocating variety of functions such as dense housing, Mixed uses spines, recreation facilities in ecological areas within that are important for everyday human experiences | Hierarchical distribution of functions and overlapping those functions |
| 5 | Increased car dependency | Encouraging pedestrian friendly environment | Creating walkable neighbourhoods | Allocating public facilities within walking distances 500m (10mm walk) | Integrating live, work and play environment with good pedestrian and cycle networks |

Source: Adapted from Kaji, *et al.* (2003) and Kariack (2013)

2.0 Implications of Compact City for Urban and Regional Planning Education

Formal planning education in Nigeria did not start until the post-colonial era when institutions that offered planning courses were established (Wahab and Lasisi, 2017). These institutions served as training grounds for future physical planners in the country. The curricula were based on the then contemporary issues that were perceived as bothering on the environment.

The new agenda for engendering the compact city form in the city environment needs a revitalized curriculum whereby proper policies and design skills for compact city forms are articulated and incorporated. That is, skills which inculcate ethical behaviour in the practice of physical development planning of our cities. In this way, well-grounded future planners who have the right mix of skills needed for functional compact cities are produced. This is achieved by

developing their understanding of the theories, methods and techniques for planning, designing and managing activities that relate to compact city environment.

The overall goal of the curriculum would be to expose prospective planners to the most recent social, economic, political and environmental concerns of the urban area and equip them with analytical and administrative techniques for evaluating and solving the problems of our cities using the compact city concept.

At the undergraduate course of study, the specific objectives will be to:-

- a. Produce good professional planners who can operate effectively in matters relating to nature and what nature can offer for the betterment of our city environment.
- b. Help young planners to develop ability to relate their knowledge and skill of nature with city problems.
- c. Provide the student planners with varied practical experience of realistic compact city form.
- d. Encourage student planners to develop interest in compact city form of settlement.
- e. Direct the students' projects and assignments to tackling urban problems through making reference to the attributes of the compact city.

At the postgraduate course of study, the objectives will be to:-

- a. Assist planners to develop understanding of technological and legislative frameworks for compact city.
- b. Develop in the prospective planners the ability for coherent policy formulation and implementation for compact city.
- c. Help students to be able to design frameworks for revamping the city economy through compact city ideologies.
- d. Encourage students to develop relevant research methods towards compact city concept.

Based on these objectives, the curriculum for the compact city courses can be developed at both graduate and postgraduate levels.

5.0 Conclusion

This study showcased how to foster growth and transformation of our cities using dense settlements form. The compact city concept toes the path of enabling policies and guidelines for energy efficient and liveable settlements. There are proven environmental, social and economic benefits when judged from the design strategies employed in the compact city.

However, achieving desirable outcomes requires four key concerted efforts by city, regional, and national governments. These are setting a forward-looking strategic vision, creating an enabling institutional and regulatory frame-

- Ewing, R.H. (2008). Characteristics, Causes, and Effects of Sprawl: A Literature Review. In Marzluff, J.M., Shulenberger, E., Endlicher, W., Alberti, M., Bradley, G., Ryan, C., Simon, U., ZumBrunnen, C. (Eds) *Urban Ecology*. New York: Springer. Pp. 519–535.
- Goodyear, S. (2015). The Keys to Designing Cities with Fewer Traffic Fatalities. Available at <https://www.citylab.com/design/2015/07/> (Accessed 19/11/2017).
- Iyi, E. A., Ezeilo, O. L and Ugwu, L. N (2005). *Issues in Environmental Sciences*. Enugu: Celex Publishers Nig.
- Iyi, E. A and Ugwanyi, B. C. (2014). Community Participation Approach to Flood Disaster Management: The Case of Enugu East Local Government Area of Enugu State, Nigeria. *International Journal of Engineering Science Invention*, 3(12):04-13
- Kaji, H., Kenegae, H., Ishibashi, K and Hara, N. (2003). Compact City and Developing Countries: Is Compact City Approach Appropriate as an Urban Development Policy for Cities in Developing Countries? Paper presented at the Open Meeting of the Global Environmental Change Research Community, Montreal, Canada, 16-18 October.
- Karteek, G. (2013). An Urban Design Approach to a Sustainable Compact City; in Kotharkar, R., Bahadure, P and Sarda, N. (2014). Measuring Compact Urban Form: A Case of Nagpur City, India. *Sustainability*, 6: 4246-4272. doi: 10.3390/su6074246.
- Kotharkar, R., Bahadure, P and Sarda, N. (2014). Measuring Compact Urban Form: A Case of Nagpur City, India. *Sustainability*, 6: 4246-4272. doi: 10.3390/su6074246.
- Matsumoto, T. (2012). *Compact City Policies: A Comparative Assessment*. Organization for Economic Corporation and Development (OECD) Presentation at the World Bank seminar, March 13th, 2012, Washington DC, US.
- Omuta, G. E. D and Onokerhoraye, A. G (1986). *Regional Development and Planning*. Benin City: Editorial Committee, Geography and Planning, University and Benin.
- Rogers, L (2010). The Key Components of a Mixed-Use and Integrated Urban Neighbourhood. Available at <http://gehlcitiesforpeople.dk>. (Accessed 04/01/2018).
- UNDESA [Department of Economic and Social Affairs], Population Division (2012). World Urbanization Prospects: The 2011 Revision. *Urbanization Beyond*. New York: UNDP.

- Wahab, B. and Lasisi, M. (2017). Culture in Egunjobi, L (ed) *Contemporary Concepts in Physical Planning* (Vol. III). Ibadan: Dept. of URP, University of Ibadan.
- Williams, K. (1999). Urban Intensification Policies in England: Problems and Contradictions. *Land Use Policy*, 16(3): 167-178.
- Zuhkal, K. (2016). The Concept of Urban Sprawl and Its Causes. *The Journal of International Social Research*: 9(45): 815-818.

A STUDY OF FACTORS AFFECTING INLAND WATER TRANSPORT PATRONAGE IN LAGOS STATE, NIGERIA

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Abstract

This study examined factors influencing patronage of Inland Water Transport in Lagos State Nigeria. Primary data were obtained from two sets of questionnaires on Ferry Passengers plying Lagos State's inland waterways. The questionnaires were administered on 20 Ferry Passengers purposively selected at each of the eight loading points, the total number of questionnaires administered on passengers of inland water transport for this study was 207(10 %) of average patronage per day per jetty. Data were analysed using descriptive and inferential statistics. Secondary data were from Lagos State Waterways. The result on socioeconomic attributes of patrons revealed from the study that, males were 66.9% respondents. Dominant age groups 80% were 21-30 years and 31-40 years. Majority (85.1) made use of tricycles while few (24.4%) made use of other public transport mode to reach the loading jetties. The Factor Analysis revealed that factors influencing patronage of inland water transport in Lagos comprised of economic and structural quality, operator service quality, facility and environmental quality, and quality and transfer coordination. Prospective policies on inland waterways management must therefore, be sensitive to those factors.

Keywords: Inland waterway, ridership, public transport patronage, travel behaviour, urban mobility

1.0 Introduction

Urban areas of developing countries of the world are growing rapidly (UN-HABITAT, 2011; United Nations Population Fund [UNFPA], 2011; Oyinloye, 2011). The consequences of this rapid growth could be attributed to enormity of urban planning challenges in the form of overcrowded urban cores, deteriorating environmental conditions and transport related problems (Cevero, 2013). The most vexing of these challenges faced by developing cities is transport (Fadare, 2010; Cevero, 2013). Meanwhile, proffering solutions to local problems in the transport sector, for instance, is an important part of any nation's

development process (Somuyiwa, Oyesiku and Dosunmu, 2011). Inland water transport, particularly in coastal regions such as Lagos, provides opportunities and potentials to address part of these problems for efficient urban transport.

According to Akaso, Bariweni and Abowei (2011) water transport is the means of carrying goods or persons by water. It can be either of ocean transport or inland water transport. Ocean transport involves movement of passengers or freights overseas and along the coast. Inland water transport (IWT) involves movement of passengers or freights via navigable rivers, lakes, coastal creeks, lagoons and canals (Fellinda, 2006; Aderamo and Mogaji, 2010).

Inland water transport, according to Shajahan and Nilufar (2013), is one of the oldest economically and environmentally sustainable modes of transportation. Also, UNESCO (2009) remarked that where road and rail networks move the majority of the freight, inland waterways alleviate congestion by transporting significant amounts of cargo that would otherwise be on urban roads.

Studies on Inland Water Transport have been undertaken by many researchers in different parts of the world. Odeck and Brathen (2006) for example, studied the efficiency of ferries for public transport in Norway; and Amos, Dashan, Tao, Junyan and Weijun (2009) studied sustainable development of inland waterways transport in China. Soltani, Burke, Tanko and Farid (2014) also studied travel patterns of urban ferry passengers in Australia. Gautham (2015) studied the use of barge trains for cargo transport via India's inland waterways and Frigo and Bleninger (2015) reviewed the navigability of inland waterways along the Paraguay River in Brazil. Both studies by Amos *et al* (2009) and Gautham (2015) focused on the use of inland waterways for cargo haulage. Yogi (2012) studied inland water transportation in Kochi city region in India and considered crowdedness, safety issues, inadequate service frequency, irregular operation of trips, low speed of ferry and nuisance from anti-social elements as factors influencing patronage of inland water transport. Osoja, Adebakin and Olayinka

(2019) revealed that under-development of the inland of the inland waterways, mode of transport, stunted growth of inland waterways and inadequate funding and poor facility maintenance of waterways have significant impacts in attracting commuters to inland waterways transport system. Usman and Bolaji (2020) among other things noted that patronage of low inland waterways may be hindered by comparatively high fare. However, such factors as condition of the ferry, provision of stations/stops information, friendliness of ferry staffs, extreme weather condition, fare affordability and condition of route network could also be as important as observed in these studies.

Soltani, Tanko, Burke and Farid (2014) studied travel patterns of urban linear ferry passengers for Brisbane, Australia. They observed that passengers consistently used ferries more for commuting and university trips during the weekdays with significant patronage in the morning and afternoon peak periods. Soltani *et al* (2014) also revealed that despite strong use, most users are infrequent patrons. They therefore, suggested that leisure travel is a significant component of the system. The study also focused on passenger trip variation on daily and monthly bases as well as on a peak and off-peak hour basis. It also considered the trip purpose and frequency of use of the ferry service, distance covered and time taken by passengers to access jetties, mode of transport to jetties, waiting time at jetties, riding

ferry time, trip fare and type of goods transported. These factors and others are considered in this study to explain the factors affecting inland water transport in Lagos State, Nigeria.

Ezenwaji (2010), Adejare *et al* (2011) and Balogun (2010) are studies on inland water transport in Lagos State. Adejare *et al* (2011) developed a framework for efficient utilization of Lagos waterway system as a complement to other transport modes such as the dominating road mode. Balogun (2010) analysed water transport operators based on the number of fleets and their level of operation.

The studies did not consider the basic factors affecting inland water transport patronage that the present work is focused. Socio-economic characteristics of passengers of inland water transport in foreign countries based studies are most likely to be different from what to expect in Nigeria. Lagos state is likely to differ from the experiences in cases in the developed places as their population distribution, socio-economic activities and transport system are known to be at variant. This study examined the factors that influence the passenger patronage of Inland Water Transport in Lagos State in Nigeria, with a view to providing information for policies that could enhance better service development and inland water ways best practices in the study area.

2.0 An Overview of the Study Area

Taiwo (2005) stated that while Nigeria's population density is 100

persons per square kilometre, and that of Lagos is about 2,400 persons/km² with annual population growth of 5.0% to 5.5%. In 2013, Ministry of Economic Planning in Lagos State estimated the State's population to be 22 million.

Lagos State is in the South West coastal line of Nigeria. The topography of Lagos is dominated by its system of islands, sandbars, and lagoons. The city itself sprawls over four main islands: Lagos, Iddo, Ikoyi and Victoria Island, which are connected to each other and to the mainland by a system of bridges. Creeks and lagoons are plied by small coastal craft. The city is the western terminus of the country's road and railway networks, and the airport at Ikeja provides local and international services.

The Federal Road Safety Corps records revealed that Lagos with 0.4% land mass, and about 30% under water (LASWA, 2016), accommodates about 25% of total vehicles and drivers in Nigeria. The national vehicle per kilometre is about 16 but Lagos has about 200. Road, water, air, pipe and rail transport modes are all in use in Lagos, but the road mode accounts for more than 80% of all movements (Olagunju, 2011).

With perceived potentials on its inland waterways, the state government in 2008, enacted the Lagos State Waterways Authority Act, which established the Lagos Waterways Authority (LASWA). The body is charged with the responsibility for coordinating and

managing reforms necessary for the long-term growth and development of water transportation in Lagos State. It is also saddled with such responsibilities as granting of ferry licenses, dredging and concessions for the operation of terminals to the private sector. These activities entail the creation of an enabling long-term regulatory environment that attracts significant private sector involvement in the provision of water transport services. Fig. 1 shows the Lagos state inland waterways.

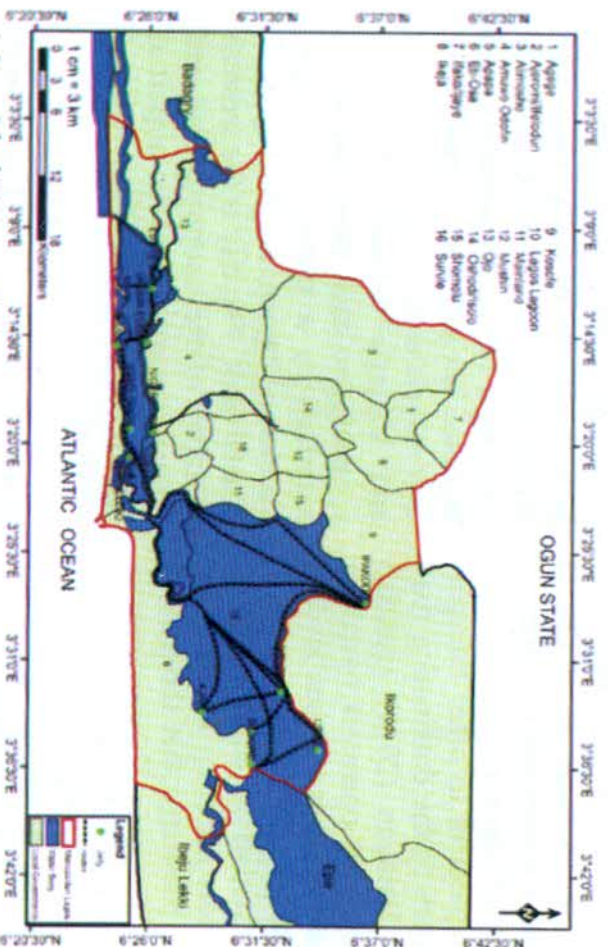


Fig. 1: Map of Inland Water Transport in Lagos

3.0 Literature Review

Many advantages were attributed to inland water transport over other means of transportation by Gautham (2015). These included cheaper capital cost, cheaper maintenance cost, greater fuel efficiency, carrying capacity and safety over other modes. Gautham (2015) observed that freight transportation by waterways is highly under-utilised in India compared to other large countries and geographic areas like the Americas, China and the European Union. According to him, Europe has more than 37,000

km of waterways connecting hundreds of cities and industrial regions. He is of the opinion that inland waterway transport is the perfect mode for all kinds of goods. The percentage of freight moved by India is merely 0.1% as against 21% for USA. These figures underscore the under-utilisation of inland water transport in India, although the navigable length comes to almost 14,500 km of which over 9,500 km in the form of rivers and canals are navigable (Gautham, 2015).

In an overview of the vast expanse of inland waterways in

Brazil, Frigo and Bleninger (2015) noted that deployment, maintenance and improvement of waterways works represent a factor of prime importance to expansion and diversification of the transport matrix. Water transport according to them, is a key factor capable of inducing planned development, linking regions and providing safe and economical handling of materials, products and people. Another relevant aspect is that only waterways feature a multipurpose aspect, as the river also operates as supply of water, hydroelectricity generation and prevention of floods (Alfredini and Arasaki, 2009). Water transport is the most economical mode to shift large volumes of cargo with low unit value, such as grain and ore, particularly when the origin or destination of the loads are located near a waterway, which can stimulate the production and storage of goods in marginal bands, adding density to the economic system.

Public transport as inland waterways, clearly has an important role in addressing the needs for fair, efficient and environmentally friendly urban transport. Litman (2015) for example, views public transport to encompass the various services that provide mobility to the general public, including buses, trains, ferries, shared taxi, and their variations. Adejare et al (2011) noted in a study in Lagos, that inland water transport could reduce journey time by an average of 46.33% relative to road transport. Yogi (2012) revealed that in Khoci city in India,

crowdedness, inadequate safety facilities and service frequency, irregular operation of trips and nuisance from anti-social passengers are factors influencing patronage of inland waterways. It also provides complementary services to Road and the other transport modes in the urban area. The demand for public transport in general, is determined by a large range of factors, which according to Fearnley (2013), are; service frequency, fare levels, travel time and punctuality as most important. In a broader view, Zuniga, Liu and Bunker (2013) identified seven latent factors underlying passengers' perceptions of rail transit which are, station, safety, access, transfer, service attitude, traveller's physical activeness and environmental concern. These are important factors that could influence any public transport patronage including inland waterways anywhere in the world.

Antoniou and Tyrinopoulos (2013) are of the opinion that a common factor that holds a high position in the preferences of public transport commuters is transfer quality, comprising attributes related to transfer coordination (distance, waiting time and information provision). Wang (2010) identified two divides to factors influencing commuter public transport ridership. The first was termed "Economic determinants" which encompasses service level (mode kilometres per capita); real fare (in real revenue per passenger); and real income (in real disposable income per capita). The

other, are Structural determinants which encompasses; car ownership (in cars per capita by region); and real fuel price.

Paulley, Balcombe, Mackett, Titheridge, Preston, Wardman, Shires and White (2006) were of the opinion that fares are fundamental to the operation of public transport since they form a major source of income to operators. In general, if fares are increased, patronage will decrease. Whether revenue increases or decreases as a result of fare increase would depend on the functional relationship between fares and patronage as represented by the demand curve. These authors noted that quality of service encompasses a wide range of attributes which can be influenced by planning authorities and transport operators. Some of these attributes (access and egress time, service intervals and in-vehicle time) directly involve time, and can be quantified with relative ease and incorporated in appropriate demand forecasting models, using relevant elasticity. Others (vehicle or rolling stock characteristics, interchanges between modes, service reliability, information provision, marketing and promotion, and various bus specific factors) are more problematic. This is because changes in these attributes are often accompanied by changes in other attributes, particularly fare and journey time. Paulley *et al* (2006) opined that traditionally, both income and car ownership have been deemed 'background factors', as compared to attributes of public transport such as

fares, service levels, journey times and vehicle quality, which are directly under the control of the operator.

Ceder and Sarvi (2007) were of the belief that loss in ferry patronage was caused by the ferry's relatively poor level of service and intense competition from more attractive alternatives in Hong Kong. The following inhibiting factors were also noted: average travel time (peak, off-peak), distance, average passenger loads (peak, off-peak), vessel's speed and capacity, competition measures of bus and rail in terms of fares, travel time, and frequency.

A number of studies on travel behaviour have found that punctuality, reliability and dependability of a public transport system are rated by users as very important features, affecting their perceptions and usage of the service (Currie and Wallis, 2007). They identified such factors relating to bus service quality improvements as cleanliness, security, amenities and comfort. The evidence Currie and Wallis (2007) presented suggested that air conditioning, CCTV and a smoother ride had the highest patronage impact improvements.

Kostakis and Ipsilandis (2009) suggested that satisfaction in customers varies in proportion to the line that they utilize as well as to the factors which affect total satisfaction. More precisely, their results indicated that customers present a medium level of satisfaction and dimension of services viewed against route safety, service of personnel and

service inside the bus. The authors noted that the time dimension with the sub-criterion of route waiting time and availability and the sub-criterion of route frequency constitute the critical points of the company. Furthermore, the study notes that customer segmentation suggested that customer satisfaction is affected by the destination and the frequency of usage which are often determined by gender, usage per week and reasons of usage among other variables.

There are many possible ways to improve transit service quality, including reduced crowding, increased service frequency, nicer waiting areas, and better user information (Litman, 2008). Litman is of the opinion that current transport evaluation methods tend to focus on quantitative factors such as speed and price, and intangible qualitative factors such as comfort, convenience and reliability. As a result, cost-effective transit improvement strategies are overlooked and undervalued, resulting in underinvestment in transit service quality improvements, making transit less attractive relative to automobile travel.

On service quality as perceived by public transport patrons in general, Litman (2015) listed the following:

- a. Availability (when and where transit service is available), and coverage (the portion of a geographic area, or the portion of common

destinations in a community, located within reasonable distance of transit service).

- b. Frequency (how many trips are made each hour or day).
- c. Travel speed (absolute and relative to automobile travel).
- d. Reliability (how frequently service follows published schedules).
- e. Integration (ease of transferring within the transit system and with other travel modes).
- f. Price structure and payment options.
- g. User comfort and security, including riding on, walking to, and waiting for transit.
- h. Accessibility (ease of reaching transit stations and stops, particularly by walking).
- i. Universal design (ability to accommodate diverse users including people with disabilities, baggage, inability to understand local languages, etc.).
- j. Affordability (user costs relative to their income and other travel options).
- k. Information (ease of obtaining information about transit services).
- l. Aesthetics and Amenity (appearance of transit vehicles, stations, waiting areas and documents/ extra features and services for enhanced comfort and enjoyment).

The way public transport services are delivered as well as their qualities are important, because of their effects both on the attitude and behaviour of travellers and the demand for services (Sam, Adu-Boahen and Kissah-Korsah, 2014). According to them, several factors influence the preference and patronage of one public transport mode as against the others. They found out and concluded that the issues of fare, perceived safety and accident record of a transport service operator, the comfort and vehicle quality as well as service reliability in terms of time schedules are the main criteria commuters look out for in deciding which public transport service to patronize.

4.0 Sources of Data

The data for the study was derived from primary and secondary sources. They include field work, involving physical observation, direct interviews and administration of a set of questionnaire. The set of questionnaire was administered on patrons (passengers) of inland water transport. Information obtained include socio-economic characteristics of the passengers, trip purpose, waiting time at jetty, riding ferry time, trip fare and activities of passengers at jetties and on-board a ferry. The sampling frame covers all the loading points along the major water routes as identified by the

Lagos State Waterways Authority (LASWA, 2016). These loading points include 21 jetties, 3 terminals and 3 landings. Also, part of the sample frame are the passengers waiting for water transport services of the passenger ferries.

The study adopted multi-stage sampling method. First, loading jetties/terminals were selected using the cluster sampling technique. The Lagos lagoon was used as a central point and relative to this point, major loading points with respect to their locations, which is to the North, South, East and West of the Lagoon were identified as separate clusters as presented in Table 1. There are five (5), five (5), six (6) and eleven (11), perceived mostly patronized loading points in the North, South, East and West cluster respectively. Within each cluster, two (2) loading points were selected using a simple random sampling technique as presented in Table 1. Therefore, a total of eight (8) jetties were considered for this study as presented in Table 2. The total number of questionnaires administered on passengers of inland water transport for this study was two hundred and seven (207) being 10 % of average patronage per day per jetty. The secondary data, comprised of, maps of waterways route, passenger ridership, safety measures, accident casualties' records, major or functional jetties and registered operators were from LASWA.

Table 1: Location of Water Jetties/Terminals and Sampled Loading Jetties

| S/N | Major Jetties (Loading & Offloading Points) | Cluster Group | Sampled Loading Jetties |
|-----|--|---------------|--|
| 1 | Ibeshe 2 Jetty, Ikorodu LG | North | *Ibeshe 2 Jetty, Ikorodu LG *Oworonsoki Jetty |
| 2 | Agboyi Ketu Jetty | North | |
| 3 | Oworonsoki Jetty | North | |
| 4 | Mile II Terminal | North | |
| 5 | Metro Ferry Jetty (Ipakodo Ferry Terminal 2) | North | |
| 6 | Ayetoro Jetty, Epe | East | *LANGBASA JETTY *Oke Ira Nla (Ajah Jetty) |
| 7 | Ijede Jetty, Ijede LCDA (Tarzan) | East | |
| 8 | Langbasa Jetty | East | |
| 9 | Oke Ira Nla (Ajah Jetty) | East | |
| 10 | Badore, Eti Osa LGA (Tarzan) | East | |
| 11 | Baiyeku Water Jetty | East | *Ijegu Egba Floating JETTY *Liverpool Jetty |
| 12 | Sagbokoji Jetty, Amuwo-Odofin | West | |
| 13 | Ijegu Egba Floating Jetty | West | |
| 14 | Ebute Ojo Ferry Terminal | West | |
| 15 | Alex Jetty, Apapa | West | |
| 16 | Yafin Jetty, Badagry | West | |
| 17 | Tolu- Ajegunle Jetty | West | |
| 18 | Liverpool Jetty | West | |
| 19 | Temidire, Ajagunle | West | |
| 20 | Coconut Jetty | West | |
| 21 | Slave Route | West | |
| 22 | Takwa Bay Jetty | West | |
| 23 | Ijora Jetty | South | *Falomo Floating Jetty *CMS Jetty |
| 24 | Falomo Floating Jetty | South | |
| 25 | Elegbata Terminal | South | |
| 26 | C.M.S. Jetty | South | |
| 27 | Addax Jetty, Victoria Island | South | |

Source: LASWA (2016) and Author's Survey (2018)

Table 2: Sample at Loading Points and Number of Questionnaire Administered

| S/N | Major Loading Jetties (Loading & Offloading Points) | Total Sample Size |
|-----|---|-------------------|
| 1 | Ibeshe 2 Jetty, Ikorodu LG | 28 |
| 2 | Oworonsoki Jetty | 26 |
| 3 | Langbasa Jetty | 25 |
| 4 | Oke Ira Nla (Ajah Jetty) | 25 |
| 5 | Ijegu Egba Floating Jetty | 24 |
| 6 | Liverpool Jetty | 26 |
| 7 | Falomo Floating Jetty | 27 |
| 8 | C.M.S Jetty | 26 |
| | T o t a l | 207 |

Source: Lagos State Waterways Authority 2018

Factor Analysis was employed to the data on 42 variables known to influence the patronage of inland water transport for the eight jetties being studied. This was performed such that the observed variables comprising crowdedness and safety issues, among others, were reduced into their latent variables called factors. Factor analysis is a multivariate statistical technique which basically facilitates the reduction of a large data matrix $X_1, X_2, X_3, X_4, \dots, X_n$ against $Y_1, Y_2, Y_3, Y_4, \dots, Y_n$ into a smaller one without much loss of information. This it does by using orthogonal (Varimax) rotation or transformation which converts a set of data of possible correlated variables into a set of uncorrelated data called factors. The Kaiser-Meyer-Olkin (KMO) index and Barlett's test significant at p equals to zero ($p = 0.000$), is usually used to ascertain the suitability adequacy of dataset. The measures vary between 0 and 1 and values closer to one are better. The two tests provide a minimum standard required for factor analysis technique.

5.0 Research Findings and Discussion

The factors which affect the patronage of inland waterways in Lagos is explored in this study through the result of the factor analysis. The Kaiser-Meyer-Olkin (KMO) index of 0.586 and Barlett's test significant at p equals to zero ($p = 0.000$), ascertained the suitability of dataset for patronage of inland water transport for Factor Analysis, as noted previously.

Rotation converged in 10 iterations and a four-component solution yielded clearly interpretable results. Communalities, total variance explained and rotated component matrix results are as presented in Table 3. The initial communality for each observed variable was unity while it was less than unity after extraction. The variable with the lowest communality was "Punctuality and timely arrival of ferries" (0.197) and that with the highest communality was "Capacity" (0.756) (see Table 3). The communality after extraction was fairly high (0.72.842) explaining 72.84% of total variance in the observed variables by the extracted four components.

| No | Variables | Components | | | |
|----|--|------------|------|------|------|
| | | 1 | 2 | 3 | 4 |
| 1 | Travel time | | | | .702 |
| 2 | Reliability | | | | .768 |
| 3 | Punctuality | | | | .813 |
| 4 | Identity and image | | | | .682 |
| 5 | Safety and security | | | | .791 |
| 6 | Capacity | | | | .747 |
| 7 | Convenience | | | | .740 |
| 8 | Information provision | | | | .552 |
| 9 | Cleanliness of the jetty | | | .763 | |
| 10 | Provision of route time table awareness | .646 | | | |
| 11 | Provision of stations/stops information | | | .541 | |
| 12 | Friendly Response and courtesy from ferry staffs | .686 | | | |
| 13 | Extra services offered | | | .682 | |
| 14 | Availability of toilets jetty | | | .631 | |
| 15 | Nuisance from anti-social elements | | | .672 | |
| 16 | Type and sophistication of vehicles and infrastructure | .601 | | | |
| 17 | Captains making phone call while sailing | .517 | | | |
| 18 | Sailing speed by captains | | | .652 | |
| 19 | Professionalism/Competency of captains /conductors | .633 | | | |
| 20 | Number of ferry conductors on board | .577 | | | |
| 21 | Quietness of the vehicle while sailing | .524 | | | |
| 22 | Reliability of ferries | .697 | | | |
| 23 | Service frequency of the system | .677 | | | |
| 24 | Boarding time at stations | .668 | | | |
| 25 | On board safety satisfaction instruction | .763 | | | |
| 26 | On board safety satisfaction equipment's | .721 | | | |
| 27 | Safety at jetty / terminal | .571 | | | |
| 28 | Availability of parking spaces at the jetty | | | .523 | |
| 29 | Transport fare affordability | .586 | | | |
| 30 | Changing Transport fare | | | | |
| 31 | Condition of the route network | .596 | | | |
| 32 | Ease of access and service provision at the disabled | .506 | | | |
| 33 | Arrangement of ferry seats | .578 | | | |
| 34 | East of access to tickets | | .573 | | |
| 35 | Number of available ticketers at jetties | | .722 | | |
| 36 | Shortage of change from ticketers | | .753 | | |
| 37 | Number of available ferries at jetty | | .714 | | |
| 38 | Drug vendors operation on the ferry | | .786 | | |
| 39 | Ferry departure time from the jetty after loading | | .630 | | |
| 40 | Congestion on board the ferry | | .658 | | |
| 41 | Presence of the extinguisher on board the ferry | | .622 | | |

Table 3: Rotated Component Matrix for Patronage of Inland Water Transport

The cumulative of total percentage is 72.84 indicating the total variance in the observed variables accounted for by the extracted four components which were the four factors (Economic and facility quality factor, service quality factor, facility and environmental quality and quality and transfer factor) affecting patronage of IWT, with an unexplained variance (27.158%). Variables with component loadings greater than 0.50 were considered while excluding those with loadings of less than 0.50 (see Table 3). The four components with high loading on variables were considered for nomenclature as noted earlier.

The first factor (Component 1) had an Eigen value of 9.727 and therefore accounted for the highest proportion (27.953%) of variance of the dataset. This component loaded highly on variables which were: provision of route time table awareness (0.646), friendly response and courtesy from ferry staffs (0.686), and type and sophistication of vehicles used and infrastructure used (0.601). Others in this category are, captains making phone call when sailing (0.517), professionalism/ competency of captains/conductors (0.633), number of ferry conductors on board (0.577), quietness of the vehicle while sailing (0.524). Further to these in Factor 1 are, reliability (service hours and days) of ferries (0.697), service frequency of the system (0.677), boarding time at

stations (0.668), on-board safety satisfaction instruction (0.763) and on-board safety satisfaction equipment (0.721). Hence, it was referred to as "Economic and facility Quality Factor" by and large in consonance with the classification by Wang (2010). The components discussed here have implications for effective passenger inland water transport patronage. In effect, there is need for capacity building of staff including the captains for efficient service delivery. It is also necessary for Government to provide new ferries that will accommodate more patrons.

The second factor (Component 2) which had an Eigen value of 6.086, accounted for a very high proportion (16.756%) of variance in the dataset. It loaded highly on some variables which were: ease of access to tickets (0.573), number of available ticketers at jetties (0.722), shortage of change from ticketers (0.753), number of available ferries at jetty (0.714), drug vendor's operation on the ferry (0.786), ferry departure time from the jetty after loading (0.630), congestion on board the ferry (0.658) and presence of fire extinguisher on board the ferry (0.622). It was therefore referred to as "Service Quality Factor". From this factor and components, it is imperative to note the need for ease to access tickets. The method of ticketing must be overhauled in line with available and emerging technologies. Adequate measures must be taken to avoid any kind of distraction including drug

and other merchandize vendors on board of ferries. Safety precautions and infrastructure including fire extinguishers and life jackets must be provided.

The third factor (Component 3) had an Eigen value of 5.882 and accounted for a high proportion (15.168%) of variance in the dataset. It loaded highly on variables which were: cleanliness of the jetty (0.763), provision of stations/stops information (0.541), extra services offered (0.682), availability of toilets at jetty (0.631), nuisance from anti-social elements (0.672) and sailing speed by captains (0.652). It was then named "Facility and Environmental Quality". This result here calls for proper hygiene of the ferries and provision of necessary sanitary infrastructure. The standard speed regulation must be kept to forestall avoidable accidents.

The fourth factor (Component 4) had an Eigen value of 5.408, of all the components accounted for the lowest proportion (12.966 %) of variance in the dataset. It loaded highly on variables which were: travel time (0.702), reliability (0.768), punctuality (0.813), identity and image (0.682), safety and security (0.791), capacity (0.747), convenience (0.740) and information provision (0.552). It was therefore referred to as "Quality and Transfer Coordination Factor" in agreement with the classification of Fearnley (2013) and Antoniou and Tyrinopoulos (2013). From here the need for information, congestion avoidance, and punctuality are

needed to enhance adequate service delivery and encouraging patronage of service.

This study examined the patronage of inland water transport in Lagos State and concluded that the patronage of the service was influenced by the following major factors, which were economic and structural quality, service quality, facility and environmental quality and transfer coordination. A major examination of these factors showed that in factor 1 the following observations are crucial: on board safety, reliability of ferries, time table, staff patron relationship. In factor 2, were: ease of access to ticket, Drugs vendor on board, more ticketers and adequate fare collection are needed and more ferries to accommodate potential patrons. In factor 3 cleanliness of the jetty, Toilet availability, Miscreant patrons that affect security on board, and uncontrolled sailing speed. In factor 4, Issues of travel time, service reliability, punctuality, information provision and safety and security.

6.0 Conclusion

In ensuring an effective and sustainable patronage of inland water transport in Lagos State, there is the need for concerned management bodies to consider the outcome of this study in any policy that may be formulated to encourage patronage of inland water transport in Lagos.

The government must provide more public inland water services to provide better services at reduced cost and better patronage. Similarly, as noted earlier better ticketing method must be adopted for better accountability and service delivery. Up-to-date and functional on-board safety equipment including life jackets and fire extinguishers should be made available in the ferries.

Retraining and capacity building programmes should be provided for all staff. The programmes should focus on: modern sailing techniques; safety precautions such as use of life jacket, not receiving calls while sailing; captain passenger relations; captain-traffic agent relation; among others. This will improve the overall job performance of staff and the security and safety of lives and property of patrons. Finally, the environmental quality of jetties should be improved on by the management in which case provision must be made for environmental amenities like convenience (modern baths and toilets, change room by gender) for operators and patrons.

References

- Adejare, Q., Nwilo, P., Olusina, J. and Opaluwa, Y. (2011). A study of ferry service route network in Lagos Lagoon- Nigeria using graph theory. *Journal of Geography and Regional Planning*: 4(6), 326-337
- Aderamo, A. and Mogaji, S. (2010). Rural Transportation of Public Facilities in Nigeria: A Case study of Edu Local Government Area of Kwara State. *Journal of Human Ecology*, 29(3), 171-179
- Akaso, A.A. Bariweni, P.A. and Abowei, J.F. (2011). Some Economic and Environmental Benefits of Maritime Transportation in Nigeria. *Nigerian Journal of Agriculture, Food and Environment*. 7(4), 97-110
- Alfredini, P. and Arasaki, E. (2009). *Obrase gestão de portos e costas - A técnica aliada ao enfoque logístico e ambiental*. Editora Blucher.
- Amos, P., Dashan, J., Tao, N., Junyan, S. and Weijun, F. (2009). *Sustainable Development of Inland Waterway Transport in China. (Theme I of a World Bank Project: Comprehensive Transport System Analysis in China-P109989)*.
- Antoniou, C. and Tyrinopoulos Y. (2013). Factors Affecting Public Transport Use in Touristic Areas. *International Journal of Transportation*. 1(1), 107-112
- Ceder, A. and Sarvi, M. (2007). Design and Evaluation of Passenger Ferry Routes. *Journal of Public Transportation*. 10(1), 59-62
- Cervero, R. (2013). Linking Urban Transport and Land Use in Developing Countries. *The*

- Journal of Transport and Land Use*. 6(1), 7-24
- Currie, G. and Wallis, I. (2008). Effective Ways to Grow Urban Bus Markets – A Synthesis of Evidence. *Journal of Transport Geography*, 16(6) 419-429
- Fadare, S.O. (2010). *Urban Form and Households' Travel Behaviour – Implications for Nigeria*. An Inaugural Lecture Series 230 delivered at Obafemi Awolowo University, Ile-Ife, Nigeria. Obafemi Awolowo University Press Limited.
- Fearnley, N. (2013). Free Fares Policies: Impact on Public Transport Mode Share and Other Transport Policy Goals. *International Journal of Transportation*: 1(1), 75-90
- Fellinda, L. (2006). World's Water Transport needs further Development: *Transport and Development*. 1(1), 68-72
- Frigo, A. and Bleninger, T. (2015). *A Review of the Navigability Modelling For Inland Waterways*. E-proceedings of the 36th IAHR World Congress 28 June – 3 July, 2015, The Hague, the Netherlands
- Gautham, K. (2015). Barge Train for Cargo Transportation In Nw-1: A New Concept In Indian Inland Shipping: *International Journal of Engineering Research and General Science*: 3(5), 232-253.
- Gray, L. (2004). An Examination of the problems of water transportation in old Degama province, Nigeria. *Journal of Waterways, Africa*. 33(1), 20-26
- Kostakis, A. and Ipsilandis, P. (2009). Measuring Customer Satisfaction in Public Transportation: An Empirical Study Based In Urban Buses in the City of Larissa (Greece) - "The MUSA Methodology". *MIBES-Oral*, 260-275
- Litman, T. (2019): *Evaluating Public Transit Benefits and Costs Best Practices Guide Book*. Victoria Transport Policy Institute
- Odeck, J. and Brathen, S. (2008). Travel Demand Elasticities and users' attitude; A case study of Nowegian toll project *Transportation Research, Part A Policy and Practice*. 42(1), 77-94
- Olagunju, K. (2015). Evaluating Traffic Congestion in Developing Countries: A Case Study of Nigeria. A Paper Presented At The 2015 *Chartered Institute of Logistics and Transport (CILT) Africa Forum* Held At Mount Meru Hotel Arusha, Tanzania.
- Osoja, A.O. (2019). An assessment of complimentary of water transport travel along Ikorodu Lagos Island areas of Lagos Metropolitan, *East African Scholars Journal of Education, Humanities and Literature*. 2(2), 78-92
- Oyinloye, M.A. (2011). Geo Information for Traffic

- Management in a Rapidly Growing City: The case study of Ado-Ekiti, Nigeria. *Research Journal in Engineering and Applied Sciences*. 3(2), 79-90.
- Sam, E., Adu-Boahen, K. and Kissah-Korsah, K. (2014). Assessing the Factors That Influence Public Transport Mode Preference And Patronage: Perspectives of Students of University of Cape Coast (UCC), Ghana. *International Journal of Development and Sustainability*: 3(2), 324-334
- Schrank D. and Lomax, T. (2007). *The 2007 Urban mobility Report*. College Station Texas, Texas Transportation Institute and Texas A and M University
- Shajahan, A. and Nilufar, F. (2013). Reviving the Inland Waterways of Dhaka: A Morphological Approach towards an Integrated Transportation System. *Proceedings of the Ninth International Space Syntax Symposium*
- Soltani, A., Tanko, M., Burke, M. and Farid, R. (2019). *Travel Patterns of Urban Linear Ferry Passengers: Analysis of Smart Card Fare Data for Brisbane, Queensland Australia*. Transportation Research Board, Australia.
- Somuyiwa, A., Oyesiku, O. and Dosunmu, V.A (2011). Transport and logistics research and its impact on capacity building of local institutions in Nigeria. *American Journal of Scientific and Industrial Research*. 2(4), 560-566
- Taiwo, K. (2005). *The Case of Lagos: Air Quality Improvement Project. A Position paper*. Lagos Metropolitan Area Transport Authority (LAMATA), Lagos, Nigeria.
- Usman, B.A and Animashaun, K.H (2020). Inland Water Transport and Urban Mobility in Ikorodu – Ebutte Ero Route Lagos Nigeria. *Geosfera Indonesia Journal. Ures*. 5(1), 127-146
- UN-HABITAT, (2010). *State of the World's Cities 2010/2011 – Overview and Key Findings*. Nairobi: United Nations Human Settlements Programme
- United Nations Educational, Scientific and Cultural Organization [UNESCO], (2009). *Inland Waterborne Transport: Connecting Countries. The United Nations World Water Development Report 3. Water in a Changing World*. UNESCO
- Wang, J. (2010). *Appraisal of Factors Influencing Public Transport Patronage in New Zealand*. Auckland, New Zealand: The Energy Centre, University of Auckland Business School.

- Yogi, J. (2012). A Study on Inland Water Transportation in Kochi City Region. Centre for Public Policy Research, *Working Paper Series*. www.cppr.in
- Zuniga, K., Liu, Y. and Bunker, J. (2013). *Making the Train: Re-*

Conceptualising Accessibility for Intra-Urban Rail Travel. Australasian Transport Research Forum 2013 Proceedings 2 - 4 October 2013, Brisbane, Australia.

**ENVIRONMENTAL HEALTH:
A CONCEPT ESSAY OF TRIBUTE IN HONOUR
PROF TUNDE AGBOLA**

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Abstract

Environmental Health (EH), a sub-discipline of public health concerns with explanation of how and why all aspects of the natural and the built environment affect human health. Using a thematic analysis of literature, this paper discusses the background to EH in Nigeria, identifies some models used in studying environmental health and provides highlights of the relationships between environmental parameters and health. It examines also the contribution of Prof Tunde Agbola to the field of Environmental Health. Areas of research needs and windows of opportunity which can be pursued to enhance environment-health benefits and promoting sustainable resilient urban development are highlighted.

1.0 Introduction

The concern to understand the links between health and environment could be traced to time in memorial because the nexus between the two provides a platform to recognize the underpinning issues around inter-generational health equity (Confalonieri et al., 2007), health inequality (United Nations Department for Social Affairs, Population Division, 2017) and non-medical factors that impacts public health outcomes (Oloukoi et al., 2014). Globally, nearly 25 percent of all deaths and the total disease burden can be attributed to environmental factors (Building Healthy People, 2014). According to the World Health Organization (WHO), Africa recorded 2.2 million deaths of which environmental-related risks contributed to 36 percent (WHO, 2017) and children of 0-14 years old are mostly affected as a result of land degradation, air pollution and poor access to water (Corey et al., 2019).

Environmental risk factors include biological pathogens,

chemical pollutants, physical hazards, living and working conditions, climate-related risks and natural resource degradation (Oloukoi et al., 2014). Against 2030, Ebi et al., (2019) in the Intergovernmental Panel on Climate Change (IPCC) report indicated that more ill-health will be recorded because climate change/variation will trigger emergence and re-emergence of some diseases and that the challenges will affect social determinants of health in poor countries of the world.

Despite numerous global and regional health promotions, the burden of environment-health-risks are still persistent in some regions as a result of poverty and poor access to clean environmental services. For instance, World Health Report of the WHO in 2018 indicated that Neglected Tropical Diseases (NTDs) are well associated with poverty in tropical environments where multiple infections in a single individual are common. In low-income countries, NTDs affected 27% equating to 409 million people

which adds to their disproportionate burden borne by these countries (WHO, 2017). Poor access to clean air alone caused one in every eight deaths globally in 2016, and household air pollution was estimated to have caused 3.8 million deaths, while outdoor air pollution caused 4.2 million deaths worldwide (WHO, 2017).

Given the above data which are based on only the reported cases, this paper aims at presenting to the public the importance of environmental health, the dimensions of association between the environmental conditions and the health of a population group. The paper has five sections. Section one is the introduction, followed in section two by literature review which provides some conceptual issues. Section three explains the methodology and the forth section focuses on the data analysis and discussion of findings. The conclusion was done with highlights of challenges, research needs and recommendation in EH studies.

2.0 A Brief Literature Review

Environmental Health (EH) is a science which studies the introduction of biological, chemical or physical agents and other environmental media or settings into the environment or occurring naturally and their effects on human health and ecological systems (National Environmental Health Association, NEHA, 2013). It evaluates hazards to health, prevents or controls disease, injury, and

disability related to the interactions between people and their environment and protects health and wellbeing (WHO, 2006; NEHA, 2013). EH refers to those aspects of human health that are determined by environmental factors (Nwokoro, 2017). It is an assessment of factors in the environment that can potentially affect health, controlling of human activities and its impacts on wellbeing of man are of major concern (University of Georgia, UGA, 2005). In another sense, EH is the science of controlling or modifying those conditions, surrounding man which relate to promoting and maintaining health across generations (Egunjobi and Agbola, 1996).

Environmental health as used by the European Centre for Environment and Health (ECEH), which is the driving force for the WHO Regional Office for Europe, is perceived as holistic health, including both the direct pathological effects of chemicals, radiation and some biological agents, and the effects (often indirect) on health and wellbeing of the broad physical, psychological, social and aesthetic environment which includes housing, urban development, land use and transport (ECEH, 2018). In general term, EH comprises all aspects of human health including quality of life. This school of thought on holistic health takes input from demography, medical geography, medical sociology, economics, medical administration, public health and

epidemiology (Editors, Health and Place, 1996). However, the definition of environmental health has undergone changes over the years to include more emerging and the totality of all externalities (physical, social, economic, political, living and working conditions and systems) that support human existence (Kistenkas et al., 2018).

Since its inception in April 4, 1948, the World Health Organization (WHO) has environmental concern in health agenda as listed in Article 2(1) of its constitution. To establish this concern, environmental sanitation was given the same priority as malaria, maternal and child health, tuberculosis, venereal diseases and nutrition and these priorities became known as 'the big six' during the First World Health Assembly on 24 June, 1948 in Geneva. The WHO Committee's first ground breaking report published in 1949 concluded that physical development, health and survival depended on the management of environmental factors which included excreta and community waste disposal, safe drinking water, food safety, healthy personal habits, understanding the causes of diseases and control of disease vectors (WHO, 1948). According to WHO (2003:12),

“Safe water supply and adequate sanitation to protect health are among the basic human rights. Ensuring their availability would

contribute immeasurably to health and productivity for development.”

Five basic disciplines generally contribute to the field of environmental health and they are: environmental epidemiology, toxicology, exposure science, environmental engineering, and environmental law. Each of these disciplines contributes different information to describe the problems and solutions in environmental health, but there is some overlap among them.

In terms of scientific studies in Nigeria, there were earlier epidemiological surveys (e.g. Nash, 1948; Propheto, 1983) which emphasized the roles of physical environmental factors in the creation and communication of some diseases. Buchanan and Pugh (1955) in their work clearly showed the nexus between living conditions and incidence of certain diseases. Their work categorized diseases in Nigeria into the following spatial order:

- Wide-world disease; e.g. measles, heart diseases and tuberculosis.
- Diseases induced by backward living condition e.g. fever, leprosy and intestinal worms: focusing on population dynamics and survival of pathogens.
- Climate-induced diseases e.g. tropical diseases such as malaria and sleeping sickness.

Other earlier studies include those from medical geography such

as Ajaegbu and Ikusemiju, (1970) on factors in medical geographical studies; Okafor (1979) on application of health data to investigate health services efficiency; Iyuni (1987) and Adesina, (1990) on disease ecology; Egunjobi, (1983) on regional planning and health care service utilization; and Shehu, (1992) on social-cultural factors and health status. Other studies focussed on gender inequalities and health (Nwokoro and Agbola, 2017), and seasonal climate variation and health risks (Oloukoi et al., 2014).

This paper therefore, adds to the body of knowledge by providing a history of the sub-discipline, identifying the relationship between environmental parameters and health, describing some models that are used in environmental health studies and highlighting scholarly works of Agbola to show the nexus between water, sanitation and health related issues, and environmental planning, health and wellbeing.

3.0 Methodology

The methodological approach for this study is desk research in which the historic antecedence to environmental health study and practice in Nigeria was traced. Analysis of areas of relationship between environment and health was done while different models that are used in environmental health studies are also presented. Prof. Tunde Agbola's contribution to environmental health studies was done by conducting a meta-analysis

of his publications, scientific engagements and mentorship over a period of 3 decades.

4.0 Results and Discussion

In this section, analysis and discussion of findings are done under these four sub-headings:

1. Historical background to environmental health as a discipline
2. Highlights of relationship between environment and health
3. Models used in studying environmental health
4. Agbola's relative contributions to Environmental Health studies

4.1 Historical Backgrounds to Environmental Health as a Discipline

In research and practice, health related topics have been viewed in holistic perspective many years ago in human history. As far back as 4th century B.C. Hippocrates, the founder of modern medicine held a view that:

'Whoever wishes to investigate medicine properly should proceed thus...consider the seasons of the year...Hence, the winds...the mode in which the inhabitants live and what are their pursuits' (Hippocrates, ~460 to 377 B.C., quoted by Hudson (1886).

Globally, Environmental Health as a branch of knowledge has its root in public health services and health promotions (Smith, 1977), welfare

services (Phillips, 1981) and urban planning (Agbola and Egunjobi, 1996). It is important to emphasize here that modern town planning has its roots in the Public Health and Housing Legislation of the late nineteenth century in the Great Britain. By the 1840s, politicians who were so alarmed by the very appalling urban conditions, came together to enact series of legislative measures to combat the deteriorating sanitation and housing conditions and growth of diseases. For instance, Public Health Act of 1848 was passed at a time when an epidemic of cholera had killed 54,000 people in England. The Metropolitan Water Act was enacted in 1852, which required that water supply to be filtered (Ratcliffe, 1974). In 1877, the Royal sanitary Institute was established. The routine bacteriological examination of London's water supply was introduced in 1885, and in 1908 the chlorination of water supplies started, becoming perhaps the most efficient and effective health technology at that time.

In the Americas, the Pan American Sanitary Bureau (PASB) was founded in 1902 with the aim of improving sanitation conditions and services. In 1936 the Health Organization of the League of Nations published reports on water supply, sewage treatment and the collection and treatment of domestic refuse. These acts provided the backgrounds for the international actions on environmental sanitation and the establishment of first World Health Assembly in 1948.

In Nigeria, the historical antecedent to environmental health is traced to various urban planning interventions, policies and laws prior and during colonial era. These laws were enacted to promote health and well-being of colonial settlements. For instance, Town Planning Ordinance of 1863 was a health regulation focusing on development and sanitation in Lagos. Cantonment promulgation of 1893-1904 was developed to protect the colonialists from health hazards. Planning Legislation of 1904 focused on establishment of Government Reservation Areas (GRAs) for the purpose of preserving the European's health, environmental sanitation improvement with provision of latrines and cemeteries in the non-European areas. During this same period, Sanitary Inspectors were appointed for Lagos Colony and later, the Colonial masters introduced the position of Sanitary Officer, who also became a member of the Legislative Council in 1913 and after the amalgamation of the Northern and Southern Protectorates of Nigeria (Akinyede, 1957, cited by EHORECON, 2015).

As a matter of fact, Dr Isaac Ladipo Oluwole, the pioneer African Medical Officer of Health [MOH] in the Lagos Colony in 1920 facilitated some changes in the status of Nigeria health workers when he started working on sanitation issues. He pioneered school sanitary services and the establishment of first Nigerian School of Hygiene at Yaba, Lagos in that same year. Graduates

from the school became sanitary Inspectors who were responsible for inspection of ports, ships and health services. In 1928, the town planning ordinance which established Lagos Executive Development Board (LEDB) came into existence to take care of the bubonic plague of 1924, and make provision for slum clearance and for health promotion. Other town and regional planning laws in Nigeria took off from the aforementioned pro-health planning ordinances.

4.2 Highlights of Relationship between Environment and Health

The following highlights are few evidences that relate how environmental conditions impact public health:

1. Climate change and climate seasonal variation

According to Smith et al., (2014) in the IPCC Fifth report, effects of extreme climate events occur directly, due to changes in the distribution of disease vectors as a result of ecological disruption (Ebi, 2006). Variability in temperature is a risk factor in its own right, over and above the influence of average temperatures on heat-related deaths. High rise of mortality is observed in hot weather as shown by more than 2000 excess deaths that were reported in England and Wales during the major heat wave that affected most of Western Europe (Ebi et al., 2019). In Burkina Faso, Diboulo et al., (2012) observed that

daily temperature and mortality were similar to those reported in many high-income settings, and susceptibility to heat varied by age and gender. Measles and hay fever are also notable diseases during dry season while cholera epidemic is common during the onset of rainfall due to pollution of water bodies (Oloukoi et al., 2014).

2. Green space and Land use changes.

Closeness to nature influences public health status. For instance, accessibility of population to green spaces for recreation has been observed to promote adventure therapy outcomes among young population in Australia (Bowen et al., 2016). Green space provides mental health benefits and possibly lower risk of psychiatric disorders (Engemann et al., 2019), stimulates the general well-being of urban settlement by shades and natural freshness (Wood et al., 2018); while removal of vegetation cover aids emergence and re-emergence of some zoonotic diseases such as Lassa Fever (Mofolorunso et al., 2016).

3. Urbanization and urban slum formation

Urbanization and city annexation without proportional services provision could trigger the vulnerability of urban dwellers by creation of slums and other forms of informal settlement (Alcayna, 2015). Depending on other environmental intricacies, health-security outcomes are skewed to further add to

inequality and vulnerability, especially in elderly people, slum dwellers, female gender and young children (Nwokoro, 2017). The health status of the population in the slum is always lower than the population in the upper class residential zones as a result of population congestion and poor access to basic services such as water, sanitation, transportation, adequate living rooms and open space (Beenackers et al., 2018).

4. *Food and water insecurity*

Two major components of water security are water quality and quantity (Levengood et al., 2018). The concept of water-energy-food nexus highlights that there is always an interplay among the three variables and that the failure of one will alter the supply of the other two which could impact the public health system. Public health is also affected by regional conflicts over food and water shortages (McMichael et al., 2006). Increases in temperature have been noted to be associated with food poisoning in the United Kingdom and Peru (Checkley et al., 2000).

5. *Access to health related information*

Improved access to health-related information is essential for health system policy development and health governance system. Population groups which are informed about certain risk factors can be said to have coping capacity more than the ignorant (Thomson, 2018). Studies have shown that people will work with known facts in

terms of health risks, available health care services and even health related policies (Hawkins and Alvarez-Rosete, 2017). Ybara (2008) noted that internet health information-seeking experience is probably influenced by age-specific lifestyle trends and typical health status. Access to better education has been linked with less disease risk and changes in health outcomes (Feiberg, 2016).

6. *Access to water and sanitation facilities*

Global reports indicate that every minute, a new-born dies from infection caused by lack of safe water and sanitation and an unclean environment (WHO, 2015). This is so because absent, inadequate or inappropriately managed water and sanitation services exposed individuals to health risks. For instance, the Hamburg Cholera epidemic in 1892 indicated an association between polluted water and the disease (WHO, 2003). People living in localities where water and sanitation accessibility is poor are more prone to water-related diseases. Inequities in access to safe water, is also a factor for impoverish status of families in some developing countries where larger proportion of productive time is used to out source water from unreliable sources. Poor sanitation and hygiene also threatens livelihoods of smallholder farmers, and contributes to low levels of school enrolment especially among girls (USAID, 2019).

7. *Social belief and behavior*

The Health Belief Model (HBM) was developed to help understand how people's beliefs about risk factors or health problem influence their readiness to take action and in-action (Becker and Maiman, 1975). The use of vaccine, mammography screening and contraceptive as well as other sexual risk behaviors and injury prevention are influenced by social perspective. The decision to engage in a particular medical channel is influenced by a variety of socio-economic variables such as cultural myths, household power sharing etc. For instance, McCally (2018) reported that the use of contraceptive by women is influenced by their ethnicity, religion affiliation and other socio-demographic variables. Behavior or lifestyle has been noted to predispose to health problems. For instance, smoking lifestyle significantly triggers asthma symptoms and attacks (Tatum and Shapiro, 2005).

8. *Poverty and socio economic status*

The Secretary-General of the United Nations (UN), during the UN Assembly in 2001, ascertained that the biggest enemy of health in the developing world is poverty and the

struggle for health is part and parcel of the struggle for development (Annan, 2001). This assertion is valid because, poverty creates its own health risks, more locally. Approximately 1.2 billion people in the world live in extreme poverty (less than one dollar per day) (UNDP, 2006). Poverty creates ill-health because it forces people to live in risk. Again, since poverty is a spatial phenomenon, spatial vulnerability will impoverish population and thereby increase their susceptibility to ill-health in terms of economic cost of securing health care services (Ubi and Ndem, 2019). Also, SES including access to technology facilities is seen as one of social determinants of health which has a dominant influence on population health in Iran (Shafiei, 2019).

4.3 *Models used in Studying Environmental Health*

Studies in environmental health are guided by models which are rooted in ecology, spatial analysis, public health and epidemiology as well as medical sociology and behavioural sciences. Figure 1 provides a graphical representation of these models and the study approaches that could be adopted.

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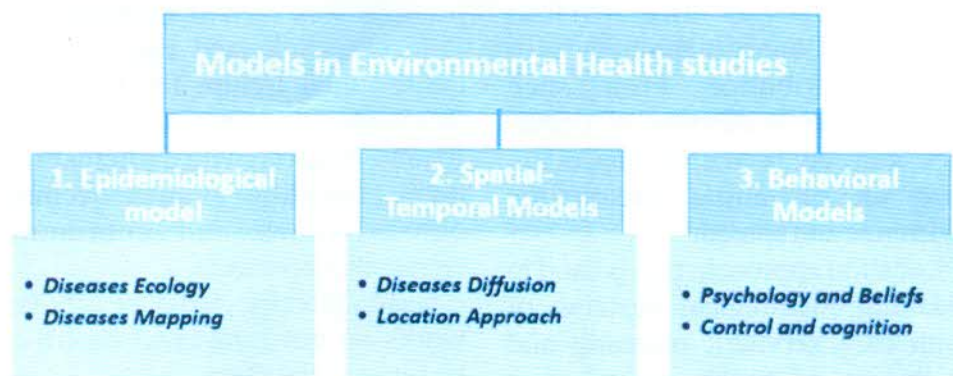


Figure 1: Models used in Environmental Health Studies

Source: Authors' Conceptualization

1. Ecological Model of Epidemiology:

Ecological epidemiology focuses on explaining the ecology of infectious diseases. It includes population and community level studies of the interactions between hosts and their pathogens and parasites, and covers diseases of both humans and wildlife. Study approaches may include:

- a. Disease ecology: this is the study of relationship between natural environment and contagious disease. It is also the development of various methodologies for detailed mapping of disease patterns to the ends that singular or multiple associations with cultural and naturally occurring phenomenon can be identified and understood. Researchers in this area mostly use disease ecology to explain the interaction between man and his total environment, changes in climate, vegetation, mineral traces, bedrocks and hydrology.
- b. Disease mapping: this approach came into being in the 18th century.

The methodology helps in providing understanding to spatial aspect of human health problems. Two approaches are common: the dot maps and the progress maps. The dot maps is used to show the localized epidemic pattern while the progress maps is used to illustrate the epidemic flow over time and space. The first map of this kind was produced in 1792 in Germany (by German physician L.L. Finke) in order to show the distribution of various diseases on a world scale (Barrett, 2000).

2. Spatio-temporal models

These models are used to show the spread and flow pattern of diseases, the journey to medical institutions and utilization of health facilities. Distances in space could be route, time and cost (cost in relation to monetary term and human cost in terms of population at risk). There are two study approaches that could be adopted when using these models. These are:

a. Disease diffusion: this approach largely utilizes the formal geographical theory in the analysis of disease distribution. From such studies, future prediction of occurrence can be predicted especially based on prevailing seasonality, occurrence and spread.

b. Location approach: this is used in modelling hierarchical systems of health care services; planning and distribution of health services and need for medical intervention in form of health care provision. It is also done with the use of quantitative techniques to understand relationships between the socio-economic status of the population and their accessibility to health care services.

3. Behavioral Model of Epidemiology

In using this model, the concern is to explain the influences of psychological perception, sociological systems, cognition and belief factors on the use of health care services by the consumers. In this model, appreciable effort is made to provide a correlation between the roles of education (awareness) attitude and health-related behaviour of a population group.

4.4 Agbola's Relative Contributions to Environmental Health Studies

Prof. Tunde Agboola's works in the area of environmental health can be traced to his background in Economics which quickly helped him to conceptualize 'health as

wealth'. He followed the works of his predecessors such as Folasade Iyun, Poju Onibokun and Layi Egunjobi (at the then Centre for Urban and Regional Planning, University of Ibadan, Nigeria) with participation in many scientific studies, technical consultancies and community engagement projects.

Specifically, Agbola's scholarly works on environmental health can be categorized thus:

a. Water, sanitation and waste management: In Agbola, 2001; Agbola and Jinad, 2006; Agbola, 2003; and Adeniji-Oloukoi and Agbola 2014 poor management of water and sanitation were described as critical environmental health issues. Agbola (2009) and Agbola et al., (2009) used case studies to describe healthcare waste management approaches and applications in developing countries. In relation to water issues, Agbola, (1993) used gender analysis to describe women, water and health nexus; while Agbola and Adeniji, (2009) focused on deduction of urban water stress through the development natural springs as alternatives

b. Theories and theorizing: In some of his works, Agbola concentrated on the application of theories and concepts to explain the contribution of environment to healthy city (e.g. Agbola and Egunjobi, 1996; Agbola and Mabawonku, 1996). In Agbola and Nwokoro 2001; 2008); direct and indirect interplay between environmental happenings and health outcomes were identified to

show that environmental conditions and dynamics impact human and animal health.

c. Environmental planning and health: planning the environment as the bedrock for healthy city were captured (Agbola and Odufuwa, 2008; Agbola and Kasim, 2009). In relation to housing and health, Agbola and Akinbajo (1995), Agbola et al. (2007) and Agbola and Omirin (2008) linked the health of residents to the quality of their housing in terms of structural conditions, access to ancillary services, quality of indoor air and types of energy used for cooking in homes.

d. Climate change and health: Land use and land cover dynamics studies with emphasis on the impetus of human activities on environmental degradation and its impacts on quality of life were reported in Agbola and Olurin (2005). Forces of urbanization and health implications were examined in Agbola (1989). Other contributions include descriptive analysis of the linkage between extreme weather events and environmental health in human settlement (Agbola et al., 2014; Agbola, 2019).

Agbola has also contributed to knowledge in environmental health studies through consultancy services in the area of development of Environmental Profile of Cities (1993), Health related conclusions of the Sustainable Ibadan Project in 1995; Urban Management Programme's project on Biomedical Waste Management in 1999; Urban Housing indicator program in 2001

were carried out to trace the non-medical parameters to the wellness of the environment.

Agbola, as a member of Africa's Panel of Experts on Urban Environmental Planning and Management has also coordinated many studies which were supported by the WHO, United Nations Centre for Human Settlement (UNCHS) and the UN-Habitat. Examples include: the Urban Management Programme's Project on Environmental Sanitation in Low Income Communities in year 2000; the Global Campaign for Good governance in Nigeria: Safer Cities Programme in 2001.

In terms of capacity building, Agbola taught environmental-health related modules for the Postgraduate Classes (Masters, MPhil and Ph.D) of Urban and Regional Planning; Masters Class of Housing Management and Development programme and the Masters Class of Public Health. Courses taught include; Environmental Planning and Management, Housing and Health, Urbanization and Health etc. He has supervised more than 140 students' postgraduate theses and dissertations and not less than 40 of these focused on environmental health issues as categorized in Table 1 (Agbola, 2019). For the purpose of reference, Nwokoro 2008 work 'women and environmental health inequality' which was supervised by Agbola is the first Ph.D graduate's thesis of the Department of Urban and Regional Planning, University of Ibadan, Nigeria.

Table 1: Some Postgraduate Students' Projects that were supervised by Agbola (1985-2017)

| S/N | Sub-themes | Authors and the years the theses were submitted to the University of Ibadan |
|-----|---|--|
| 1 | Housing and health | Akinbamijo, 1988; Ibimilua, 1988; Olawale, 2005; Bello, 2008; Fidudusola, 2009, Adedeji, 2011 |
| 2 | Environmental quality, risk management and health | Ejiogu, 1994; Oladukan, 2003; Oladimi, 2004; Eweoya, 2006; Latef, 2001; Adetunji, 2004; Nwokoro, 2008, Aiworo, 2010, Jemlawo, 2012, Oladejo, 2015, Adejare, 2015 |
| 3 | Physical planning, livelihoods and health | Okewo, 1989, Badeku, 1989; Lateef, 2001; Oladosu, 2013, Jihan, 2014 |
| 4 | Climate change, land use and health | Gana, 2000; Adebayo, 2012; Adeniyi, 2017 |
| 5 | Water services and health | Adewoyin, 1999; Adejuwon, 2000; Gognage, 2004; Adeniji, 2005 |
| 6 | Sanitation, waste management and health | Odeyemi, 2000; Osoko, 2000; Oke, 2003 |
| 7 | Health policy and Institutional analysis | Kazim, 2004; Adediran, 2003. |

Source: Categorized based on Agbola, 2019

5.0 Conclusion

From Hippocrates till date, environmental factors influence health outcomes in both developed and developing countries. As highlighted in this paper, studies on environmental health-related themes are largely done with the application of theories, concepts and models to show that there is an interplay between health and the environmental conditions. However, there are some challenges and research needs that must be addressed. These include:

1. Inadequate referenced data: There are no coordinated data systems that can be sourced and used for effective EH planning in most developing countries. And where some data are available, they are not accessible for the end-users. For instance, there are no up-to-date

census data. Surveillance mapping and environmental health risks assessment are not up-to-date in Nigeria. This is a major setbacks in tracing the progress of Global health agenda at micro and macro levels. Most often, donor agencies, academia and practitioners rely on estimates. There is a need for a coordinated, periodic data capturing and sharing for EH planning.

2. Uncertainties in environmental dynamics: There are a lot of uncertainties in terms of pressure on the quality of resulting from environment-health outcomes of globalization and environmental changes. Emergence and re-emergence of diseases; and the diffusion of diseases which have capability to impact environmental health and other socio-economic systems, not just at community level

but at the global level are difficult to predict and managed.

3. Multidisciplinary nature of EH studies: As shown in the section on study models, no single discipline or single professional approach can claim entirety of knowledge and techniques that can be used to address EH problems. And this is the reason why solution by one disciplinary approach might create other dimensions of the problem for other disciplines.

In order to address the identified challenges, the following are recommended:

1. National funding systems for data capturing should be revitalised. New studies should focus on feedbacks from environmental conditions and progress on health-related targets which may actually form the basis for health planning especially at micro level. Also, robust analytical tools can be used to aid analysis of environmental health 'big data' especially when researchers are working on mesoscales should be explored.

2. Scenario planning: In order to address the uncertainties, scenario planning is essential by creating possible alternative futures. This allows planners to anticipate problems by studying trends, reassessing assumptions and designing for alternative better future.

3. Holistic and inclusive research approach. This is needed in order to engage communities, governmental, academic and other

stakeholders in developing a shared agenda for applied research on EH. There is a need for deliberate collaboration among researchers for inter-disciplinary and multi-disciplinary discourse through exchange programme across universities and faculties.

In conclusion, emerging themes that researchers in environmental health can explore include, disaster and risk assessment of settlement, application of Geographical Information System (GIS) for mapping of diseases, climate change/ variation and emergence/re-emergence of ill-health especially at micro levels, trends and patterns of environmental ill-health, social polarization and bio-terrorism. There could never be a better time for planners to be proactive in environmental health planning than now.

References

- Adesina, H. (1990). Modelling the Cholera diffusion processes. In Rais A and Yola V. (Eds.) *Disease Ecology and Health: Readings in Medical Geography*. India: Rawat Publications, pp. 51-57.
- Agbola, T. (1993). The Meaning, Origin and Challenges of the Healthy Cities Approach, in Agbola, T. and Egunjobi, L. (eds), *Environmental Health and the Potential of the Healthy City Approach in Nigeria*. Proceedings of the First Healthy City Conference in Nigeria, 14th – 16th June, 1993.

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References

- Adesina, H. (1990). Modelling the Cholera diffusion processes. In Rais A and Yola V. (Eds.) *Disease Ecology and Health: Readings in Medical Geography*. India: Rawat Publications, pp. 51-57.
- Agbola, T. (1993). The Meaning, Origin and Challenges of the Healthy Cities Approach, in Agbola, T. and Egunjobi, L. (eds), *Environmental Health and the Potential of the Healthy City Approach in Nigeria*. Proceedings of the First Healthy City Conference in Nigeria, 14th – 16th June, 1993.

- Agbola, T. and Akinbanjo, A.O. (1995). Housing and Health Characteristics: An Epidemiological Study of a Tropical City in Iyuna, B.F., Verhasselt, Y., and Hellen, J. A. (eds), *The Health of Nations: Medicine Diseases and Development in the Third World*, Aldershot: Avebury, pp. 97-105.
- Agbola, T. and Egunjobi, L. (eds.), (1996). *Environmental Health and the Potential of the Healthy City Approach in Nigeria*, Ibadan: Joytal Press.
- Agbola, T. and Mabawonku, A.O. (1996). Indigenous Knowledge, Environmental Education and Sanitation: Application in an Indigenous African City in Warren, D. M., Egunjobi, L. and Wahab, B. (eds.), *Indigenous Knowledge in Education*, Ibadan: Ageless Friendship Press. pp.78-94
- Agbola, T., Olatubara, C. Wahab B., Sanni L., Ipingbemi. O. (eds), (2008). *Environmental Planning and Health in Nigeria: Essays in Honour of Professor Timothy Olayiwola Egunjobi*, Ibadan: Department of Urban and Regional Planning, University of Ibadan.
- Agbola, T. and Olurin, T.A. (2000). Social and Environmental dimensions of the Changing Land Cover Pattern in Ibadan: A Hilly indigenous African City, *Nigeria Journal of Economic and Social Studies*, 42(3), 381-400.
- Agbola, T. and Nwokoro I. (2001). Environment and Health in Developing Countries: Explaining the Intra-Urban Health Differentials in an Indigenous African City. *African Notes*, 25(1 & 2), 5-19.
- Agbola, T. (2001). Turning Municipal Waste into Compost: the Case of Ibadan, in Drechsel, P. and Kunze, D. (eds), *Waste Composting for Urban and Peri-Urban Agriculture: Closing the Rural-Urban Nutrient Cycle in Sub-Saharan Africa*, New York: CABI Publishing, pp 69-81.
- Agbola, T. (2003). Water Supply and the Protection of Urban Watersheds, in NWRI (eds), *Towards the Millenium Development Goals: Actions for Water and Environmental Sanitation*, Proceedings of the 29th WEDC International Conference, 17-19th Sept, Abuja, Nigeria, pp. 26-28
- Agbola, T. and Olurin, T.A., (2005). Land use and Land cover Change in the Niger Delta, in Fayemi, K., Amadi, S. and Bamidele, O. (eds), *Towards an Integrated Development of the Niger Delta*, Lagos: Centre for Democracy and Development. pp. 157-186.
- Agbola, T., Nwokoro, I. and Kassim

- F. (2007). Housing and Health, in Agbola, T., Egunjobi, L. and Olatubara, C. (eds), *Housing Development and Management: A Book of Readings*, Ibadan, Department of Urban and Regional Planning, University of Ibadan, pp. 499-537.
- Agbola, T. and Adeniji, G. (2007). Water and Sanitation in Ibadan: Issues and Remedial Interventions. Paper Presented at the National Stakeholders Conference on Sanitation Organised by the National Orientation Agency, Held at the Cultural Centre, Mokola, Ibadan on Wednesday, 15 August, 2007.
- Agbola, T. and Adeniji, G. (2009). Natural Spring Project: Communities Initiatives to Water resources Management in Ibadan, Nigeria. *Paper presented at the 7th International Science Conference on the Human Dimensions of Global Environmental Change*, Bonn, 26-30th April.
- Agbola, T. and Nwokoro, I. (2008). Conceptualizing Environment and Health in Agbola, T., Olatubara, C.; Wahab B., Sanni L., and Ipingbemi. O. (ed), *Environmental Planning and Health in Nigeria: Essays in Honour of Professor Timothy Olayiwola Egunjobi*, Ibadan: Department of Urban and Regional Planning, University of Ibadan. pp. 18-34.
- Agbola, T. and Odufuwa, B. (2008). "Shifting Paradigms in Environmental Planning and Health" in Agbola, T., Olatubara, C.; Wahab B., Sanni L., and Ipingbemi. O. (eds), *Environmental Planning and Health in Nigeria: Essays in Honour of Professor Timothy Olayiwola Egunjobi*, Ibadan: Department of Urban and Regional Planning, University of Ibadan. pp. 35-61.
- Agbola, T. and Omirin, J.O. (2008). Housing: The Health Implication, in Agbola, T., Olatubara, C., Wahab B., Sanni L., and Ipingbemi. O. (eds), *Environmental Planning and Health in Nigeria: Essays in Honour of Professor Timothy Olayiwola Egunjobi*, Ibadan: Department of Urban and Regional Planning, University of Ibadan. pp. 134-170.
- Agbola, T. (2009). Healthcare Wastes and Their Management: Global Scenario, in Sridhar, M.K.C., Wahab, B., Agbola, T. and Badiane, A. (eds), *Healthcare Wastes Management: A Handbook for Developing Countries*, Ibadan: Ibadan University Press.
- Agbola, T. and Kasim, O.F. (2009). Unbundling the Potentials of Waste: Recycling Urban Organic Waste for Urban Agriculture, *Paper Presented at the Formal Inauguration of*

- the FUTA Alumni Association, Oyo State Branch, 19th Sept at the Board Room of the Postgraduate School, University of Ibadan.*
- Agbola, T., Sridhar, M.K.C., Wahab, B., Olatubara, C.O., and Olurin, T.A. (2009). *Healthcare Wastes management in Ibadan: A Case Study from Nigeria*, in Sridhar, M.K.C., Wahab, B., Agbola, T., Badiane, A. (eds), *Healthcare Wastes Management: A Handbook for Developing Countries*, Ibadan: University Press.
- Adeniji-Oloukoi, G., and Agbola, T. (2014). An Assessment of the Quality of Natural Spring Water Used as Alternative Domestic Water Sources in Ibadan, Nigeria, in Oku, E., Asubonteng, K. and Nitakor, P. (eds), *Harnessing Land and Water Resources for Improved Food Security and Ecosystem Services in Africa*, Accra: United Nations University, INRA, pp. 61-80
- Agbola, T. (2019). Effects of Climate Change on Human Settlement Development. *Paper presented for Key Note Panel Session at the 3RD International Research Conference on Climate Change & the Built Environment*. BA ISAGO Convention Centre (Gaborone, Botswana), 3-4, October.
- Agbola, T. (2019). *From 'Ceteris Paribus' to the 'Overall Public Interest': The Making of the Ibadan School of Planning*. A Valedictory Lecture, Ibadan: University of Ibadan.
- Ajaegbu, H and Ilusemiju, B. (1970). The distance factor in medical geography: Examples from studies in Nigeria. *Paper presented at the West Africa Science Association Conference*, Ibadan, 30th March - 4 April.
- Alcayna, T. (2015). *Slum Socio-Ecology: an exploratory characterisation of vulnerability to Climate change related disasters in the urban context*. Harvard humanitarian Initiative and Universidad de Oviedo, MSc. Thesis. Available online at 10.13140/RG.2.1.2294.2800. Accessed on March 11, 2020.
- A. (2008). The role of the state in public health. In Heggenhougen, *International Encyclopedia of Public Health*, 2nd ed. Oxford: Academic Press pp. 211-218.
- Anna, K. (2001). "The biggest enemy of health in the developing world is poverty" *The UN Secretary General's Speech at the fifty-fourth World Health Assembly held in Geneva, May 17, 2001*. Available at <https://www.un.org/press/en/2001/sgsm7808.doc.htm>, Accessed February 4, 2020.
- Barrett, F. (2000). Finke's 1792 map

- of human diseases: The first world disease map? *Social Science & Medicine*, 50, 915-21. 10.1016/S0277-9536(99)00344-5.
- Barton, H. (2009). Land use planning and health and well-being. *Journal of Land use Policy*, 26, (1), S115 - S123. doi.org/10.1016/j.landusepol.2009.09.008
- Becker, M. H. and Maiman, L. A. (1975). Socio-behavioral determinants of compliance with health and medical care recommendations. *Medical Care*, 134(1), 10-24.
- Beenackers, M. A., Groenigera, J., Carlijn B.M., Kamphuisb, O., Frank, J. and Van L. (2018). Urban population density and mortality in a compact Dutch city: 23-year follow-up of the Dutch GLOBE study. *Health and Place*, 53 (2018), 79-85. <https://doi.org/10.1016/j.healthplace.2018.06.010>.
- Bimal Kanti, P. and Harun, R. (2017). *Climatic Hazards in Coastal Bangladesh*, Butterworth-Heinemann, Amsterdam: Elsevier. <https://doi.org/10.1016/B978-0-12-805276-1.01001-2>
- Blashki, G., McMichael, T. and Karoly, D. (2007). Climate change and primary health care. *Australia Family Physician*, 36(12), 986-989.
- Bowen, D., Neill, J., Williams, I., Mak, A., Allen, N., and Olson, C. (2016). A Profile of Outdoor adventure interventions for young people in Australia. *Journal of Outdoor Recreation, Education, and Leadership*, 8, 26-40. doi: 10.18666/JOREL-2016-V8-I1-7281.
- Confalonieri, U., Menne, B., Akhtar, R., Ebi, K.L., Hauengue, M., Kovats, R.S., Revich, and Woodward, A. (2007). Human Health. In M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge: Cambridge University Press, pp.391-431.
- Corey J. A., Bradshaw, S., Zia. M., Annamalai, A., Heft-Neal, S., Wagner, Z. and Souëf, P. (2019). Testing the socioeconomic and environmental determinants of better child-health outcomes in Africa: a cross-sectional study among nations. *BMJ Open*, 2019; 9 (9): e029968 doi: [10.1136/bmjopen-2019-029968](https://doi.org/10.1136/bmjopen-2019-029968)
- Costello, A., Abbas, M., Allen, A., Ball, S., Bell, S., Bellamy, R., Friel, S., Groce, N., Johnson, A., Kett, M., Lee, M., Levy, C., Maslin, M., McCoy, D., McGuire, Montgomery, H., Napier, D., Pagel, C., Patel, J., Puppim de Oliveira, J.,

- Redclift, N., Rees, H., Rogger, D., Scott, J., Stephenson, J., Twigg, J., Wolff, J. and Patterson, C. (2009). Managing the health effects of climate change. *Lancet*, 373, 1693-1733.
- Ebi, K. L., Burton, I. and Menne, B. (2006). Policy implications for climate change related health risks. In: Menne, B. and Ebi, K. (eds), *Climate Change Adaptation Strategies and Human Health*. Darmstadt:Steinkopff, pp. 297-310.
- Ebi, K.L., Berry, P., Campbell-Lendrum, D., Cissé, G., Hess, J., Ogden, N. and Schnitter, R. (2019). *Health System Adaptation to Climate Variability and Change*. Rotterdam and Washington, DC:Elsevier Science Ltd,. Available online at www.gca.org. Accessed on August 4, 2020.
- Editors, *Health and Place*, (1996). 2(1), pg iii-v, England.
- Egunjobi, L. (1983). Factors that influence choice of hospitals: a case study of the northern part of Oyo State, Nigeria. *Social Science & Medicine*, 150D (13), 121-132.
- Engemann, K., Pedersen, C., Arge, L., Tsirogiannis, C., Mortensen, P and Svenning, J. (2019). Residential green space in childhood is associated with lower risk of psychiatric disorders from adolescence into adulthood. *PNAS*, 116 (11), 5188-5193.
- doi.org/10.1073/pnas.1807504116.
- Environmental Health Officers Registration Council of Nigeria (EHORECON, 2015). History of Environmental Health. Available at <https://www.ehorecon.gov.ng/welcome>. Accessed on January 10, 2020.
- European Centre for Environment and Health (ECEH, 2018). *Healthy environments for healthier people*, WHO Regional Office for Europe. Copenhagen O, Denmark, WHO. Available at <https://www.euro.who.int/en/about-us/organization/office-locations/who-european-centre-for-environment-and-health-eceh,-bonn,-germany/healthy-environments-for-healthier-people-2018>. Accessed on August 3, 2020.
- Hawkins, B. and Alvarez-Rosete, A. (2017). *The Role of the State in Public Health in International Encyclopedia of Public Health* (2nd Edition), 2017, London: Routledge, doi.org/10.1016/C2009-1-28516-9.
- Hippocrates, A. (1886). On Airs, Waters and Places: *The Genuine Works of Hippocrates*. New York; William Wood. Translated by Francis Adam. Available at <http://classics.mit.edu/>

- [Hippocrates/airwatpl.1.1.html](#). Accessed on January 10, 2018.
- Iyun, B. (1987). Ecology of Disease in Nigeria. *Geographical Media*, 17:85-128.
- Jimon, A. and Oliver, R. (2014). "Health Behaviour and Illness Behaviour" in Jimon A. (ed.) *Medical Sociology in Africa*. doi:10.1007/978-3-319-03986-2-3. Switzerland Springer International Publishing.
- Kistenkas, F. and Bouwma, I. (2018). *Barriers for the ecosystem services concept in European water and nature conservation law. Ecosystem Services*, 29 (2018), 223-227
- Levengood, J., Horman, A., O'Brien, K. (2018). Water Security in a Changing World in Hernman J.A and Johnson-Walker, Y. (eds) *Beyond One Health: From Recognition to Results*. New Jersey: John Wiley and Sons, Inc. doi.org/10.1002/9781119194521.ch4.
- McCalley, E. M. (2018). Catholicism, Contraception, & the Bottom Billion: A Grounded Theory Study of Family Planning & Global Poverty. An Honors Thesis Submitted to the Faculty of Baylor University, Texas. Available at https://baylorir.tdl.org/bitstream/handle/2104/10279/emily_mccalley_honorsthe sis.pdf?sequence=1&isAllowed=y, Accessed on March 10, 2020
- McMicheal, A. J., Friel, S. Nyong, A. and Covalan, C. (2008). Global environmental change and health: impacts, inequalities, and the health sector. *BMJ*, 26 (336), 191-194.
- Mofolorunsho, K. C. (2016). Outbreak of Lassa fever in Nigeria: Measures for prevention and control. *Pan African Medical Journal*, 23 (2 0 1 6) , 23 <https://doi.org/10.11604/pamj.2016.23.210>.
- Nash, T. (1948). *The Auchan Rural Development and Settlement Scheme*. London: HM50 for the Colonial Office
- National Environmental Health Association (NEHA, (2013). New Perspectives on Environmental Health: The Approval of New Definitions, *Journal of Environmental Health*, 76(3), 72.
- Nhamo, G., Nhemachena, C. and Nhamo, S. (2019). Is 2030 too soon for Africa to achieve the water and sanitation sustainable development goal? *Science of the Total Environment*, (June), 129-139. <https://doi.org/10.1016/j.scitotenv.2019.03.109>.
- Nwokoro, I. and Agbola, T. (2018). Environment and Health Inequalities of Women in Different Neighbourhoods of Metropolitan Lagos, Nigeria. In Juliana A. Maantay Sara McLeary (ed.), *Geospatial Analysis of Environmental*

- Health*. Switzerland: Springer Nature, pp.283-302
- Nwokoro, I. (2017). *Cascading Myths of Environmental Health: Planning for the Poor and the Vulnerable Groups in Nigeria's Urban Areas*, Inaugural Lecture, Lagos: University of Lagos.
- Nwokoro, I., Olayinka, D. and Okolie, C. (2017). Stress and Environmental Health of Women in different Neighbourhoods of Lagos Metropolis. *Nigerian Journal of Environmental Sciences and Technology (NIJEST)*, 2(1), 1-10
- Okafor, S. (1979). *Spatial Efficiency of General Hospitals in Afenmai, Nigeria*. *The Nigerian Geographical Journal*, 22(2), 175-184.
- Oloukoi, G., Bob, U. and Jaggernath, J. (2014). Perception and trends of associated health risks with seasonal climate variation in Oke-Ogun region, Nigeria. *Journal of Health and Place*, 25 (2014): 47–55. doi 10.1016/j.healthplace.2013.09.009.
- Phillips, D. R. (1981). *Contemporary Issues in the Geography of Health Care*, Norwich: Geo Books, pp. 1-44.
- Propheto, R. (1983). "Medical Geography in Tropical Africa", in McGlashan, N. and Blunden, J. (eds) *Geographical Aspects of Health*, London: Academic Press, pp. 23.
- Prüss-Üstün, A., Bonjour, S., and Corvalán, C. (2008). The impact of the environment on health by country: a meta-synthesis. *Environmental Health*, 7(1), 7.
- Ratcliffe, J. (1974). *An Introduction to Town and Country Planning*. London: Hutchinson & Co. Publishers Ltd.
- Shafiei, S., Yazdani, S. and Jadidfard, M. (2019). Measurement components of socioeconomic status in health-related studies in Iran. *BMC Research Notes*, 12(70). <https://doi.org/10.1186/s13104-019-4101-y>.
- Shehu, D. (1992). "Socio-Cultural factors in the causation of maternal mortality and morbidity in Sokoto", in Kisseka, M. (ed.) *Women's Health Issues in Nigeria*. Zaria: Tamaza Publishing Company Limited, pp. 203-214.
- Smith, K.R., Woodward, A., Campbell-Lendrum, D., Chadee, D.D., Honda, Y., Liu, Q., Olwoch, J.M., Revich, B. and Sauerborn, R. (2014). Human health: impacts, adaptation, and co-benefits. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge: Cambridge University Press, pp. 709-754.

- Smith, D. M. (1977). *Human Geography: A Welfare Approach*. London: Edward Arnold
- Thomson, K., Hillier-Brown, F. and Todd, A. (2018). The effects of public health policies on health inequalities in high-income countries: an umbrella review. *BMC Public Health* 18, 869. <https://doi.org/10.1186/s12889-018-5677-1>.
- Tong, S. and McMichael, A.J. (2011). Climate Change and Health: Risks and Adaptive Strategies. In *Reference Module in Earth Systems and Environmental Sciences*, 2013. *Encyclopedia of Environmental Health*, 690-698. <https://doi.org/10.1016/B978-0-12-409548-9.01752-8>.
- Ubi, P. and Ndem, B. (2019). Poverty and Health Outcomes in Nigeria. *International Journal of Economics and Financial Issues*, 9: 132 - 141. doi_10.32479/ijefi.8704.
- United Nations, Department of Economic and Social Affairs, Population Division; 2017. *World Population Prospects. The 2017 Revision*. New York: The United Nations Available online at <https://esa.un.org/unpd/wpp/Download/Standard/Fertility/>. Accessed 10 April 2019).
- University of Georgia (UGA, 2005). Global Health Institute Available at <https://publichealth.uga.edu/research/research-institutes/>. Accessed February 20, 2017.
- USAID (2019). Improved access to resources lie water an prevent potential conflict <https://www.usaid.gov/nigeria/water> accessed February 4, 2020.
- World Health Organization (WHO, 1946). WHO Constitution. WHO, Geneva. Available at www.who.int/governance/who_constitution_en. Access on February 10, 2020.
- WHO (2003). *Looking back: looking ahead: five decades of challenges and achievements in environmental sanitation and health*. Geneva: WHO.
- WHO (2006). *Preventing disease through healthy environments*. Geneva: WHO.
- WHO (2016). *Neglected tropical diseases. Prevention, control, elimination and eradication*. Report by the Secretariat to the Sixty-sixth World Health Assembly, Geneva, 20-28 May 2013. Geneva: World Health Organization; 2013. Provisional agenda item 16.2 (http://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_20-en.pdf?ua=1, accessed 12 April 2019).
- WHO (2018). *Global Health Estimates 2016: Deaths by cause, age, sex, by country and by region, 2000–2016*. Geneva: WHO. Available online at <http://www.who.int/healthinfo/>

global_burden_disease/estimates/en/index1.html. Accessed 22 April 2019.

WHO (2019). Poverty and Health. Available at <https://www.who.int/hdp/poverty/en/>. Accessed on February 4, 2020.

WHO/UNICEF JMP (2019). *Joint Monitoring Programme: Progress on household drinkingwater, sanitation and hygiene, 2000-2017*, New York: WHO/UNICEF.

SPATIAL DISTRIBUTION OF DUMPSTERS URBAN SOLID WASTE COLLECTION STRATEGY IN ENUGU METROPOLIS, NIGERIA

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Abstract

The Enugu State Waste Management Authority (ESWAMA) established by Act No.8, Edict 19 of 2004, of Enugu State, Nigeria is responsible for the management of wastes in the state. It introduced the use of dumpsters as a waste collection strategy to replace the initial open dump sites scattered all over the city. At such, dumpsters were placed at various locations in the city. Incidentally, the utilization of dumpsters requires efficiency in its location, distribution and management. This study therefore examined the spatial distribution of dumpsters in Enugu metropolis with a view to determining its effectiveness and evolving measures for efficient waste collection strategy. The study adopted the survey approach. Primary and secondary data were used. The Nearest Neighbour statistical analysis was employed in determining the effectiveness of the spatial pattern of dumpster distribution for solid waste collection in Enugu metropolis. Findings showed that the pattern of dumpster locations was randomly. Furthermore, most dumpsters were found to be outside the convenient reach of the target population of residents in the metropolis at a record of 2.10 Rn, index and a determined deficit of 1,187 dumpsters. This undermining factor indicates the point of ineffectiveness of ESWAMA at solid waste management in the city. The study therefore recommended a planned distribution of dumpsters in the metropolis at a determined Rn index value of 0.8 and the provision of additional dumpsters in the city so as to attain a suitable standard spacing distances that can be convenient enough for the residents for effective solid waste disposal in the city.

Keywords: urban; solid waste collection; spatial distribution; dumpster

1.0. Introduction

Rapid urbanization and population growth have brought about an unprecedented and disproportional increase in the amount of waste generation and disposal in most cities of developing countries like Nigeria. Initially, open refuse dump sites were situated at different locations across the various urban residential neighborhoods in Enugu for solid waste disposal. This method is associated with pollution and poor environmental quality. Recently, the trend was improved by the

introduction of dumpsters and compactors with a view to providing solutions to the numerous environmental problems posed by the use of open dump sites for waste disposal as was the case of Enugu (ESWAMA, 2004). The inability of many government agencies to effectively manage the collection of these wastes especially in most urban areas; have become an issue of great concern given the huge sums of money spent on procurement of dumpsters as indicated by ESWAMA (2013). Besides hampering the

aesthetic quality of urban landscape, the inefficient way of managing the entire solid waste collection system is also a problem. On the other hand, the littered heaps of refuse dumps and dumpsters that are overflowing with refuse seen at nooks and crannies of the city do not only constitute obstructions to traffic flow, but also constitute health and environmental hazards.

The Enugu State Waste Management Authority (ESWAMA) was established by Act No. 8, edict 19 of Enugu State, Nigeria in 2004. The agency introduced the use of dumpsters as a solid waste collection strategy. In recent times, the efficacy of this strategy in addressing the issues of urban solid waste collection in Enugu has become questionable and needs to be examined. At the moment, there are hundreds of dumpsters placed at different locations all over the metropolis, in order to facilitate the collection of generated solid wastes. However, mountainous heaps of solid wastes still deface most parts of Enugu metropolis, obstruct traffic flow and generate unpleasant odors that pollute the air. Poor distribution of solid waste collection points also leads to other problems including indiscriminate waste disposal and blockage of drainage channels thereby increasing the risk of urban flooding and leachates that pollutes ground water sources. The pollution of air and water can be associated with some health issues such as

diarrhea, typhoid fever among others.

The major drawback in the present waste collection arrangement is the issue of the spatial distribution of dumpsters at many locations. This research was therefore directed towards finding suitable spatial pattern for dumpster location in the various neighbourhoods of the city. This is with a view to generating viable index distribution or pattern which can entrench efficiency in the solid waste management system in Enugu metropolis.

Waste has been defined as materials that have been considered by the producer to have no value. Tchobanoglous (1993) defined solid waste as all the wastes arising from human and animal activities which are normally solid and are discarded as useless or unwanted. Furthermore, the term solid waste is seen to be all-inclusive, encompassing the heterogeneous mass of throwaways from the urban community as well as the more homogeneous accumulation of agricultural, industrial, and mineral wastes (Tchobanoglous, 1993).

A waste manager, in order to determine the types and quantities of facilities required for solid waste management and the best disposal options needed in a particular city, would need precise information about the quantities (generation rate) and the nature of the constituents (composition) of the solid wastes produced in the city. In order to plan

for future provisions of facilities, a projected increase in quantities of each waste stream (source) should be estimated (Rushbrook, 1999). It follows therefore, that the frequency of collection, the size and number of facilities (both waste storage containers and collection vehicles), the capacity of landfill, and number of labour forces required are seemingly highly dependent upon the rate of generation of solid wastes (Anierobi, 2010; Anierobi and Efobi, 2013). This means that the composition and the nature of the components of solid wastes generated in a city, influences the method of disposal. The decision to use compositing, recovery and recycling, incineration or mere land-filling (or dumping) depends on the nature of the constituents of the solid waste.

The characteristics, quantities and rate of generation, as well as the composition of solid wastes vary from region to region, from city to city and even from community to community within a city, as well as from time to time, depending on a number of factors. Some of the main factors that influence the rate of generation and composition of solid wastes, for instance, as indicated in a report by World Health Organization, (1976) and cited in Rushbrook, (1999), include population, standard of living (i.e. economic status of the people via the average level of income of the people), the social, religious and customs of the people, attitude of the

people, physical characteristics of the city (e.g. climate and seasonal variation), the sources of the wastes, and awareness of public health. As the economic prosperity of a people increases, the quantity of solid wastes generated increases in weight, volume, and nature, while the relative proportion of constituents of solid wastes also changes (Rushbrook, 1999; Edelman, 1997; Anierobi, 2010). Similarly, the average income level of society affects the composition of generated solid wastes both physical and chemical. Typically, individual components of municipal solid wastes include putrescible and non-putrescible items such as food wastes, paper, plastics and rubber, textiles, leather, cardboard, wood, bones and straw, metals, glass and ceramics, ashes, particles of 10mm size, etc (Rushbrook, 1999 and Edelman, 1997). Income groups in the society vary significantly with the type of wastes generated such as electronic wastes, pieces of furniture, metals, paper, cardboard, plastics, textiles, heavier organic materials among others which proportionally constitute larger part of higher-income groups than in lower income groups in various countries of the world. Besides these, putrescible items like garbage and ashes constitute a predominant proportion of the municipal solid wastes in less developed countries especially in the lower income groups (Rushbrook, 1999; Edelman, 1997; Tchobanoglous, 1977 and 1993).

The influence of population size on the characteristics of municipal solid wastes, particularly on the quantities of solid wastes generated is very high and direct. Obviously, when there is an increase in the population size, there will be an increase in the total amount of waste generated, even if other variables remain the same. Adequate knowledge and information on these and other characteristics of waste produced in a particular urban center will also help an urban manager identify and select suitable waste treatment processes, storage and collection facilities, disposal methods, and disposal sites (Rushbrook, 1999; Tchobanoglous, 1977 and 1993). From the foregoing, waste management in Enugu requires among other things, the enhancement of the collection strategy so as to achieve efficiency in the system.

2.0. Conceptual Framework and Literature Review

2.1. Solid Waste Collection Services: World View

Solid waste collection is the gathering or picking up of solid wastes from various sources. Solid waste collection services are usually provided by the government but sometimes in partnership with the private sector. However, whose responsibility it is depend upon two factors namely: the relatively unchanging (relatively permanent); and the variable factors as indicated by Hagerty, (1973). In view of that,

the relatively permanent factors were identified as the population distribution and density in the collection area, the climatic factors and the characteristics of wastes produced in different activity sections in the area; while the variable factors include the disposal methods currently used in that community, the available type of collection equipment, the customary collection frequencies in various areas, and the overlap and extent of responsibilities among municipality, contractors, private companies, and the traditional or required labour practices in the given area. According to Anierobi, (2010) there exists some contrasts in refuse collection methods; such could be by house-to-house method which is prominent in most developed countries like Britain, United States of America among others; and the other is a collection service in which residents carry their wastes in waste bins and empty them into the nearest central receptacle (dumpsters). The later is basically prominent in developing countries like Nigeria where open dumping and central receptacle is most commonly adopted. However, the system has a lot of problems associated with it as some people empty their refuse outside the receptacles and sometime, the receptacle is left to spillover before evacuation or clearance; thereby rendering the system inefficient. This opinion aptly captures the prevalent conditions

that characterize solid waste collection by the municipal agent in Enugu metropolis where most residents do not make it to the available dumpster before dropping off their wastes. This is probably because of the seeming inconveniency in the location of these receptacles or dumpsters.

2.2. Classification of Waste Collection Systems and Equipment

The classification of solid waste collection systems can be done on the basis of either the mode of operation, the equipment used, or the types of solid wastes collected as portrayed by Rushbrook, (1999) and Tchobanoglous, (1977). As regards the type of equipment, two types of container systems can easily be distinguished namely: Hauled and Stationary systems. The former uses large containers and are usually used in areas where there is high rate of generation and they seem more economical. However, since they are filled manually, low volume of utilization or misuse of the large containers are common phenomena. The United Nations Centre for Human Settlement (UN Habitat, 2011) has classified the collection system practiced particularly in developing countries under four headings: (i) Communal Collection (ii) Block Collection (iii) Curbside Collection and (iv) Door-to-door Collection. Each of the four methods have certain advantages and disadvantages. Thus, it is possible to

have the most economical and productive collection method, or by adopting a combination of these methods.

The onus therefore lies on the waste managers, to recognize and appreciate any existing local differences and selection of suitable collection method and equipment (International City Managers Association, 1957). The multiple and diverse equipment and workforce programmes, mechanization of collection operations, and labour efficiency as well as customer service levels, frequency of collection and location of containers, and the analysis of collection systems; that is, the unit time required to perform each task are also part of management's major concerns. Then collection routes must be laid-out so that both workforce and equipment are used effectively. Moreover, a master schedule for each collection route, on which the location and order of pick-up point to be serviced are found; should be prepared for use by the transportation dispatches and drivers (Tchobanoglous, 1977). In providing for these criteria, efficient collection of refuse can be achieved in solid waste management system, contrary to what is obtained in the operation of ESWAMA.

2.3. Spatial Distribution Standards for Dumpsters

Spatial distribution of dumpsters is essential for efficiency in municipal solid waste collection. At

such, the spatial location requires specific standards. In advanced countries, dumpsters are placed along the fence-lines for easy access to waste collectors and managers. According to the Department of Public Works and Environmental Services, City of Santa Barbara, USA (DPWES), 2011), the recommended maximum dumpster distance from residences is shown in table 1. For residential areas, the spatial maximum distance from the target population is 150 metres while that of commercial areas is measured at 250 metres.

Table 1: Standard for dumpster location in residential and commercial areas

| S | Land | Maximum Dumpster Distance from Land Uses (Metres) |
|---|------------|---|
| 1 | Resident | 150 metres from the nearest dumpster facilities |
| 2 | Commercial | 250 metres from the nearest dumpster facilities |

Source: DPWES (2011) and Ilo (2012)

2.4. Approximate Standard Dumpster Dimensions

There are different types of dumpsters for refuse collection according to need and the size of population it is intended to serve with respect to the waste generation rate. These include Decentralized Dumpsters /Simple Dumpster (kerb-side storage facility) and Centralized Dumpsters. The standard dumpster dimensions in the USA are shown in Table 2 according to the diameter with waste handles by height, width and depth characteristics.

Table 2: Dumpster dimensions for residential areas

| S | Diameter (with Waste handles) Cubic | He (inch) | He Metre | wi (inch) | wi Metre | De (inch) | De Metre |
|---|--|--------------|-------------|--------------|-------------|--------------|-------------|
| 1 | 1.5 cubic yard Dumpster | 8 | 2 | 3 | 0 | 4 | 1 |
| 2 | 2 cubic yard Dumpster | 8 | 2 | 4 | 1 | 5 | 1 |
| 3 | 2 cubic yard Dumpster | 8 | 2 | 4 | 1 | 6 | 1 |
| 4 | 3 cubic yard Dumpster | 8 | 2 | 5 | 1 | 7 | 1 |

Source: DPWES (2011) and Ilo (2012)

2.5. Centralized Waste Storage Sites for High Volume Generators

According to the Department of Public Works and Environmental Services, City of Santa Barbara, USA (DPWES, 2011), one large, central area for waste is only appropriate for developments or institutions that have dedicated janitorial staff who

can move waste from every tenant or occupant, to the site. Furthermore, the use of compaction and baling equipment can work well for a large operation with trained staff, but may not be suitable for areas where different tenants take out their trash and recycle them. At such, the situation might require that each

tenant will have to operate the compactor or balers, have a key to the system, and use it safely.

2.6. Decentralized Dumpsters

According to DPWES, (2011), temporary waste storage dumpsters are placed near kerb-sides to help collect waste materials from households to disposal sites. It is more cost effective and space efficient to have fewer dumpsters emptied more frequently, but frequent services in the early morning hours may be a quality of life issue in residential developments. Considerations like these were unlikely made in most cities of developing countries like Enugu and this seems to be affecting efficacy of dumpster utilization in the city.

2.7. Multi-Unit Residential and Dumpster Requirements

According to the Department of Public Works and Environmental Services, City of Santa Barbara, USA, (2011), it is more cost effective and space efficient to have the largest dumpster possible, but you may decide to limit the size for multi-units based upon accessibility considerations. Recommended maximum dumpster size is 3 yard³ for high densities, and 2 yard³ for low densities.

The following situations should be avoided for effective dumpster management:

- (1). Lack of easements or provisions for waste storage: Many areas in older parts of town have no outdoor provision for dumpster storage. Do not assume that containers can be placed outside the structure or that existing dumpsters can be used.
- (2). Mixing different container sizes or types: Smaller dumpsters and carts are easier to access than larger dumpsters, and people may overload the smaller ones rather than use them equally. Design for waste and recycling containers of approximately the same size and adjust for different volumes by changing the frequency of collection.
- (3). Exposed dumpsters: All outdoor dumpsters must be in enclosures so as to reduce the effects of air pollution.

2.8 Case Studies of Nearest Neighbour Analysis of the Spatial Distribution of Dumpsters in Cities

In Nigeria, Ajadi and Tunde, (2010) in their study on Ilorin adopted the Nearest Neighbour Analysis (NNA) to examine the spatial distribution of the dumpsters within the city. They discovered that the proportion of available

dumpsters for collection of generated wastes is high in some parts of the three residential areas. Despite this, the survey further revealed that, only 30%, 25% and 35% were for the old residential area (Magaji Ngeri) while the new residential area (Oko-erin) and the government reservation areas respectively could access dumpsters at distances between 100 meters to 200 meters away from their homes. However, a large proportion of more than 65% in the ORA, NRA, and GRA have waste dumpsters at not easily accessible distances to their homes and as far as between 300-700 meters apart. The distribution of dumpsters was found to be uneven and inadequate in catering for the solid waste disposal needs of residents in the metropolis. The Nearest Neighbour Analysis result of the study therefore reveals that the distribution of refuse depots is random. The Rn factor of 1.02 was computed for the three areas and the relative disposition of different locations indicates absolute randomness of refuse depots. The researchers analyzed this as showing dispersed measures in the three areas. It further indicated that some areas in the city such as ItaAmodu, Pipeline road, GaaAkanbi, Olorunshogo, Agbabiaka Lanjorin do not have dumpsters as the roads were so narrow to accommodate them. They also observed an unplanned dumpster distribution pattern and highlighted the need for

greater efficacy in solid waste management in the area. The study recommended that more efforts should be intensified to make the dumpsters more accessible to residents of Ilorin city.

In the case of Ethiopia, the municipal solid waste management agency of Ethiopia involved the Private sector like Dream Light Waste Management Company operating in Bahir Dar to decrease the amount of indiscriminate waste disposal areas around the city as reported by Cheever, (2011). Accordingly, the standard dumpster location requirement for the cities was determined and utilized at approximately 100-150 nearest neighbour distances to achieve the goal. Waste management was reportedly a major problem in Ethiopia; worsened by the killing of about 114-persons in the collapsed Koshe dump site which had been the only landfill in Addis Ababa for half a century. This incidence necessitated the waste-to-energy plant project in the city. The case studies of Addis Ababa and Bahir Dar of Ethiopia also indicated a sustainable waste management practices with an appreciable outcome in the assessment of the strengths and weaknesses.

Furthermore, the city of Santa Barbara, USA and even cities in Canada among other advanced countries, utilize the nearest neighbour technique to efficiently determine the dumpster in relation to location standards. Analysis of

DPWES, (2011) indicated that different sizes of dumpsters were utilized ranging from 1.5, 2, 3 or 4 cubic yards with different colours such as green, red, yellow or blue which were designated for recyclables or hazardous wastes. The containers were sited within 100-150 meters of walking distance from residences in the cities. For residential areas, the spatial maximum distance from the target population is 150 metres while that of commercial areas is measured at 250 metres. Incidentally, the dumpster location standard utilized by the Department of Public Works and Environmental Services, (DPWES) made for efficacy in waste disposal in the city of Santa Barbara, United States of America, (DPWES, 2011). The forgoing review is an indication of the relevance of suitable standards in the spatial distribution of dumpsters for effective waste collection. This study therefore demonstrates the application of Nearest Neighbour Analysis in determining the pattern of dumpster distribution in urban waste management system of Enugu metropolis.

3.0. The Study Area

Geographically, Enugu has an area of 72.52 square kilometers and situated between Latitude 06°21'N and 06°30'N and Longitude 07°26'E and 07°37'E. The map of Enugu is depicted in Figure 1. Historically, Enugu, popularly called the "Coal city" was founded in 1915

with a background on the discovery of coal in the Udi escarpment in 1909 hence, the name "Enu-Ugwu" meaning hill top (Chukwu, 1991). Since then, the coal mining settlement has expanded with the establishment of other mines such as Onyeama Mine, Okpara mine, Asata mine among others.

The economic significance of the coal mining activities gave rise to the establishment of administrative units by the then Sir Lord Fredrick Lugard colonial administration. Consequently, the city grew rapidly as migrants settled for mining jobs and by 1917, Enugu was classified as a second-class urban centre by the Township Ordinance of 1917 and was divided into the European and African settlement zones separated with a buffer zone or green belt. By 1925, Enugu became the administrative headquarters of the southern province and within the 1920-1930 year periods; other residential neighborhoods emerged in Enugu including Ogbete (Coal camp), Ogui, Asata, Railway Artisans' quarters, Iva Valley and Colliery Camp. With time, the increasing coal mining activities coupled with the Railway Company had ushered in more influx of people for economic and commercial ventures and by 1926, the built-up areas had extended to about two hundred and twenty hectares and by 1939, the city became the capital of Eastern Nigeria.



Figure 1: Map of Enugu Metropolis

Source: Google Map, 2015.

Demographically, the population of Enugu had increased overtime from a mere coal mining camp as recorded in various head counts. In 1926, the population of Enugu reached 3,170 while in 1931, it was 13,000 and by 1953, the population of Enugu reached 62,764 persons and by 1963 census the population of Enugu was shown as 138,451 persons. By 1978, the population of Enugu rose to 166,514 and new layouts were developed according to the 1978 master plan of Enugu. In 1986, Enugu had a population of 342,786

and in 1991, the census indicated a total population of 508,418 across the urban neighborhoods (Enugu State Ministry of Culture and Tourism, 2012). Enugu has continued to experience rapid growth such that by year 2014 and 2015, the projected urban population of the city was estimated at 953,272 and 1,009,768 respectively. This tremendous growth and expansion of Enugu has also affected the urban waste management system of the city. These are depicted in fig.1, fig.2, fig.3 and table 3 respectively.

Table 3: Population Distribution in Enugu by Neighbourhoods in 1986 and 1991

| | Neighbourhood | Land area (hectares) | Neighbourhood density | 1991 population | 2014 projected population | 2015 projected population |
|----|---------------------|----------------------|-----------------------|-----------------|---------------------------|---------------------------|
| 1 | Abakpa | 50.2 | High | 90,619 | 171,025 | 179,969 |
| 2 | Asata | 45.0 | High | 21,828 | 41,196 | 43,350 |
| 3 | Iva Valley | 50.3 | High | 8,891 | 16,323 | 17,657 |
| 4 | Akwuke | 16.6 | High | 3,326 | 6,277 | 6,605 |
| 5 | Coal Camp/Ogbete | 34.0 | High | 2,994 | 49,058 | 51,624 |
| 6 | Ogui New/ Layout | 44.3 | Medium | 41,237 | 75,707 | 81,896 |
| 7 | Emene | 53.5 | High | 79,033 | 149,160 | 156,959 |
| 8 | Gariki Awkunanau | 98.7 | High | 19,662 | 37,108 | 39,048 |
| 9 | Obiagu | 43.0 | High | 5,487 | 10,356 | 10,897 |
| 10 | Amechi Awkunanaw | 67.47 | High | 13,441 | 25,367 | 26,693 |
| 11 | Nike | 138.2 | High | 34,501 | 65,114 | 68,578 |
| 12 | Achara Layout | 955.0 | Medium | 50,427 | 91,171 | 100,148 |
| 13 | Maryland | 40.4 | Medium | 4,666 | 8,806 | 9,266 |
| 14 | Uwani | 61 | Medium | 31,875 | 60,158 | 63,303 |
| 15 | New Haven | 48 | Medium | 18,753 | 35,393 | 37,243 |
| 16 | GRA | 233.3 | Low | 19,600 | 36,992 | 38,925 |
| 17 | Independence Layout | 30.5 | Low | 24,466 | 46,175 | 48,580 |
| 18 | Idaw River | 75.0 | Medium | 3,138 | 6,231 | 6,231 |
| 19 | Trans Ekulu | 103.9 | Low | 11,474 | 21,655 | 22,787 |
| 20 | Total | 251346 | | 508,418 | 953,272 | 1,009,768 |

Source: Diary of Enugu State Ministry of Culture and Tourism, (2012);
Projected by Researcher to 2015.

The Enugu State Waste Management Agency (ESWAMA) is responsible for disposal of the wastes generated by the population across neighborhoods of the city. Although dumpsters were recently distributed across the neighborhoods for solid waste collection; heaps of refuse dumps still litter some parts of the city thereby raising concerns on the efficacy of the dumpster method.



Plate 1. Officials of the Enugu State Waste Management Agency (ESWAMA), evacuating Urban Solid Wastes from dumpsters across neighborhoods.
Source: Research Survey, 2015.

4.0. Study Methodology

The study adopted a survey approach and the Nearest Neighbour statistical analysis was utilized. The NPC, (2006) estimated area density of 72.8km² that accommodates the population of 722,664 residents and the 1991 census that indicated the population spread across 18 neighbourhoods in Enugu city were utilized. Data on the location and number of dumpsters in different neighbourhood densities were collected from the official records of ESWAMA. The average distances of dumpsters from homes and from one another were determined and recorded accordingly. The Nearest Neighbour Analytical method was utilized and the decision rule states

that the R_n value ranges from zero (when there is no distribution at all) to 2.15 (when facilities have a maximum spacing, i.e. dispersed); while a purely random distribution has an index of 1.0; and the values above 1.0 indicate a tendency towards spacing (dispersed) and those below 1.0 indicate clustering (Whynne-Hammond, 1979; Okoko, 2001). This has the formula: $R_n = 2 \bar{d} \sqrt{n/A}$. Where: R_n = the nearest neighbour index;

A = the size of the area concerned = 72.8km²;

\bar{d} = the mean distance between facilities (taken as an average of the distance between nearest neighbours) = 5,800 metres (5.8km²);

n = the number of facilities = 413 as ESWAMA in its solid waste management efforts recorded the distribution of 413 dumpsters for refuse collection in the city.

5.0. Results and Discussion

Findings showed that there is no significant random spatial distribution of dumpsters in Enugu metropolis at a computed R_n index of 2.10; which implies that the dumpsters were maximally spaced (i.e. dispersed). Contrary to the recommended standard of 150 metres for residential and 250 metres for commercial areas respectively, dumpster distances were between 300 metres to 450 metres apart. In other words, the collection system is unplanned, haphazard, poorly situated and unmaintained; thereby creating more travel distances for most residents who would want to use them. This has led to persistent indiscriminate dumping of refuse and irregular evacuation of generated refuse which hitherto

deface the neighbourhoods across the city as shown in fig. 1, fig. 2 and Table 3.

Furthermore, the study revealed that while some parts of the urban neighbourhoods of Enugu such as Independence layout, Uwani, GRA, New Haven and Trans-Ekulu were clustered with dumpsters; other parts were lacking in the facility such as Garriki, Idaw-river, Achara Layout, Mary Land, Abakpa, Nike, Obiagu and Asata, Amechi, Akwuke, Iva-Valley and Emene. Moreover, poor access roads as well as poor availability of space for strategic location of dumpsters were also identified as constraints in most residences of Abakpa, Obiagu, Nike, Asata, Garriki, Akwuke and Iva valley where some areas were not easily accessible due to bad roads. Poor location of available dumpsters far away from some residents or at secluded places hampers the utility while those located at road shoulders causes obstructions and renders the utility ineffective.

Table 3: Dumpster Distribution in Urban Neighbourhoods of Enugu Metropolis

| S/N | Neighbour | Neighbourhood Density | Nearest Neighbours | Nearest Neighbours distance |
|-----|------------------|-----------------------|--------------------|-----------------------------|
| 1 | Abakpa | High | 4 | 35 |
| 2 | Asata | High | 1 | 30 |
| 3 | Iva Valley | High | 1 | 30 |
| 4 | Akwunanaw | High | 1 | 35 |
| 5 | Ogbete/Coal Camp | High | 2 | 30 |
| 6 | Ogui New/Layout | High | 1 | 30 |
| 7 | Emene | High | 3 | 40 |
| 8 | Garki Awkunanaw | High | 3 | 35 |
| 9 | Obiagu | High | 1 | 30 |
| 10 | Amechi | High | 1 | 30 |

| S/N | Neighbour | Neighbourhood Density | Nearest Neighbours | Nearest Neighbours distance |
|-----|---------------------|-----------------------|--------------------|-----------------------------|
| 11 | Nike | High | 1 | 30 |
| 12 | Achara Layout | Medium | 2 | 45 |
| 13 | Maryland | Medium | 1 | 35 |
| 14 | Uwani | Medium | 1 | 30 |
| 15 | New Haven | Medium | 2 | 25 |
| 16 | GRA | Low | 2 | 30 |
| 17 | Independence Layout | Low | 2 | 30 |
| 18 | Trans Ekulu | Low | 2 | 30 |
| | Total | | 41 | 580 |

Source: ESWAMA (2015); Ilo, (2012) and Research Survey, (2015).

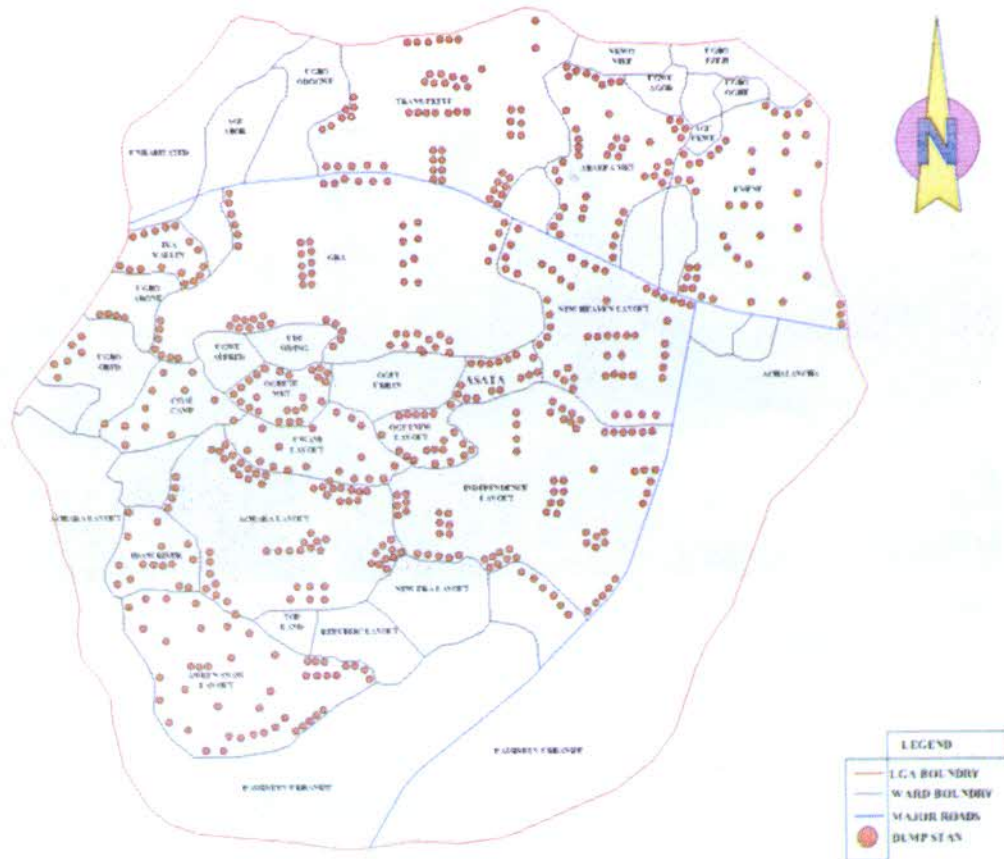


Figure 2. Map showing Dumpster distribution in Urban Neighbourhoods of Enugu metropolis

Source: ESWAMA (2015); Ilo (2012) and Research Survey, (2015).



Plate 2: Some Dumpster Locations in Uwani and Achara Urban Neighbourhoods of Enugu

Source: Research Survey, 2015.



Plate 3: Solid Waste Disposed in Some Parts of Idaw River and Coal Camp/Ogbete Neighbourhoods without Dumpster Locations

Source: Research Survey, 2015.

6.0 Conclusion

This study has shown that waste generation greatly outstrips the capacities of effective solid waste collection for disposal by ESWAMA as indicated by the observed heaps of refuse deface the

city and poses a threat to the health of residents. To overcome this problem, there is the need for accurate data on the quantities and types of solid waste generation, their characteristics, as well as a planned pattern of disposal in Enugu.

The state government ought to create a state database on waste and support ESWAMA to undertake waste management planning so as to introduce the 3R- concept (Recycling, Reuse and Reduction) in the municipal waste management system. Promoting these 3R techniques of waste management, however, requires sorting. The current practice of mixed-waste disposal attitude must therefore be discouraged. Households should be encouraged to separate generated refuse into constituent types by the process of sorting rather than the usual hasty disposal. ESWAMA should partner with universities and other research institutions to carry out relevant research in the planning and implementation of the waste management sector. Education on sustainable waste management techniques should be organized periodically for residents including manufacturers, waste pickers, re-users and recyclers who should be identified with their contributions recognized and their operations formalized and supported to improve the efficiency of waste management operations in the city.

Stakeholders in the waste management sector should be involved in policy decisions such as on waste collection and disposal methods. Participation of public including manufacturers, waste pickers, re-users and recyclers in waste management policy

formulation and implementation should be encouraged while identifying the contributions, recognizing their operations and supporting them to improve waste management in the city.

ESWAMA should adopt a distribution pattern at Rn 0.8 which will ensure a balance in dumpster accessibility to all neighbourhoods and residents. An additional total of one thousand, four hundred and eighty-seven (1,487) dumpsters is required to augment the existing stock of four hundred and thirteen (413) in order to ensure efficiency and sustainability in the management of solid waste in the city. Suitable strategic locations as well as accessibility should be maintained in dumpster distribution of 150 metres. This will likely address the issue of even distribution, convenience of location and ease of accessibility of dumpsters to the reach of residents. It will further eliminate the observed indiscriminate disposal of wastes while ensuring aesthetic quality of the environment.

References

- Ajadi B.S and Tunde, A.M. (2010). Spatial Variation in Solid Waste Composition and Management in Ilorin Metropolis. *Journal of Human Ecology*, 32(2): 101-108.
- Anierobi, C.M. (2010). An Assessment of Anambra State Environmental Protection

- Agency (ANSEPA) in Urban Environmental Management of Anambra State, Nigeria. A Dissertation for the Award of Master degree in Urban and Regional Planning, University of Nigeria. Enugu: unpublished.
- Anierobi, C.M and Efobi K.O. (2013). Waste Pickers and Urban Solid Waste Management System in Nigerian Cities: Between Sustainable Policy Gap and Survivalist Strategy. *Journal of Developing Country Studies*, 3(8): 184-187.
- Anierobi, C.M and Efobi K.O. (2013). Towards Incorporating the Informal Sector Operators in the Organizational Structure of Solid Waste Management Agencies in Anambra State, Nigeria. *Journal of Civil and Environmental Research*, 3(9): 22-25.
- Bridgwater A.V and Mumford C.J. (1979). *Waste Recycling and Pollution Control Handbook*. London: George Godwin Ltd publication.
- Cheever M, Graichen K, Homeier D, Howell J, Kefauver O and Kimball T. (2011). Environmental Policy Review: Waste Management in Ethiopia. *Indian Journal of Public Health*, 55(1): 49- 51.
- Department of Public Works and Environmental Services, City of Santa Barbara, USA (2011). City Trash and Recycling. www.sbrecycles.org City of Santa Barbara. Accessed on 12 April, 2015.
- Davis, P. (1991): *Land and Waste Management Regulations*. South Carolina, USA: SCDHEC Publication.
- Edelman, D.J. (1997). *City Wide Best Practices in Solid Waste Management in Collection, Transportation and Disposal* (No. IHS PP 012). IHS Project Papers. Institute for Housing and Urban Development Studies (IHS). <http://hdl.handle.net/1765/32679>. Accessed on 12 April, 2015.
- Efobi K.O and Anierobi C.M (2013). Evaluating the Organizational Structure of Environmental Management Agencies in Addressing Urban Environmental Problems of Nigerian Cities: Towards Efficiency in Awka and Onitsha in Anambra State. *Journal of Research on Humanities and Social Sciences*, 3(13): 126-131.
- Efobi K.O and Anierobi C.M (2013): Re-Inventing the Organizational Structure of Environmental Management Agencies of Nigerian Cities: Towards Sustainable Service Delivery in Anambra State.

- Journal of Public Policy and Administration Research*, 3(8): 117-120.
- Enugu State Ministry of Culture and Tourism, (2012). *Historical Development of Enugu Diary of Enugu State Ministry of Culture and Tourism*. Enugu: Enugu State Government Publication
- ESWAMA (2013): *Official Records for Waste Management in Enugu State, Nigeria*. Enugu: Unpublished.
- ESWAMA (2004): *Act No. 8, Edit 19 of Enugu State Waste Management Authority, Nigeria*. Enugu: Enugu State Government Official Gazette..
- Hagerty, D.J. (1973). *Solid Waste Management*. New York, USA: Von Nostrand Reinhold Company Publications.
- International City Managers Association (1957). *National Civic Review*. Annual Conference, Sage publications. www.sage.com. Accessed on 12 April, 2015.
- Ilo A.C. (2012). *An Assessment of Spatial Pattern of Dumpster Distribution as a Solid Waste Collection Strategy in Enugu Metropolis, Nigeria*. Dissertation for Award of (BURP) Department of Urban and Regional Planning, University of Nigeria, Enugu Campus. Unpublished.
- National Population Commission, (2006). *National Population and Housing Survey*. Abuja: Federal Government Official Gazette.
- Okoko, E. (2001): *Quantitative Techniques in Urban Analysis*. Ibadan, Nigeria: Kraft Books Ltd Publications.
- Rushbrook P. (1999): *Safe Management of Wastes from Healthcare Activities*. WHO Report: www.who.int/en, Accessed on 5 April, 2015.
- Sarageldin I. (1995): *The Human Face and the Urban Environment*. Alenxandria, Egypt: Sarageldin Publications.
- Sarageldin I. (1999): *Culture in Sustainable Development: Investing in Cultural and Natural Endowments*. Proceedings of Conference on Sustainable Development. Alexandria, Egypt: Sarageldin Publications.
- Tchobanoglous, G. (1977): *Solid Waste Management: General aspects*. London: New Age Publications.
- Tehobanoglous, G; Theisis, H. and Vigil, S. (1993): *Integrated Solid Waste Management: Engineering Principles and Management Issues*. New York: McGraw Hill Publications.
- UN-Habitat, (2007): *Solid Waste Management in the World's Cities*. Nairobi: UN-Habitat Publication.

UN-Habitat, (2011): *Collection of Municipal Solid Waste: Achieving Agenda 21*. UN-Habitat Pub.

Whyne-Hammond, C. (1979): *Elements of human Geography*. London: Harper Collins Publications.

World Bank (2016): *What a Waste: A Global Review of Solid*

Waste Management. New World Bank Report. International Solid Waste Association, Australia. World Bank Publications.

World Health Organization (2013): *New WHO Handbook on Healthcare Waste Management*. WHO.
www.ale.livsnews. Accessed on August, 2013