DEVELOPMENT OF FRAMEWORK FOR SEWAGE DISPOSAL MANAGEMENT IN MINNA METROPOLIS, NIGER STATE

BY

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2018/3/74390TI

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION, SCHOOL OF TECHNOLOGY EDUCATION, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF TECHNOLOGY (B. TECH) DEGREE IN INDUSTRIAL AND TECHNOLOGY EDUCATION.

APRIL, 2023

DECLARATION

I, **ADEBAYO, Sodiq Mustapha**, with matriculation number **2018/3/74390TI**, an undergraduate student of the department of Industrial and Technology Education, certify that the work embodied in this project is original and has not been submitted in part or full for any other diploma or degree of this or any other University.

ADEBAYO, Sodiq Mustapha

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2018/3/74390TI Sign and Date

CERTIFICATION

This project has been read and approved as meeting the requirement for the award of B. Tech degree in Industrial and Technology Education, School of Technology Education, Federal University of Technology, Minna.

Prof. B. M. Mohamme
Project Supervisor _____
Signature and Date

Dr. T. M. Saba
_____
Head of Department
Signature and Date

_____
External Examiner
Signature and Date

DEDICATION

With profound joy and immense gratitude in my heart, I dedicate this project to Almighty Allah for His Unshakable and Unbreakable Faithfulness. His Divine and constant guidance in my life has made this project a reality today.

ACKNOWLEDGEMENTS

In the name of Allah, the Most Gracious, the Most Merciful. He who bestowed on me the power and strength to withstand the rigorous aspect of life and challenges so far, our daily source can only be achieved with His guidance.

I wish to express my unreserved gratitude to my project Supervisor Prof. B. M. Mohammed for his unique and professional advice, suggestions and supervision which were characterized by the painstaking to cautiously read through this manuscript, criticism and words of encouragement to the successful completion of this project.

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ABSTRACT

This study seeks to develop a framework for sewage disposal management in Minna metropolis, Niger State. four research questions were developed to guide the study. The study employed a survey research design. The study used a four-point scale questionnaire, which contains a total of 45-items, as instrument. The total population of the study was 100 which consists of 50 NISEPA staffs and 50 occupants residential consists of 50 NISEPA staffs and 50 occupants residential. The findings of the study reveal the Rapid increases in sewage volumes that exceed the current capacities of the treatment plants, Proper way of sewage collection should be adopted by government in order to be able to be treated and dispose properly, ensure that mechanisms are in places which lead to the separate collection of sewage. The study therefore recommended that Government should establish stringent legal and regulatory framework that will enhance efficient and appropriate collection and disposal of waste by Minna metropolis, Niger State Waste Management Agency.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Historically, the amount of wastes generated by human population was insignificant mainly due to the low population densities, coupled with the fact that there was very little exploitation of natural resources. Common wastes produced during the early ages were mainly ashes and human and biodegradable wastes. Biodegradable waste is a type of waste, typically originating from plant or animal sources, which may be broken down by other living-organisms. Waste that cannot be broken down by other living organisms are called non-biodegradable and these are released back into the ground locally, with minimal environmental impact (Okoye *et al.,* 2018). In Nigeria, recent upsurge in waste generation and hap-hazard dumping due to poor management has translated into a serious problem.

The heaps of refuse that are dumped indiscriminately along the streets, drains and gutters not only devalue resources but pollutes soil and water resources, also constitutes potential health hazards to plants, animal and people (Otti *et al.,* 2018). With the advent of industrial revolution, waste management became a critical issue. This was due to the increase in population and the massive migration of people to industrial towns and cities from rural areas during the 18th century. There was a consequent increase in industrial and domestic wastes posing threat to human health and the environment. Domestic waste management, collection and disposal have always been a universal issue. This is because efficient and appropriate collection and disposal of solid waste has been recognized as essential to the hygiene and health of urban societies-since the nineteenth century. Over the course of the first half of the twentieth century, sanitary engineers and the broader public also came to understand that the inappropriate treatment of waste could cause major environmental degradation Fabian, (2021). The degregradable domestic waste are in the forms of solid and liquid waste. The

liquid type is known as sewage waste. Sewage is a type of waste from domestic houses which needs managements.

Sewage is running waste water that is dispose off from homes and shops which is normally transported in form of small liquid with suspension of small solid in large pipes called sewers. The waste water may either be directed to a specific pace to be recycled or be disposed off far away from people as it can lead to spread of diseases Aldosari (2019). Sewage is a complex mixture containing nutrients, suspended solids, pathogens, oxygen's dissolving substances and other contaminants and each has different environmental impact. Sewage need to be disposed off as it is unwanted water from homes and shops. Sewage disposal is therefore the return of used water to the environment. Disposal points distribute the used water either to aquatic water bodies such as oceans, rivers, lakes, stream, ponds or lagoons or to land by absorption systems, ground water recharge and irrigation. Sewage disposal methods are the ways that are available to home and shop owners for the release of waste water into the environment (Ladan, 2016).

According to United Nations Educational, Scientific and Cultural Organization (UNESCO), the global waste water generation is increasing at an exponential rate, as a result of rapid population growth and urbanization. An overwhelmingly large position of African and Asian population still remains without access to sanitation and waste water treatment facilities. A large volume of untreated waste water is dumped directly into our water resources, threatening human health, ecosystems, biodiversity, food security and the sustainability of our water resources (Muthaiyah, 2020).

In Nigeria, different cities use different methods of sewage disposal, while some cities have organized functional sewage system (such as Abuja, Port Harcourt, Kaduna, Calabar and Lagos), other cities have no sewage disposal system and as such operate disorganized and decentralized methods of waste disposal (Minna, Bida, Suleja) among other. The generation

and disposal of waste is an intrinsic part of any developing or industrial society. Waste, both from domestic and commercial sources has grown significantly in Nigeria over the past decade. Every time householders shop at the Store and open market, they contribute to the mountain of waste. It is possible to quote figures which show that the production of waste amounts to millions of tons. The percentage of Nigeria's population living in cities and urban areas has more than doubled in the last 15 years (Aliyu & Amadu, 2017). The cities and urban areas experience continuous growth which contributes enormously in the generation of solid and liquid waste.

The management of waste is a matter of national and international concern. Studies have shown that the volume of waste does not actually constitute the problem but the ability or inability of governments, individuals and waste disposal firms to keep up with the task of managing waste and the environment. There is no doubt that a dirty environment affects the standard of living, aesthetic sensibilities, health of the people and thus the quality of their lives. The corollary is that improper disposal or storage of this waste can constitute hazards to the society through the pollution of air, land and especially water (Sadiq *et al.,* 2019).

Waste management especially in urban areas of Nigeria such as minna is still very problematic. Apart from the various diseases and toxic conditions inherent in and derivable from the indiscriminate disposal and dumping of wastes, which has become a common practice in Minna metropolis, the presence of waste degenerates the aesthetic value of the environment. Governments, non-governmental organizations and private individuals have been involved in waste management through various means. Waste management in urban areas has moved from solely public management to private management and presently to public -private participation. The problems associated with waste management are made more complex by the presence of non-degradable refuse such as polythene materials (Srivastava 2020).

Development is needed to enhance the quality of the lives of citizens in a country since developmental projects affect the ecology OF environment. For the past few decades people have been talking about sustainable development. There are three components of sustainable development: economic development, social development and environmental protection. There are as well, many factors that contribute to the degradation of environmental quality. One of the factors that contribute seriously to the degradation of environmental quality is household and industrial waste. Sustainable development requires meeting the major needs of all people and extending opportunity to satisfy their aspirations for a better life.

Indiscriminate disposal and dumping of waste has become a common practice in Nigerian cities. Most of the waste dumps are located close to residential areas, markets, farms, roadsides, and creeks (plate I & II; pp 14 & 25). The composition of waste dumps varies widely with many human activities located close to dump sites. Familiar examples include domestic and industrial wastes. Industrial wastes are generated from industrial activities such as chemicals, pesticides, paints, grease, inorganic materials, oil Sewage, and so on. Domestic wastes are those generated from commercial establishments and household activities. It is against this gap that this study seek to develop a framework for sewage disposal management in Minna metropolis, Niger state.

1.2 Statement of the Problem

Improper waste handling and management pose serious threats to the environment and public health. In Nigeria, the commonly practiced waste management option in Nigeria, basically involves the collection of mixed waste materials and subsequent dumping at designated dumpsites. It is not a practice to separate waste materials at source or any point during its management (Kadafa, 2017). Development is needed to enhance the quality of the lives of citizens in a country since developmental projects affect the ecology of environment. For the

past few decades people have been talking about sustainable development. There are three components of sustainable development: economic development, social development and environmental protection. There are as well, many factors that contribute to the degradation of environmental quality. One of the factors that contribute seriously to the degradation of environmental quality is household and industrial waste. Sustainable development requires meeting the major needs of all people and extending opportunity to satisfy their aspirations for a better life. During the past decade, the increased rate of environmental pollution and degradation which brought the concept of sustainable development attracted significant attention from researchers, governments of different countries and international environmental organizations. Waste disposal habit of the people, corruption, weak government regulation, poor work attitude, lack of fund, inadequate facilities such as plants and equipment among others are factors militating against effective· waste management towards sustainable development in Nigeria. Therefore, if there is to be sustainable development in waste management in Nigeria and sepecifically in Minna, a framework which determines the availability of land (for landfill), human resources, adequate funds, plants equipment and other tools must be readily available. It's against this gap that this study seek to determine the framework for sewage disposal management in Minna metropolis, Niger state.

1.3 Purpose of the Study

The major purpose of this study is to develop a framework for sewage disposal management in Minna metropolis, Niger State. Specifically, the study will determine:

1. The types of sewage disposal method adopted in Minna metropolis.
2. Challenges facing sewage disposal in Minna metropolis.
3. Strategies for proper sewage disposal management in Minna metropolis.

4. Develop a frame work for sewage disposal

1.4 Significance of the Study

The study would be of immense benefit to the scholars/academicians, NISEPA and the Lawmakers.

The findings of this study will serve as a platform for other research works and add to knowledge of scholars/academicians that will in turn impact same on the students and future assignments of state or national course.

Apart from the various diseases and toxic conditions inherent in and derivable from the indiscriminate disposal and dumping of wastes; which has become a common practice in Minna metropolis, the presence of waste degenerates the aesthetic value of the environment. The findings of this study will contribute it quota in the quest to making Minna metropolis one of the cleanest 21st century city in the world. When this is achieved, the aesthetic attraction of the state will begin to boost her tourist industry, which is a source of revenue to the government and a job creator for her masses. Again, if the recommendations and suggestions of this study will be sincerely and adherently pursued, it will reduce, to the barest minimum, the adverse effect of such diseases like Malaria, diarrhea, cough, catarrh, cold, and fever. This will in turn cut down on the high rate of infant mortality and pregnant women mortality. Also, the money being spent by individuals/families on treating patience of waste induced diseases will be channelled to some other needs of theirs.

Worthy to mention is the fact that when NISEPA becomes effective and efficient in waste management, the heavy traffic congestions caused by spill over of refuse dumps and sewage along the major roads in Minna metropolis will seize to be an issue.

The Lawmakers will benefit from the study as it will give them the knowledge of the problems associated with waste management in Enugu state, and possible ways to solving them, will be a guide to them in making rational decisions and planning effectively.

1.5 Scope of the study

The study is delimited to the development of framework for sewage disposal management in Minna metropolis, Niger state. Specifically, the study will cover the types of sewage disposal method adopted in Minna metropolis, Challenges facing sewage disposal in minna metropolis and also make Development of new framework for sewage disposal management in Minna metropolis.

1.6 Research Questions

The following research questions will guide the study:

1. What are the types of sewage disposal method adopted in minna metropolis?
2. What are the challenges affecting sewage disposal in minna metropolis?
3. What are the Strategies for proper sewage disposal management in Minna metropolis?
4. What are the frame work for sewage disposal

CHAPTER TWO

REVIEW OF RELATED LITERATURE

The review of related literature to this study is organized under the following subheadings:

Conceptual Framework

2.1.1 Concept of Waste

Wastes is define as rubbish or materials that are not needed and are economically unusable without further processing such plastic waste (Masebinu, 2018). Here, Nigel's emphasis is that to ascertain something as a waste, it has to be economically unusable- in other words, it is unproductive since it has lost the economic value(s) therein. However, Nigel's position can be questioned because recent practices have shown that what one party considers as unneeded materials, and of course economically unusable, may be the most needed and of economic importance to another party. This is to say, what is waste in a place may turn out to become non waste in another. For example, after drinking the liquid contents of a bottle of champagne, the empty bottle is considered as a waste by the person who drank the liquid content and perhaps is thrown away. But, another person may pick it up from the point of disposal and either reuse or recycle the empty bottle for containing another liquid substance or some other item of economic importance. The bone of contention here is that it is not clear to say at what point an item constitutes a waste.

Nwankwo (2021) succinctly posits that there is no definitive list of what is and is not waste. It goes further to state that whether or not a substance is discarded as waste- and when waste ceases to be waste- are matters that must be determined on the facts of the case and the interpretation of the law. Defra is of the opinion that whether or not a substance is discarded waste rests on one hand, with the producer or holder of such substance to decide whether it is being discarded as waste and, on the other hand, with regulations or laws stipulating such.

Kurien and Qureshi (2018) proposed four perspectives by which wastes could be interpreted. To them, wastes are:

- Non-wanted things created, not intended, or not avoided, with no purpose.
- Things that were given a finite purpose thus destined to become useless after fulfilling it.
- Things with well-defined purpose, but their performance ceased being acceptable
- Things with well-defined purpose, and acceptable performance, but their users failed to use them for the intended purpose.

2.1.2 Concept of sewage

Sewage (or domestic sewage, domestic wastewater, municipal wastewater) is a type of wastewater that is produced by a community of people. It is typically transported through a sewer system. Sewage consists of wastewater discharged from residences and from commercial, institutional and public facilities that exist in the locality. Sub-types of sewage are greywater (from sinks, bathtubs, showers, dishwashers, and clothes washers) and blackwater (the water used to flush toilets, combined with the human waste that it flushes away). Sewage also contains soaps and detergents. Food waste may be present from dishwashing, and food quantities may be increased where garbage disposal units are used. In regions where toilet paper is used rather than bidets, that paper is also added to the sewage. Sewage contains macro-pollutants and micro-pollutants, and may also incorporate some municipal solid waste and pollutants from industrial wastewater.

Sewage usually travels from a building's plumbing either into a sewer, which will carry it elsewhere, or into an onsite sewage facility (Luitel, 2021). Collection of sewage from several households together usually takes place in either sanitary sewers or combined sewers. The former is designed to exclude storm water flows whereas the latter is designed to also take storm water. The production of sewage generally corresponds to the water consumption. A

range of factors influence water consumption and hence the sewage flowrates per person. These include: Water availability (the opposite of water scarcity), water supply options, climate (warmer climates may lead to greater water consumption), community size, economic level of the community, level of industrialization, metering of household consumption, water cost and water pressure.

The main parameters in sewage that are measured to assess the sewage strength or quality as well as treatment options include: solids, indicators of organic matter, nitrogen, phosphorus, and indicators of fecal contamination. These can be considered to be the main macro-pollutants in sewage. Sewage contains pathogens which stem from fecal matter. The following four types of pathogens are found in sewage: pathogenic bacteria

- Viruses
- Protozoa (in the form of cysts or oocysts) and
- Helminths (in the form of eggs).

In order to quantify the organic matter, indirect methods are commonly used: mainly the Biochemical Oxygen Demand (BOD) and the Chemical Oxygen Demand (COD). Management of sewage includes collection and transport for release into the environment, after a treatment level that is compatible with the local requirements for discharge into water bodies, onto soil or for reuse applications. Disposal options include dilution (self-purification of water bodies, making use of their assimilative capacity if possible), marine outfalls, land disposal and sewage farms. All disposal options may run risks of causing water pollution.

2.1.3 Waste Management

Literally, waste management is the process of managing waste materials (normally those produced as a result of human activities). In order to define waste management, we need to include several different processes such as collection, transport, processing, recycling, disposing, and monitoring of waste. According to Ijaiya *et al.*, (2018), waste management

does not just end at collection, transporting processing, recycling or disposal and monitoring of wastes materials but refers to the collection, keeping, treatment and disposal of wastes in such a way as to render it harmless to human and animal life, the ecology and environment generally. In other words, the primary aim of managing wastes is for the safety of human, animal, ecology and environment. We could as well add here that any other aim that goes in contrary to the aims mentioned above does not constitutes waste management. Atta *et al.*, (2020) added that waste management could also be said to be the organized and systematic dumping and channeling of waste through or into landfills or pathways to ensure that they are disposed of with attention to acceptable public health and environmental safeguard and that a proper waste management will result in the abatement or total elimination of pollution.

Waste management is a growing public concern in Nigeria. In many cities of the country, waste management is poor and solid wastes are dumped along roadsides and into open areas, endangering health and attracting vermin. In Nigeria, there is a steady increase in waste quantity and variety due to population growth and industrialisation Batagarawa and Williams (2019) while the basic solid waste management system based on collection, transportation and disposal remains highly inefficient and ineffective, especially in the urban centres (Ayotamuno, 2020). Nigeria is the most populous and the tenth largest country in Africa with a population of over a hundred and fifty million people across a landmass of 923,768 square kilometres (WDI, 2010) in (Ayuba *et al.*, 2015).

Statistics show that the population growth rate of Nigeria as at 1991 was 3.0% and an urban growth rate of about 5.5% per annum, while the average waste generation rate is put at 0.49 kg per day. Urban centers in Nigeria has also witnessed a steady rise in waste generation due to urbanization and increase in population, for instance Abuja the nation's capital generates between 0.55-0.58 kg of waste per person per day, and Lagos state one of the most populous cities in the world generated 4 million tons of waste in 1995 and by year 2000, the quantity of

municipal solid waste generated in Lagos metropolis alone was estimated to have increased to 998, 081 tons while Minna the Niger state capital generates about 90 tons of solid waste per day among others. These have put enormous pressure on the ability of the public sector to collect all the wastes generated.

Currently, the level of waste collected in Nigerian cities averages between 30-50 percent of waste quantities generated (Adedire, 2017). As a result, a large proportion of the solid waste generated remains uncollected. Large parts of the cities, particularly, the low income areas receive little or no attention of the public sector. The fundamental deficiency of the solid waste management is attributed to government's failure to assume basic responsibility in raising sufficient funds to provide acceptable levels service (Lohri *et al.,* 2015). While all the waste generated in developed countries are collected, in the developing countries, most of the waste produced are not collected (Addo *et al.,* 2015). For cities to be relatively clean, at least 75 percent of the waste should be collected (UNDP, 2005).

2.1.4 Sewage Management Processes

The key elements in sewage management include: waste generation, storage, collection, transfer and transport, processing, recovery and final disposal. This means that when waste is generated it is first stored in either dustbins or skips. It is then collected and finally disposed of in landfill. Also, when waste is collected it can be transferred from small collection equipment like the tricycle to a bigger truck for final disposal. On the other hand, waste collected can be processed and recovered for materials to be reused. These elements are further elaborated below:

Waste Generation: Waste generation encompasses those activities in which materials are identified as no longer being of value and are either thrown away or gathered together for disposal (Salau *et al.,* 2021). According to United Nations Environment Programme (UNEP)

(2009), in 2006 the total amount of Municipal Solid Waste (MSW) generated globally reached 2.02 billion tones, representing a 7% annual increase since 2003. It is further estimated that between 2007 and 2011, global generation of municipal waste will rise by 37.3%, equivalent to roughly 8 per cent increase per year (United Nations Environment Programme (UNEP), 2009). The volume and range of sewage generated daily in Nigeria has been increasing within the last few years and this is mainly due to the high population growth, urbanization, industrialization and general economic growth. These wastes as observed by Ojo (2008) are generated mostly in urban centres.

Storage: Tetteh *et al.* (2021) explained storage to mean where sewage is stored before it is collected. It could be stored in a skip or dustbins and not thrown away indiscriminately. According to them, storage is of primary importance because of the aesthetic consideration.

Collection: The element of collection includes not only the gathering of sewage, but also the hauling or moving of waste after collection to the location where the collection vehicle is emptied (Buor, 2019). According to (Buor, 2019), the most common type of residential collection services in the United States include “curbs”, “set out-setback” and “backyard carry”. Where curb service is used, the homeowner is responsible for placing the containers to be emptied at the curbs on collection day. According to the USPS (2000), in the city of Thimphu in Bhutan the collection of solid waste from households was done in concrete receptacles placed at strategic points and conveyed by trucks/tractors. Accordingly, there were concrete bins and containers provided at various locations from where the waste was lifted for disposal. Individual bins/containers were also placed alongside the shops in certain areas, which were emptied directly into the trucks/tippers.

Transfer and Transport: According to Yadav (2019), transfer and transport involves two steps: (1) the transfer of wastes from the smaller collection vehicle to the larger transport

equipment and (2) the subsequent transport of the wastes, usually over long distances to the final disposal site.

Processing and Recovery: The element of processing and recovery includes all the technology, equipment, and facilities used both to improve the efficiency of other functional elements and to recover usable materials, conversion products or energy from solid wastes (Tetteh, 2019). In the recovery, separation operations have been devised to recover valuable resources from the mixed solid wastes delivered to transfer stations or solid waste processing plants (Tetteh, 2019).

Disposal: It is the ultimate fate of all sewage whether they are residential wastes collected and transported directly to landfill site.

Several methods of sewage management have evolved over the years. These methods according to the Centre for Environment and Development (2003) vary greatly with types of wastes and local conditions. This is divided into early practices of managing solid waste and contemporary methods of waste management systems.

2.1.5 Sustainable Sewage Management

Sustainable sewage Management Fact Sheet (2013) stressed that sustainable sewage management aims to address these long term pressures through the recovery, recycling, and reuse of resources, and the minimization of waste streams. This includes the management of resources in an environmentally sound and economically effective manner. The Rio declaration on sustainable development (UNCED, 1992) defined sustainable development management as the application of the integrated life cycle management concept in sewage management. This was later elaborated by the (UN, 2005) as environmentally sound sewage management which must go beyond the mere safe disposal or recovery of sewage that are generated and seek to address the root cause of the problem by attempting to change unsustainable patterns of production and consumption. In effect, the declaration suggests an

approach to waste management that incorporates environmental, social and economic perspective unto environmental policy, planning and practice.

However, it is only recently that sewage management policies, plans and programmes have begun to consider all these different stand of sustainability. Nilsson-Djerf and McDougall, (2000) argued that for a sewage management system to be sustainable, it needs to be environmentally effective, economically affordable, and socially acceptable. For Sustainable waste management a good Integrated sewage Management system approach is the best way to go. It requires government policies that encourage waste prevention, reuse and both materials and thermal recycling recovery and proper disposal options. IWM involves simply the combination of all the sewage management techniques in order to minimize waste (Ayedun *et al.*, 2015).

Although majority of large cities have administered sewage management practices at different levels of sophistication, in some African countries there is no official solid waste management policy. For example, in many Nigerian towns and cities, including Minna, there is no door to door sewage collection programme. Roadsides, ditches, drainages, water bodies, empty plots of land, farms, wetlands, uncompleted buildings are sites observed for dumping of household sewage in most Nigerian cities.

Plate I: Roadside dumping site Bosso Minna, Niger state

This unsanitary and indiscriminate indulgence of the public has been attributed to the ineffectiveness of sewage management of the environment by the government (Ojo and Adejugbagbe, 2017). However, the issue of proper sewage management is not just a government task but is a shared responsibility that includes the citizens and households, who are the main end-users of sewage management facilities and services. When reorganizing sewage management systems, understanding the role of households, their attitudes, their waste handling practices and their interactions with other actors in the sewage system is therefore essential (Oberlin, 2011).

2.1.6 Sewage treatment

The biochemical processes that take place in water bodies have also been relied on to neutralize sewage. Aerobic, or oxygen-requiring, bacteria feed on the organic material in sewage, decomposing it. However, this process uses the oxygen that is dissolved in water. Often the concentration of organic waste is so great that the biochemical oxygen demand (BOD) depletes the water's oxygen supply, killing fish and plants. In order to avoid these problems, it is now recognized that all sewage except unmixed storm sewage must be treated before it is discharged (Ahmed et al, 2021).

Industrial wastes are treated by a number of methods, depending on the specific nature of the waste. Increasingly, governments are forcing industries to process effluents either chemically or mechanically, or both ways, so that harmful substances are removed.

Domestic sewage must be treated to produce discharge water that is free of odors, suspended solids, and objectionable bacteria. (Coliform bacteria, which inhabit the lower intestines of mammals, while not pathogenic of themselves, are taken as an index of contamination of watercourses.) In rural areas, sewage can be stored in a holding tank, e.g., a septic tank; naturally occurring anaerobic bacteria can decompose the solids, which then settle to the bottom. While suitable for small systems, this method has several disadvantages. First,

anaerobic decomposition produces noxious gaseous effluents, and it is fairly slow. Second, harmful bacteria may still be present in the liquid effluent.

In large urban systems, a combination of processes must be used. Decomposition can be speeded by forcing air through the mass so that aerobic bacteria can be used. This oxidation process is typically combined with filtration, either in sand or in granular activated carbon, and with several hours of aeration. The liquid can then be discharged, often after being disinfected with chlorine. The liquid may be also treated by microfiltration, reverse osmosis, and hydrogen peroxide and ultraviolet light to produce very clean water that can be reused. Another method of removing solids is to allow the liquid to stand in large tanks until the solids fall out and form a sediment, but the process is slow and requires the accumulation of large volumes of liquid (Saravanan et al, 2021).

Once solids are removed, they are treated in one of several ways. Most often they are removed in a semiliquid mass referred to as Sewage. According to Siciliano, Limonti & Curcio, (2021) Sewage may be transferred to tanks where it is digested by aerobic or anaerobic bacteria. Gaseous by-products of this digestion are collected for use as fuels. After digestion, solids may be dried and enriched with plant nutrients for use as fertilizer. In other cases, with or without digestion, they may be dried and incinerated at 1200 to 1400 degrees F (650 to 760 degrees C). In other cases solids are buried in landfills or dumped far at sea, although environmental objections to such dumping has led to its drastic curtailment.

Sewage systems collect wastewater and treat it before discharging it back into the environment. These systems consist of intricate networks of underground conduits, or sewers that convey the sewage through the treatment process to the point of disposal.

Sewage systems also handle the flow of rainwater, either separately or as part of a single system. Separate systems are generally preferable because, in single systems, heavy rainfall can overload treatment plants, with the result that untreated overflow can become a source of

pollution. In separate systems, rainwater is often allowed to flow into streams untreated because it is assumed to be relatively clean.

According to Parashar and Hait (2021) Sewage treatment is classified as primary, secondary, or tertiary, depending on the degree to which the effluent is purified. Primary treatment is removal of floating and suspended solids. Secondary treatment uses biological methods such as digestion. Complete, or tertiary, treatment removes all but a negligible portion of bacterial and organic matter.

Primary Treatment

The initial, and sometimes the only, method of cleaning wastewater is primary treatment, which consists of removing floating chunks and fine particles of solid waste Saleh (2021).. The simplest form of primary treatment is a cesspool, now found primarily in rural areas. A cesspool is a big tank with a porous bottom and sides that lets the liquid wastewater filter into the ground while holding the solid waste. Periodically the tank must be cleaned; the solid matter, called sludge, is sometimes used for fertilizer or landfill. Septic systems are somewhat similar, though the tank is connected to a drainage field so that more waste can be dispersed over a wider area.

In larger communities, sewer water passes first through a screen, which filters out the larger debris. It then runs through a grit chamber, a long, shallow trough with a dip in the bottom that acts like a trap. As water moves through, hard materials in the water drift down to the bottom and fall into the trap. Grease floats to the surface and is skimmed off. The trap, like a cesspool, is periodically scraped clean.

After going through the screen and grit chamber, the sewage still contains small suspended solids—about 1 ton per million gallons (3,790,000 liters) of wastewater. To remove some of these, the sewage is trickled into a sedimentation tank, or settling basin. The water enters

through a pipe, then circulates slowly while the suspended particles settle to the floor. The top layer of water continually runs out through exit holes.

The sludge from sedimentation tanks may be sent through a tank called a digester, where bacteria digest it, producing carbon dioxide and methane gas and other by-products (Hajizadeh, 2021). . Any combustible gases may then be collected and used to heat the digestion tanks and buildings and to fuel gas engines in the plant. The sludge may also be buried or dumped as landfill, burned, or dried in sludge drying beds for use as fertilizer.

Primary treatment removes about half of the suspended solids and bacteria in sewage, and about 30% of the organic wastes. Sometimes chlorine gas is added to the effluent (the liquid remaining after sedimentation) to kill most of the remaining bacteria. Some cities use chemicals that coagulate some of the solids into particles of a size and weight that will settle, so that they can be separated in a settling tank. The use of chemicals makes it possible to remove 80 to 90% of the suspended solids.

Secondary Treatment

Today, large cities are usually required to put their wastes through both primary and secondary treatment because primary treatment alone removes so little organic material. Secondary treatment uses aerobic, or oxygen-breathing, bacteria to decompose organic wastes. The main object is to put the wastewater in contact with as many bacteria as possible while keeping it aerated so that the bacteria have an adequate supply of dissolved oxygen.

According to Hajizadeh (2021) one of the most common secondary treatments of this type is the activated-sludge method, so called because it uses sludge that is activated, or teeming with microorganisms. After going through primary treatment, the sewage is put into the activated-sludge tank, where it is aerated by pumps or blasts of compressed air. The

compounds produced by the bacteria remain mostly suspended in the water and flow out with it into a secondary sedimentation tank.

The sludge from the bottom of the tank is handled in much the same way as the sludge from the primary sedimentation tank, except that about a quarter of it is recirculated back into the activated-sludge tank. This recirculation serves to seed the activated-sludge tank with fresh bacteria. The activated-sludge method permits almost any desired degree of treatment by varying the period of aeration. It removes about 95% of bacteria and more than 90% of suspended solids and organic matter.

Another method of secondary treatment is the trickling-filter method. Generally, rotating arms slowly spray the sewage over a shallow circular tank containing a layer of gravel or crushed rock. The rocks are covered with a slimy coating of microorganisms that break down the organic wastes in the sewage. After this process, as in the activated-sludge method, the water that has been filtered is passed into a secondary sedimentation tank for removal of organic matter that has sloughed off from the stones of the filter. Trickling filters, together with primary treatment and final sedimentation, will remove most suspended solids.

Tertiary Treatment

Wastewater that has received primary and secondary treatment still contains dissolved materials that make it unsuitable for almost all uses except irrigation (Chaganti et al, 2021). Tertiary treatments, which depend largely on artificial chemical processes, are designed to remove these materials in order to make the effluent safer to discharge into waterways and safer for industry to use. A number of methods may be used, including radiation treatment, discharging the effluent into lagoons, and chlorination. Chlorination is the process of adding chlorine to drinking water to kill parasites, bacteria, and viruses.

Sewage may also be passed through filters made of activated carbon, which consists of finely ground charcoal grains with rough, pitted surfaces that trap impurities. Alternatively, sewage may be strained through a screen made of tiny seashells called diatomaceous earth. The effluent may also be treated with chemicals that transform the dissolved organic material. Some chemical compounds, for example, combine with the nitrates in sewage to produce various salts. Such treatments are expensive, however, and are difficult to perform routinely.

2.1.7 Methods of Sewage Disposal

Treatment plants: Municipal sewage systems feed directly into sewage treatment plants. The plants remove the bacteria from the sewage in multiple treatment sessions, removing harmful microbes from the substance.

Sewage lagoons: Sewage lagoons are exactly what they sound like. Wastewater flows from the home into a lagoon of standing water. Wind and sunlight allow the right bacteria to grow and subject the sewage to a natural treatment.

On-site systems: In an on-site disposal system, wastewater empties into a septic tank, which keeps the Sewage and sends the water through a drain. The septic tank must be pumped regularly to ensure the Sewage does not accumulate.

Off-site systems: An off-site sewage system receives sewage from surrounding homes and buildings and treats the water for bacteria. It then redirects all wastewater to a community "water collection" before dumping extra water into a nearby water source (river, creek, etc.).

Full sewage systems: Full sewage systems use blades inside of pipes to separate solid waste from water. Once everything has been reduced, the pipes redirect it to a lagoon or a treatment plant.

2.1.8 Framework for Efficient sewage disposal

A framework that can be used to describe the situation facing policymakers is presented in Figure 2. This schematic diagram can act as a guide to the approach pursued in this study.

The central component of this approach is the physical pathway through which sewage is generated, collected, treated and distributed, which is the common system for all the countries irrespective of their economic status. It is then argued that the emphasis on different phases of this pathway depends on the level of development in any region. As regions become more developed they concentrate on factors further down the pathway.

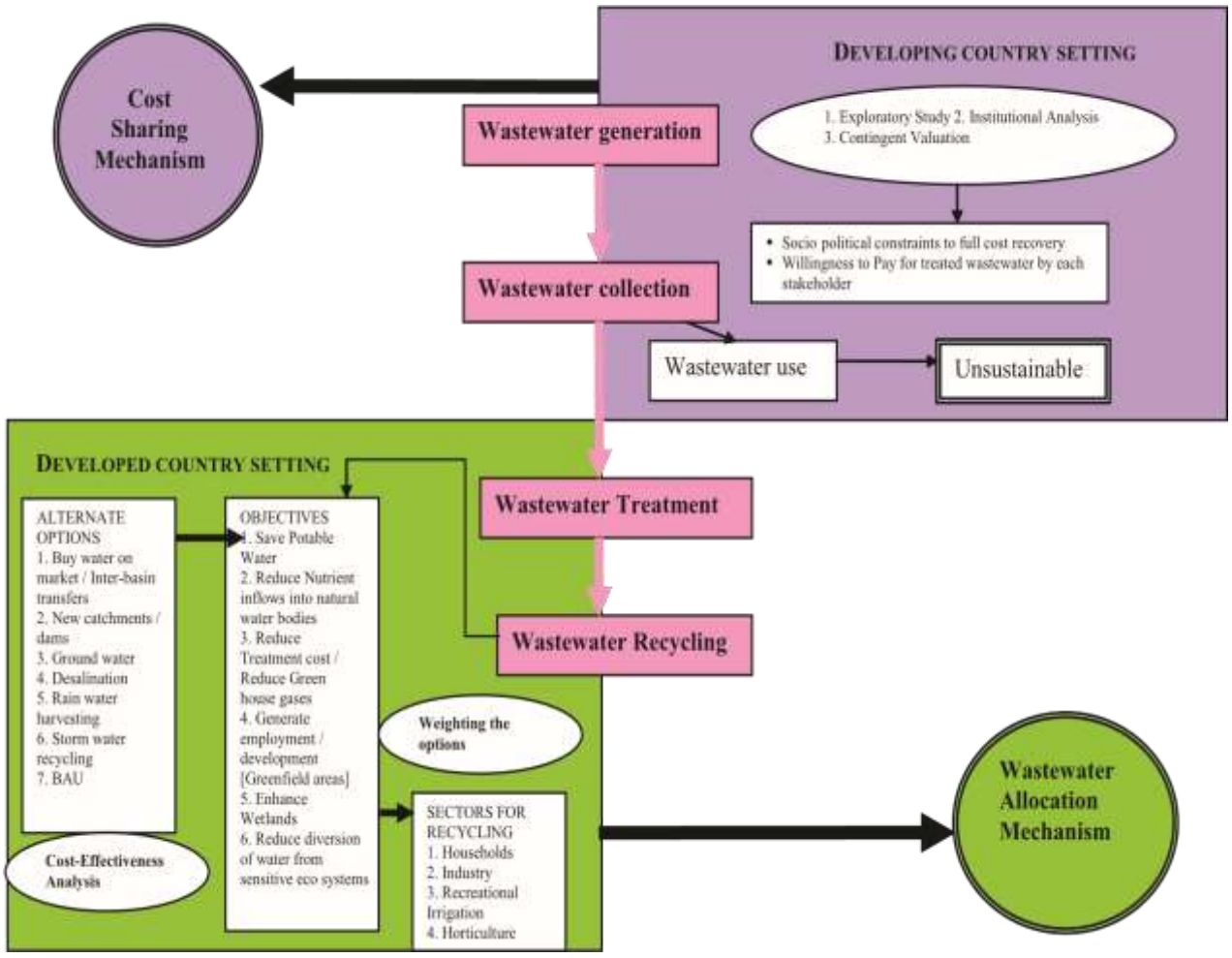

FIGURE 1. A framework for efficient sewage disposal across nations
A typical pathway of sewage consists of four phases:

A. Sewage generation: With increasing urbanization and changing lifestyles, sewage generated in the urban areas is large and continues to grow over time. As cities are the centers of political and economic power, their water needs usually receive a higher priority, but are subject to physical and economic scarcity constraints. Increases in urban water supply ensure

increased sewage generation. The depleted fraction of domestic and residential water use is typically only 15 to 25% and the remainder returns to sewage (Scott et al. 2004).

B. Sewage collection: Most cities in the developing world are only partially sewered, resulting in substantial volumes of sewage (including toilet wastes) finding their way into surface water networks within cities. On an average only 28% of the population in the developing world in large cities is actually skewered, whereas more than 90% of the population is skewered in developed countries (Kahl, 2018).

C. Sewage treatment: The sewage network is used to bring sewage to the treatment plant. It can then be treated to primary, secondary or tertiary levels before it is discharged for further use or returned to a natural water body. Sewage treatment is an expensive process, both in terms of the land required and the energy consumed. The percentage of total sewered sewage that actually undergoes treatment to secondary level is 35% in Asia. Almost no sewerage is treated in Africa and more than 65% is treated in developed countries Van Puijenbroek, et al (2019).

D. Sewage discharge/use/recycling: In most developing countries, sewage receives little or no treatment and is discharged into a river or lake from which farmers divert it into the fields to grow different crops. In many of the developed countries, sewage is being recycled in a number of sectors other than agriculture for various reasons, but only after suitable treatment and guidelines are in place for recycling.

Developing Country Setting: In developing countries a lack of sufficient funds, high treatment costs of the conventional treatment systems and rapid increases in sewage volumes that exceed the current capacities of the treatment plants, results in a poor percentage of sewage undergoing primary/secondary treatment. The farmers whose lands are along these water bodies often channel the partially treated or un-treated sewage that is released into the rivers and lakes for irrigation. Though in the short run this water provides a reliable source of

irrigation and income for these farmers, in the long run, it has adverse effects on the farmers' health, soil and also pollutes the groundwater thereby making the process unsustainable. It has been argued that state governments receive grants to cover the capital costs of treatment plants, but still do not have enough money to operate and maintain these treatment plants. Hence, the very need for their establishment fails.

Developed country setting

In developed countries sewage disposal is common in:

- Water scarce regions such as in Australia, Middle East and southwest of United states,
- Regions with severe restrictions on disposal of treated sewage effluents, such as Florida, coastal or inland areas of France and Italy, and
- Densely populated European countries such as England and Germany (Marsalek et al. 2002).

Even in high rainfall countries like Japan whose mean annual precipitation is 1,714 mm, urban sewage use is common due to high population density in some regions, which suffer from water shortages (Ogoshi et al. 2001). The developed countries have generated techniques and guidelines for the safe use of sewage, which can be adopted by developing countries. After reviewing many overseas recycling projects, Radcliffe (2004) concluded that worldwide, water use is becoming an increasingly common component of water resource planning as the costs of sewage disposal rise and opportunities for conventional water supply development dwindle. However, the efficiency of disposal can be enhanced if the authorities and communities have a clear vision of the key objectives that need to be fulfilled in the long run through disposal which would then determine the particular sectors to which sewage should be allocated. A combination of two techniques (which weight the objectives that a community wishes to achieve and cost-effectiveness analysis for sewage disposal in different

sectors) can be used to develop a decision support tool for efficient sewage disposal in developed countries.

2.1.9 Sewage management in Developing countries

Based on observation, as Taiwo (2010) noted, sewage management problem in most of Nigerian communities is multidimensional in nature. It is associated with lack of community participation in sewage management. Most of policies concern with this issue are made without considering the community people that are the waste generators. For instance, in a study conducted at Orita-Aperin communities in the year 2004, it was found out that attitudes and belief of community people affected their waste management practices. Furthermore, Taiwo stated that in Nigeria context, sewage disposal is normally seen by the municipal government as a venture without any financial gain. That is the issues of environmental protection and healthful living are not very important to some health planners. In addition to this, the question of whose responsibility is to take care of waste generated in a community has not been clearly answered. Unless in some civilized areas, many people do not realized that they are liable to the disposal of sewage generated by them as they dump them by the road side for government workers to pick up

Atsegbua (2003) observes that the problem associated with sewage management in Nigeria does not appear to be a problem of absence of legislative framework for sewage management but other factors have been identified as being responsible for penetrating the crises experienced in the management of sewage in Nigeria. He highlighted four other factors that include:

- Lack of Adequate Funding and Excessive Population
- Lack of Trained/Professional Waste Managers
- Lack of Effective Monitoring and Control
- Peculiarity of Attitude among Nigerian

2.1.10 Sewage Disposal Methods in Minna Metropolis

A. Sewage Flow into Storm Water Drainages

This is the method by which residents dig or construct small outlets at ground level which were used to discharge waste water into storm water drainages constructed by the State Government. In some houses very close to the storm drainages the sewage flow in directly while in other areas some meters away the sewage has to travel to reach the drainages. Some of these drainages are found along major roads and others are found within residential areas. However inside all these drainages the sewage does not flow freely as waste materials of different kinds and sizes fall into the drainages choking and blocking sewage flow.

Plate II: General hospital Minna.

B. Sewage Flow into Open Ground

By this method, residents of homes just construct outlet to let the sewage flow out of their houses into the open ground. The sewage flowing into the open ground at times goes on ends up forming puddles. These puddles were seen in these areas during field work.

2.2 Related Empirical Studies

Okafor (2011) examined problems and prospects of waste management in Enugu state. A case study of Enugu State Waste Management Authority (ESWAMA). The generation and disposal of waste is an intrinsic part of any developing or industrial society. Studies have shown that the volume of waste does not actually constitute the problem but the ability or inability of governments, individuals and waste disposal firms to keep up with the task of managing waste and the environment. Past and present administrations in Enugu State have made several attempts to address the problems of waste management in the state. The establishment of the ESWAMA, in 2004, has not significantly addressed the menace of waste disposal as heaps of refuses are still seen all over the state on daily basis. Inadequate funding, incompetent staff, people‟s attitudes and ineffective monitoring/control mechanism are variables posing challenges to ESWAMA and as such, prompted this research. The study investigated the extent to which fund affects the efficiency of ESWAMA and the professional training status of staff of ESWAMA. We also verified the impact of people's attitudes towards ESWAMA‟s mandate as well as the impact of monitoring and control on the management of waste in Enugu State. Data collection were employed using the simple percentage and chi square analytical tools. The study hinged its theoretical framework on the Functional Structural theory. Increment of the supplementary funds allocated to ESWAMA, regularization and staff wider participation in the training packages, merit and transparency in the recruitment exercises, among others, were recommended.

Ndubisi-okolo (2016) conducted a study to investigate waste management and sustainable development in Nigeria with particular reference to Anambra State Waste Management Agency (ASWAMA). Survey research design was adopted and the instrument used for data collection was questionnaire (QWMSDN) which was structured utilizing five point likert scale. Pearson product Moment Correlation coefficient and one-sample Kolmogorov Smirnov Test were employed to analyze the data generated. The findings revealed that waste management practice has a significant impact on environmental sustainability in Anambra State. It was recommended that Government should establish stringent legal and regulatory framework that will enhance efficient and appropriate collection and disposal of waste by Anambra State Waste Management Agency. This will ensure environmentally sound waste management system that prevents damage to the Earth's ecosystems and maintain a high quality of life for the inhabitants of the State. Also, Government should pump sufficient funds into the agency to enable them dispose waste generated appropriately since hygiene and health of the citizens are very essential. This is pivotal because improperly stored waste can cause health, safety and economic problems which are detrimental to human existence.

Buba (2016) conducted a study on household solid waste management practices and the role of agencies responsible for its management in Gombe. The research gathered data from two main sources: primary and secondary sources. The secondary data were obtained from the library and internet sources while the primary data were obtained from the household heads, field surveys and oral interviews of employees of relevant waste management agencies such as: Gombe State Environmental Protection Agency (GOSEPA), Gombe Local Government, Formal Private Contractor (Inex Cleaners Limited), Informal Private Operators, operating in high and medium income neighborhoods, CBOs and waste collectors. In all, two hundred (200) copies of structured questionnaires were distributed randomly among selected household heads on the basis of density that is Low, Medium and High. The study revealed

that the socio-economic characteristics of the households in the study area have influence on waste generation, collection and disposal interms of their educational levels, monthly income, households' family size. At the high and medium income neighborhoods such as G.R.A and Federal Lowcost the rate of waste generation is higher compared to the low income neighborhoods of Gombe such as Ajiya and Kagarawal. This is as a result of the high income levels of the residents of the high and medium income neighborhoods in purchasing more items than the residents of the low income neighborhoods.

The study also revealed that majority of the residents in Gombe often dump their wastes in open spaces, drainages and vacant plots. About 32% of the residents do not have their wastes collected at all most especially in the low income neighborhoods such as Kagarawal. The results also indicated that waste separation does not take place at both households' level and official dumpsites. Most of the wastes generated are food, paper, textile materials, plastic materials, polythene bags, bottle and tin cans. The results indicated that the agencies in charge of solid waste management in Gombe were not efficient. This could be closely linked with the lack of equipments, trained manpower, and poor funding of these agencies and also the negative attitude of the households towards solid waste management. Based on these findings, the study recommended strategies options for efficient and effective management of solid waste in Gombe. These include community participation, payment for waste management, public-private partnership, adequate resourcing of waste management agencies, monitoring and supervising, use of integrated solid waste management model and use of appropriate technology etc.

Musa (2016) carried out a study on Challenges of Solid Waste Management in Minna and Environs. Solid waste disposal problem in urban centres such as Minna in most developing countries is a major concern to both the governments and residents of the area; this problem

has become most worrisome in Nigeria where the generation is always on the increase because of increase in population and some socioeconomic factors. Data for this study were obtained through the administration of questionnaires, direct interview and review of existing literature. The data obtained from the field were analyzed using pie chart. A total of three hundred questionnaires were distributed to some selected residents and business centres in Minna. For the various age groups 50 questionnaires were distributed per group. 56% of the respondents keep their waste containers inside the building, another category keep their containers outside their homes while business areas have a common collection points where the wastes are collected by the waste disposal agencies. 5% of the respondents admitted that they keep their containers in the curb side of their building while 25% of the respondents keep their containers outside their building. 60% of the generated wastes are disposed off on the major streets of Minna for the waste disposal agencies to collect while the second largest disposal method is the collective burning of the waste while 5% of the generated waste is burnt off by the respective owners. 63% of the respondents stated that the wastes generated were collected regularly by those in-charge while 37% stated otherwise. On further questioning, 61% of the respondents do not have an idea of those who collects their waste from wherever they are placed or dumped while 1% of the respondents stated that their wastes are disposed by the some community groups. It was concluded that people of the study area had poor attitudes and perceptions toward solid waste handling. They would store their household refuse in substandard refuse containers such as old buckets, sacks, baskets, polythene bags, and boxes that had no coverings.

2.3 Summary of Review of Related Literature

The literature was reviewed under the following: conceptual frame work, reviewed of related studies and related empirical studies. The literature review for this study revealed that technological advancement is on the increase daily in some developed countries in terms of

waste management. Several studies have been conducted on solid waste management especially sewage disposal. This study, therefore, seeks to find out the he development of framework for sewage disposal management in Minna metropolis, Niger state.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Design of the Study

The study adopted the descriptive survey research design. Survey design according Nworgu (1991) is aimed at collecting data on and describing in a systematic manner, the characteristics features or facts about a given population. This study was aimed to develop a frame work. The design is suitable for the study because it solicit information from NISEPA staffs and residential occupants.

3.2 Area of the study

The study was carried out in Minna metropolis, Niger state. Niger state, North-central Nigeria, bounded to the south by the River Niger. It is also bounded by the states of Kebbi and Zamfara to the north, Kaduna to the north and Northeast, Kogi to the southeast, Niger state falls on the land mass area of about 76,363km^2 and with the population of about 3,950,349 (NPC, 2006).

3.3 Population for the Study

The population for the study consists of 100 respondents of 50 NISEPA staffs and 50 residential occupants. The table below shows the distributions of the occupants residential.

Table 3.1 showing the distribution of the residential occupant.

S/N	AREAS	NO. OF OCCUPANT
1	Bosso estate	10
2	Tunga	10
3	M.I Wushishi	10
4	F layout	10
5	Kpakungu	10
	Total	**50**

Table 3.1 showing the distribution of the residential occupant.

3.4 Sample and Sampling Technique

There was no sampling since the population is small and manageable. The entire population will be used for the study.

3.5 Instrument for Data Collection

The instrument that was used in collecting data for the study is structured questionnaire titled questionnaire on framework for sewage disposal management (QFSDM) in Minna metropolis, Niger state. The questionnaire was made up of four sections (A, B, C, and D). Section 'A' contains items on personal information of the respondents. Section 'B' seeks information on the types of sewage disposal method adopted in Minna metropolis. Section 'C' find out the Challenges facing sewage disposal in Minna metropolis while Section 'D' deals with Strategies for proper sewage disposal management in Minna metropolis. The questionnaire items were based on four points scale. Items for section 'B', 'C' and 'D' contain four

responses category each. The response categories for section 'B', 'C' and 'D' are strongly Agree (SA), Agree (A), and Disagree (D) and strongly disagree (SD). These response categories was assigned numerical values of 4, 3, 2 and 1 respectively. Respondents were required to check (√) against the response category that best satisfies their opinion.

3.6 Validation of instrument

The instrument was faced validated for construct and content by three lecturers in the department of Industrial and Technology Education, Federal University of Technology, Minna and contributions on the appropriateness of the instrument was considered in the production of the final copy of the research instrument.

3.7 Reliability of instrument

In order to determine the reliability of the research instrument, a pilot test was conducted using fifteen (8 NISEPA staffs and 7 residential occupants) at Suleja. During the test, the questionnaires were distributed by the researcher. The questionnaire was filled by the NISEPA staffs and occupants of the buildings and then returned to the researcher. The data collected was analyzed using Crombach's Alpha statistics and a coefficient of 0.78 was obtained.

3.8 Administration of instrument

The instrument that was used for the data collection was administered to the respondents by the researcher and three research assistant in the study area.

3.9 Method of data analysis

Data collected for the research question will be analyzed using mean and standard deviation while the hypothesis will be analyze using t-test.

$$\bar{X} = \frac{4+3+2+1}{4} = \frac{10}{4} = 2.5$$

3.10 Decision Rule

The cut-off point for the mean score of 2.50 is be chosen as the agreed. This was interpreted relatively according to the rating point scale adopted for this study. Therefore, an item with response below 2.49 and below were regarded or considered as disagreed while an item with response at 2.5 and above was regarded or considered as agreed.

CHAPTER FOUR

PRESENTATION AND ANALYSIS OF DATA

4.1 Research Question 1

What are the types of sewage disposal method adopted in Minna metropolis?

Table 4.1: Mean responses of the NISEPA staff and residential occupant on the types of sewage disposal method adopted in Minna metropolis.

		N_1= 50		N_2=50
S/N	ITEMS	$\bar{X}$	SD	Remark
1	Treatment plants	2.40	.532	Disagreed
2	Sewage lagoons	3.66	.497	Agreed
3	On-site systems	3.60	.550	Agreed
4	Off-site systems	3.60	.620	Agreed
5	Full sewage systems	3.60	.620	Agreed
6	Garden lime	3.65	.520	Agreed
7	Dry or conservatory system	3.62	.599	Agreed
8	Water carriage system	3.64	.578	Agreed
9	Recycling plant	3.57	.655	Agreed
10	Incineration.	3.71	.498	Agreed
11	Biological treatment	3.56	.686	Agreed
12	Vermicomposting	3.56	.556	Agreed
13	Biogas Generation	3.68	.490	Agreed
14	chemical process and sludge method	3.71	.478	Agreed

15	physical process of removal of small and large floating and suspended solids from sewage through two processes of sedimentation and filtration	3.59	.668	Agreed

N=100

$\bar{X}$= mean of the respondents

N_1 = NISEPA staff

N_2= Residential occupant

SD = standard deviation of the respondents

Table 4.1 showed that both the NISEPA staffs and residential occupants agreed on items from 2 to 15. This is because none of the mean response was below 2.50 which was the beach mark of agreed on the 4-points response options while the response for item 1 is was below 2.50 it is therefore regarded as disagree. The standard deviation score ranged between 0.478 and 0.668. This showed that the responses of the NISEPA staffs and residential occupants on the items were not divergent.

4.2 Research Question 2

What are the challenges affecting sewage disposal in minna metropolis?

Table 4.2: mean response of the NISEPA staffs and residential occupants on the challenges affecting sewage disposal in minna metropolis.

		N_1= 50		**N_2=50**
S/N	ITEMS	$\bar{X}$	**SD**	Remark
1	Lack of Adequate Funding	3.45	.869	Agreed
2	Lack of Trained/Professional Waste Managers	3.47	.627	Agreed
3	Lack of Effective Monitoring strategies	3.60	.512	Agreed
4	Peculiarity of Attitude among Nigerian	3.56	.641	Agreed
5	High treatment costs of the conventional treatment systems	3.61	.618	Agreed
6	Rapid increases in sewage volumes that exceed the current capacities of the treatment plants	3.63	.525	Agreed
7	Poor percentage of sewage undergoing primary/secondary treatment	3.61	.601	Agreed
8	Excessive Population	3.58	.638	Agreed

9	Lack of sewage control team	3.60	.586	Agreed
10	Lack of energy to run sewage treatment plant	3.44	.671	Agreed
11	Sludge is produced during sewage treatment processes	3.56	.641	Agreed
12	Improper Real-Time monitoring by sewage monitoring team	3.65	.500	Agreed
13	Blockage of Sewage disposal System	3.63	.580	Agreed
14	Lack of adequate sewage disposal trucks	3.63	.580	Agreed
15	Contamination of river water as a result of sewage flowing into the river	3.55	.657	Agreed

N=100

$\bar{X}$**=** mean of the respondents

N_1 = NISEPA staff

N_2= Residential occupant

SD = standard deviation of the respondents

Table 4.2 showed that both the NISEPA staffs and residential occupants agreed on all items. This was because none of the mean response was below 2.50 which was the bench mark of agreed on the 4-point response options. The standard deviation score ranged between 0.500 and 0.869. This showed that the responses of the NISEPA staffs and residential occupants on the items were not divergent.

4.3 Research Question 3

What are the Strategies for proper sewage disposal management in Minna metropolis?

Table 4.3: mean responses of the NISEPA staffs and residential occupants on the Strategies for proper sewage disposal management in Minna metropolis.

		N_1= 50		**N_2=50**
S/N	ITEMS	$\bar{X}$	**SD**	Remark
1	There should be reduction in the sewage generation in urban areas.	3.60	.512	Agreed

2	Proper way of sewage collection should be adopted by government in order to be able to be treated and dispose properly	3.66	.476	Agreed
3	The sewage treatment network should be provided by the government since it might be cost for individual.	3.59	.534	Agreed
4	Sewage discharging and reclying plant should be made available after the treatment.	3.61	.601	Agreed
5	Export of wastes from the source of generation should be minimized to promote efficiency and reduce the spread of pollution.	3.60	.620	Agreed
6	Waste should be managed as close as possible to its source	3.68	.490	Agreed
7	Creating awareness of sewage management.	3.65	.575	Agreed
8	Making of polices to guide sewage waste in the state.	3.67	.551	Agreed
9	Making of sewage disposal measures for building constructions so as to enable new building to be properly constructed to manage sewage.	3.56	.641	Agreed
10	Creation of sewage monitoring team for proper management and sewage waste quality control team	3.73	.468	Agreed
11	Ensure that mechanisms are in places which lead to the separate collection of sewage	3.59	.668	Agreed
12	Implement policies or mechanisms that encourage the use of products of Bio-waste management	3.59	.534	Agreed
13	Ensure that where incineration or co-incineration are employed, permits should not be issued	3.72	.473	Agreed
14	Provision of energy supply for treatment plant	3.74	.441	Agreed
15	Ensure that every sewage polices are adhere to by every citizens	3.57	.685	Agreed

N=100

$\bar{X}$**=** mean of the respondents

N_1 = NISEPA staff

N_2= Residential occupant

SD = standard deviation of the respondents

Table 4.3 showed that both the NISEPA staffs and residential occupants agreed on all items from 1 to 15. This was because none of the mean response was below 2.50 which was the bench mark of agreed on the 4-point response options. The standard deviation score ranged

between 0.441 and 0.685. This showed that the responses of the NISEPA staffs and residential occupants on the items were not divergent.

4.3 Research Question 4

What are the frame work for sewage disposal?

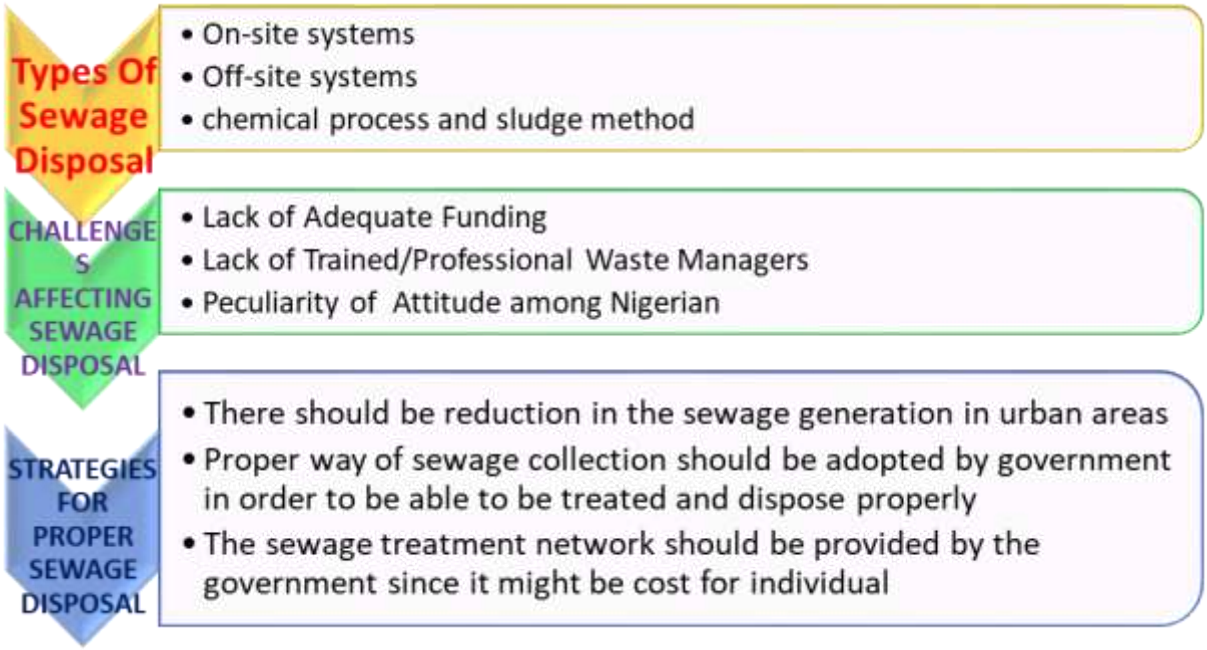

Figure 1: Framework for sewage disposal in Minna metropolis.

The above shows the framework for effective sewage disposal management in Minna metropolis. Edokpayi *et al.* (2017) stated that

"*In developing countries such as Nigeria, Minna lack of sufficient funds, high treatment costs of the conventional treatment systems and rapid increases in sewage volumes that exceed the current capacities of the treatment plants, results in a poor percentage of sewage undergoing primary/secondary treatment*"

Findings of the study

The following are the main findings of the study; they are prepared based on the research questions and hypothesis tested.

1. All the disposal methods (except no 1treatment plants) are adopted in Minna.

- Treatment plants: The wide range of centrifugal decanters and vertical centrifuges, enabling the recovery of water used in various municipal and industrial process, reducing the volume of sludge by more than 98%, in addition to applications in plants for the production of biogas and alternative energies made from biomass.
- Sewage lagoons; Sewage lagoons are also called effluent ponds. The sewage and effluent are broken down by germs in the lagoon. The sun and wind play an important role in the working of the lagoon.
- On-site systems; This is a multi-stages system that collect, treat, and disperse waste water generated by a home or business. The waste water is treated and discharged to the soils rather than collected and transported to a wastewater treatment plant.
- Off-site systems; This is a sanitation system in which excreta and wastewater are collected and conveyed away from the plot where they are generated .
- Full sewage systems; This is a network of pipes, pumping stations and appurtenances that convey sewage from its points of origin to a point of treatment and disposal.
- Garden lime; Lime is a manufactured product made from limestone. The raw material is processed into quicklime and hydrated lime. It is often used to adjust the PH of water and soils containing acidic components.
- Dry or conservatory system; Refuses or garbages is collected in dustbins and is conveyed by trucks to the disposal point. Then, combustible and non combustible portions are separated.
- Water carriage system; This is a method for the disposal of wastes, where water carries the wastes from its point of production to the point of treatment for final disposal.
- Recycling plant; This means a premise in which recoverable resources, including newspapers, magazines and other paper products.

- Incineration; This is the destruction of waste materials by burning
- Biological treatment; This is a type of treatment that uses substances made from living organism to treat disease.
- Vermicomposting; This is a process that relies on earthworms and micro-organisms to help stabilize active organic materials and convert them to a valuable soil amendment and source of plant nutrients.
- Biogas Generation; This is produced when bacteria digest organic matter (biomass) in the absence of oxygen.
- chemical process and sludge method; Chemicals are used during treatment in an array of process to expedite disinfection
- physical process of removal of small and large floating and suspended solids from sewage through two processes of sedimentation and filtration

2. All are the challenges affecting sewage disposal in Minna metropolis.

- Lack of infrastructure and environmental pollution
- Lack of infrastructure and environmental pollution
- Lack of Adequate Funding
- Lack of Trained/Professional Waste Managers
- Lack of Effective Monitoring strategies
- Peculiarity of Attitude among Nigerian
- High treatment costs of the conventional treatment systems
- Rapid increases in sewage volumes that exceed the current capacities of the treatment plants
- Poor percentage of sewage undergoing primary/secondary treatment
- Excessive Population
- Lack of sewage control team

- Lack of energy to run sewage treatment plant
- Sludge is produced during sewage treatment processes
- Improper Real-Time monitoring by sewage monitoring team
- Blockage of Sewage disposal System
- Lack of adequate sewage disposal trucks
- Contamination of river water as a result of sewage flowing into the river

3. All the strategies for proper sewage disposal management in Minna metropolis.

- There should be reduction in the sewage generation in urban areas.
- Proper way of sewage collection should be adopted by government in order to be able to be treated and dispose properly
- The sewage treatment network should be provided by the government since it might be cost for individual.
- Sewage discharging and reclying plant should be made available after the treatment.
- Export of wastes from the source of generation should be minimised to promote efficiency and reduce the spread of pollution
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- Export of wastes from the source of generation should be minimized to promote efficiency and reduce the spread of pollution.
- Waste should be managed as close as possible to its source
- Creating awareness of sewage management.
- Making of polices to guide sewage waste in the state.

- Making of sewage disposal measures for building constructions so as to enable new building to be properly constructed to manage sewage.
- Creation of sewage monitoring team for proper management and sewage waste quality control team
- Ensure that mechanisms are in places which lead to the separate collection of sewage
- Implement policies or mechanisms that encourage the use of products of Bio-waste management
- Ensure that where incineration or co-incineration are employed, permits should not be issued
- Provision of energy supply for treatment plant
- Ensure that every sewage polices are adhere to by every citizens

Discussion of findings.

The result from table 4.1 showed the findings on the types of sewage disposal method adopted in minna metropolis. The findings of the study revealed Treatment plants, Sewage lagoons, On-site systems, Off-site systems, Full sewage systems, Garden lime, Dry or conservatory system, Water carriage system, Recycling plant, Incineration, Biological treatment, Vermicomposting, Biogas Generation, chemical process and sludge method, physical process of removal of small and large floating and suspended solids from sewage through two processes of sedimentation and filtration. The findings of the study is inline with Ahaneku and Njemanze (2015) noted that open dumpsites disposal method is a commonly adopted method of disposal in Nigeria and other developing countries, which involves people disposing of their waste on open grounds most often indiscriminately, they are generally unsanitary, unsightly and smelly, attracting rats, insects, snakes and flies.

Table 4.2 shows the result of the findings on the the challenges affecting sewage disposal in minna metropolis. The findings of the revealed lack of infrastructure and environmental pollution, lack of infrastructure and environmental pollution, lack of adequate funding, lack of trained/professional waste managers, lack of effective monitoring strategies, peculiarity of attitude among Nigerian, high treatment costs of the conventional treatment systems, rapid increases in sewage volumes that exceed the current capacities of the treatment plants, poor percentage of sewage undergoing primary/secondary treatment, excessive population, lack of sewage control team, lack of energy to run sewage treatment plant, sludge is produced during sewage treatment processes, improper real-time monitoring by sewage monitoring team, blockage of sewage disposal system, lack of adequate sewage disposal trucks, contamination of river water as a result of sewage flowing into the river. The findings of the study is inline with Nwosu and Chukwueloka (2020) who points out loop holes in policies and non-existence of policies in some states towards waste management. Although good policies exist, implementation remains a challenge. Other challenges include poor funding, low level of government support, limited environmental awareness, inadequate facilities, corruption, politics, inappropriate technology, urbanization and low public participation.

The result from table 4.3 reveal the findings on strategies for proper sewage disposal management in Minna metropolis. The findings of the study revealed that there should be reduction in the sewage generation in urban areas, proper way of sewage collection should be adopted by government in order to be able to be treated and dispose properly, The sewage treatment network should be provided by the government since it might be cost for individual, sewage discharging and reclying plant should be made available after the treatment, export of wastes from the source of generation should be minimised to promote efficiency and reduce the spread of pollution, export of wastes from the source of generation should be minimised to promote efficiency and reduce the spread of pollution, export of

wastes from the source of generation should be minimised to promote efficiency and reduce the spread of pollution, export of wastes from the source of generation should be minimized to promote efficiency and reduce the spread of pollution, waste should be managed as close as possible to its source, creating awareness of sewage management, making of polices to guide sewage waste in the state, making of sewage disposal measures for building constructions so as to enable new building to be properly constructed to manage sewage, creation of sewage monitoring team for proper management and sewage waste quality control team, ensure that mechanisms are in places which lead to the separate collection of sewage, implement policies or mechanisms that encourage the use of products of bio-waste management, ensure that where incineration or co-incineration are employed, permits should not be issued, provision of energy supply for treatment plant, ensure that every sewage polices are adhere to by every citizens. The findings of the study is inline with Nnaji (2015) who stated that there is a need for both government and individuals to adopt holistic and sustainable waste management strategies in order to safeguard public/environmental health. Nnaji further stated that Sustained cooperation could be developed among all key actors (government, waste managers, public health workers and inhabitants) to implement an economic, sustainable, and reliable management practices in Nigeria. Also provision of sizable funds by the government and proper education to the people among others will help in sustainably managing the waste problem.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Study

The main focus of this research study was to develop a framework for sewage disposal management in Minna metropolis, Niger State.

Chapter 1 of the study discussed the background of the study, the statement of problem, purpose, significance, scope and the research questions were all stated and discussed for the conduct of this research.

The review of related literature looked into Concept of Waste, Concept of sewage, Waste Management, Sewage Management Processes, Sustainable Sewage Management, Sewage treatment, Methods of Sewage Disposal, Framework for Efficient sewage disposal, Sewage management in Developing countries, Sewage Disposal Methods in Minna Metropolis. Various views of different authors concerning the topic were harmonized in a comprehensive literature review and empirical studies.

A survey approach was used to developed instrument for the study; the respondents identified as the population of the study were the NISEPA staffs and occupants of residential apartments. The entire respondents were used. A number of 100 questionnaires were administered. The instrument used was analysed using frequency count, and mean scores. The research questions were discussed base on the findings from the responses and results of the instrument used.

Implication of the study and conclusions were also drawn from the findings discussed. Recommendations and suggestions for further study were formulated and stated according to the findings of the study.

5.2 Implication of the Study

The findings of the study had implications for government, NISEPA and citizens. The findings of the study may implicate the stakeholders by motivating stakeholders to take collective action towards the management of sewage waste. To maintain and develop a healthy and sustainable environment, the community, environmental health authorities, the private sector, and the government must all work together to accomplish success.

5.3 Conclusion

Based on the findings of the study, the following conclusions were drawn: The findings results have proven that there are two major problems relating to domestic waste disposal in the area: The first one is the high usage of pit latrines resulting in sewage problems and related health risks, and the second one is the open disposal of waste, that leading to bad odour, unpleasant view and health risks due to leakage of refuse to riverbeds and causing pollution of water. The findings of the study proved that the majority of respondents were homeowners and therefore willing to participate in the management of waste disposal, and collection, as well as the introduction of appropriate toilet facilities and a sewage collection system.

5.4 Recommendations

Based on the findings of the study, the following recommendations were made:

1. Government should establish stringent legal and regulatory framework that will enhance efficient and appropriate collection and disposal of waste by Minna metropolis, Niger State Waste Management Agency.
2. Government should set up a formal recycling sector where wastes of all kinds will be recycling instead of informal recycling which scavengers adopt who buy unused

valuables from people and go to legal and illegal dumpsites in search of materials that can be reused and recycled. The implication is that formal recycling of waste will ensure friendly environment as well as effective waste management practice. However, formal recycling of waste will generate wealth to the state. This will contribute significantly to sustainable development in the state.

3. Government should pump sufficient funds into the agency to enable them dispose waste generated appropriately since hygiene and health of the citizens are very essential. This is pivotal because improperly stored waste can cause health, safety and economic problems.

5.5 Suggestion for Further Study

The following are suggested for further studies:

1. Development of framework for sewage disposal management in other locations.
2. Development of framework for effective wood waste disposal management.

References

Addo, I. B., Adei, D., & Acheampong, E. O. (2015). Solid waste management and its health implications on the dwellers of Kumasi Metropolis, Ghana. *Current Research Journal of Social Sciences*, *7*(3), 81-93.

Adedire, F. M. (2017). *Housing Development Characteristics in Lagos State Peri-Urban Settlements* (Doctoral dissertation, University of Lagos (Nigeria).

Ahaneku, I. E., & Njemanze, C. F. (2015). Material flow analysis of abattoir solid waste management system in Minna, Nigeria. *The Journal of Solid Waste Technology and Management*, *41*(2), 165-172.

Aldosari, K. R. (2019). Marine safety and pollution prevention from oil spills in the Arabian Gulf: a comparative study of applicable international and regional conventions.

Aliyu, A. A., & Amadu, L. (2017). Urbanization, cities, and health: the challenges to Nigeria–a review. *Annals of African medicine*, *16*(4), 149.

Aliyu, A. A., & Amadu, L. (2017). Urbanization, cities, and health: the challenges to Nigeria–a review. *Annals of African medicine*, *16*(4), 149.

Atta, U., Hussain, M., & Malik, R. N. (2020). Environmental impact assessment of municipal solid waste management value chain: A case study from Pakistan. *Waste Management & Research*, *38*(12), 1379-1388.

Ayedun, H., Gbadebo, A. M., Idowu, O. A., & Arowolo, T. A. (2015). Toxic elements in groundwater of Lagos and Ogun States, Southwest, Nigeria and their human health risk assessment. *Environmental monitoring and assessment*, *187*, 1-17.

Ayotamuno, A. (2020). The Impact of Indiscriminate MSW Collection Points in Greater Port Harcourt City, Nigeria. *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*, *13*(3), 26-35.

Ayuba, I. G., Achuenu, S., & Musa, C. C. (2015). Sustainability of Solidwaste Management in Nigerian Urban Areas: challenges and solution. *Int J Sci Energy Res*, *3*, 522-543.

Batagarawa, R. L., & Williams, J. (2019). Viability of 'Dilute and Attenuate'Landfill as a Final Disposal Method for Solid Waste in Nigeria. *Civ. Environ. Res.*, *11*(10), 55-61.

Buor, D. (2020). Perspectives on Solid Waste Management Practices in Urban Ghana: A Review. *Journal of Waste Management and Disposal*, *2*(3), 1-8.

Edokpayi, J. N., Odiyo, J. O., & Durowoju, O. S. (2017). Impact of wastewater on surface water quality in developing countries: a case study of South Africa. *Water quality*, *10*, 66561.

Fabian, N. (2021). *The Trash and Treasures of Chinese Cities: Early to Late Twentieth-Century Approaches to Waste Management in Shanghai, Chengdu and Hong Kong* (Doctoral dissertation, Ruhr-Universität Bochum).

Ijaiya, H., Abbas, W. I., & Wuraola, O. T. (2018). Re-examining hazardous waste in Nigeria: practical possibilities within the United Nations system. *African Journal of International and Comparative Law*, *26*(2), 264-282.

Kadafa, A. A. (2017). Solid waste management practice of residents in Abuja municipalities (Nigeria). *IOSR Journal of Environmental Science, Toxicology and Food Technology*, *11*(2), 87-106.

Kurien, G. P., & Qureshi, M. N. (2018). House of sustainable waste management: an implementation framework. *International Journal of Sustainable Manufacturing*, *4*(1), 79-96.

Ladan, M. T. (2016). Sanitation and waste management-part 1: Overview. *Envtl. Pol'y & L.*, *46*, 175.

Lohri, C. R., Faraji, A., Ephata, E., Rajabu, H. M., & Zurbrügg, C. (2015). Urban biowaste for solid fuel production: Waste suitability assessment and experimental carbonization in Dar es Salaam, Tanzania. *Waste Management & Research*, *33*(2), 175-182.

Luitel, E. S. (2021). Review on case study of faecal sludge management in urban areas of Bangladesh.

Masebinu, S. O. (2018). *Anaerobic digestion process stabilisation and in-situ upgrading of a biogas system*. University of Johannesburg (South Africa).

Muthaiyah, N. P. (2020). Rejuvenating Yamuna River by wastewater treatment and management. *International Journal of Energy and Environmental Science*, *5*(1), 14-29.

Nnaji, C. C. (2015). Status of municipal solid waste generation and disposal in Nigeria. *Management of Environmental Quality: An International Journal*, 26(1), 53-71.

Nwankwo, C. (2021). Environmental literacy and waste disposal behaviour of university undergraduates in Enugu state, Nigeria.

Nwosu, A. O., & Chukwueloka, H. E. (2020). A review of solid waste management strategies in Nigeria. *Journal of Environment and Earth science*, *10*(6), 132-43.

Ojo, O. O., & Adejugbagbe, J. A. (2017). Solid waste disposal attitude in Sango Ota, Ogun state: Implication for sustainable city development in Nigeria. *Journal of Environment and Waste Management*, *4*(3), 253-260.

Okoye, B., Umeora, C., Ifebi, O., & Onwuzuligbo, C. (2018). Effects Of Sewage Disposal Systems On The Environment In Public Housing Estates In Enugu Metropolis. *coou African Journal of Environmental Research*, *1*(1), 120-130.

Otti, V. I., Nwafor, A. U., & Dan, N. K. (2018). The role of an environmental engineer in preventing and reducing environmental stress. *African Journal of Environmental Science and Technology*, *12*(11), 417-420.

Sadiq, Q. O., Ezeamaka, C. K., & Butu, A. W. (2019). Municipal Solid Waste Disposal and Its Environmental Implications in Wuse Zone 5, Federal Capital Territory, Abuja, Nigeria. *International Journal of Environmental Protection and Policy*, *6*(6), 97.

Salau, O., Fatusi, O., & Bwala, S. (2021). Assessment of household waste disposal system in tudun-wada area of billiri local government, Gombe state. Nigeria'. *IOSR Journal of Environmental Science*, *15*(1), 59-62.

Srivastava, R. (2020). Solid waste management and its impact on the environment. In *Handbook of research on environmental and human health impacts of plastic pollution* (pp. 389-400). IGI Global.

Tetteh, S., Yazdani, M. R., & Santasalo-Aarnio, A. (2021). Cost-effective Electro-Thermal Energy Storage to balance small scale renewable energy systems. *Journal of Energy Storage*, *41*, 102829.

Van Puijenbroek, P. J. T. M., Beusen, A. H. W., & Bouwman, A. F. (2019). Global nitrogen and phosphorus in urban waste water based on the Shared Socio-economic pathways. *Journal of environmental management*, *231*, 446-456.

Yadav, D. (2019). Impact of chemical reaction on the convective heat transport in nanofluid occupying in porous enclosures: a realistic approach. *International Journal of Mechanical Sciences*, *157*, 357-373.