A TERM PAPER ON THE

CRITICAL APPRAISAL OF WASTEWATER MANAGEMENT IN NIGERIA

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**ABSTRACT**

The goal of wastewater management is to clean and protect water. This means that water must be clean enough so that it can be used by people for drinking and washing, and by industry for commercial purposes. It also must be clean enough to release into oceans, lakes, and rivers after it has been used.

Environmental pollution due to improperly managed wastewater has been a major challenge and of public health concern in Nigeria.

**CHAPTER ONE**

**INTRODUCTION**

**1.1. Background of Study**

 Rapid population growth in Nigeria, as well as in many other developing countries, has resulted in an equally rapid increase in urbanization and these are generators of increased domestic and industrial wastewater. In addition to the already prevalent natural scarcity of freshwater in many such regions, the quality of the available water is also quickly deteriorating due to pollution. Industrial discharges into rivers are one of the causes of irreversible degradation occurring in surface water systems and improper wastewater management has a very direct impact on the biological diversity of aquatic ecosystems and disrupts the integrity of the systems which support a wide range of sectors, from urban development to food production and industry. The Pan-American Health Organization (PAHO) has stated that less than 10% of municipalities in developing countries treat sewage adequately before emptying it into natural water courses and that wastewater treatment for industrial efﬂuent are often non-existent.

In Nigeria, apart from very few areas in the federal capital city, Abuja, and some parts of Lagos, there are no central sewage systems in any other city in Nigeria; thus, the onus of wastewater management is on individual citizens or businesses through the decentralized wastewater management system. Therefore, water pollution is one of the most evident forms of pollution in the country. Even though waterways can absorb substantial quantities of toxic substances, local pollutants have already exceeded this level. Thus, it is evident that the concentrations of pollutants are high in different water environments and a proper environmental management and monitoring program is urgently required.

**1.2. Nigeria’s Existing Environmental Regulations and Framework**

Over the years steps, have been taken by the Nigerian government to establish institutions for environmental protection and conservation. The National Water Resources Institute (NWRI) and the River Basin Development Authorities (RBDA) were established in 1976 and Federal Ministry of Water Resources (FMWR) was created in 1977 [12]. While the FMWR is in charge of policy formulation and advising, the NWRI is responsible for research and manpower training. The RBDAs, on the other hand, are responsible for making water available to communities for agricultural, domestic, and industrial purposes. In the same vein, in 1988, the government established the Federal Environmental Protection Agency (FEPA) through decree 58 of December 1988 [19]. The major aim of FEPA was to formulate national environmental guidelines, standards, and criteria, speciﬁcally in the domain of water quality, efﬂuent discharge, and air and atmospheric quality. This institution was transformed into the Federal Ministry of Environment (FMENV) in 1999 [20]. Even with the creation of the FMENV, a lacuna existed in the effective enforcement of environmental laws, standards and regulations in the country and in order to address this problem, the federal government established the National Environmental Standards and Regulations Enforcement Agency (NESREA).

**CHAPTER TWO**

**3.1. Wastewater Management in Nigeria**

There is a significant lack of proper wastewater treatment in most African countries. Untreated wastewater effluent is one of the most common types of pollution found around urban rivers and

in groundwater sources in many African cities (Omosa et al., 2012).

Nigerian cities are expected to participate in the global trend of sustainable environmental improvements or innovations that focus on projects such as water supply and sanitation, solid waste management, air pollution, environmental health, and access to means of livelihood; hence, there is a need for a better understanding of the existing situation of facilities and infrastructures in these cities.

In Aba, one of the Nigeria’s commercial cities, Odurukwe (2012), reported that there is no central wastewater system, and there are no septic tanks for domestic wastewater. The sewers for industrial wastewater coming from big industries and the open drains used for the wastewater of medium- and small-scale industries are channeled in such a way that their contents are emptied into Aba River. The pollution of Aba River is very likely to increase in the next decade. There is inadequate or hardly any treatment of the wastewater produced by the industries, and no efforts are being made to change this situation.

In Minna, the capital of Niger state, Idris-Nda et al. (2013) reported that domestic wastewater management consists of the use of septic tanks, unplanned and partially planned open drainage systems. In their report, about 35% of domestic wastewater generated goes into the septic tank while the remaining 65% flows freely on ground surface and sometimes forming stagnant pools.

The residents in some areas resort to the use of unlined channels to convey wastewater away from their residential areas. A result of this method of disposal is a pool of stagnated water at the terminal end and the production of obnoxious odors.

According to Mustapha (2013), in Kano, Nigeria’s third largest city, most of the industries do not have wastewater treatment facilities and thus discharge their untreated effluents into the adjoining receiving water bodies; the receiving water courses are now grossly polluted, and the polluted water courses are being extensively used for water supply, irrigation, fishing, and recreation while the only treatment plant in Kano central is nonfunctional.

Adesogan (2013) discovered in his study that only Kaduna has a functional industrial wastewater treatment facility (Nigerian Brewery, Kaduna) in the northern part of Nigeria. Similarly, the only functional system in the middle belt is in Abuja, while Benue, Niger, Kogi, Kwara, and Plateau states have non-functional wastewater treatment facilities. Despite the preponderance of wastewater treatment plants in the south, many of the southern States lack functional wastewater treatment systems while some states (Bayelsa, Ondo, Anambra, Ebonyi, Abia, Imo, Cross River, and AkwaIbom) do not have wastewater treatment facilities.

It is disheartening to note that Nigerians still dispose wastewater from domestic areas (washrooms, laundries, and kitchen) directly into surface waters without any treatment.

Wastewater from commercial and industrial applications has also experienced the same fate without any plan by most environmental stakeholders to ensure safe disposal. The indiscriminate release of wastewater into the environment in many Nigerian cities has adversely affected sanitation and claimed the lives of many people through diseases such as cholera, hepatitis B, and typhoid (Giwa, 2014). The endocrine-disrupting substances in untreated wastewater can alter the hormone system of human beings, resulting in reproduction predicaments, cancerous growths, and

deformations of body organs. In many densely populated areas in Lagos State such as Badagry, Mushin, Oshodi, and Ikorodu, most septic tanks are in dilapidated conditions, leading to severe cases of groundwater contamination. Lagos State alone generates a massive 1.4 trillion cubic centimeters of wastewater every day, according to government statistics (Giwa, 2014).

Change of attitude toward wastewater management is the key to sustainable management of water resources. Government at all levels needs to embrace implementation of wastewater

treatment and reuse programs and policies. Without this, the preservation of our water resources and the environment for the future (i.e. sustainability) remains an illusion.

**3.2. Wastewater Management System**

Wastewater management system is a wastewater system that processes wastewater from home, industrial and agricultural sources. Wastewater management is the collection, transport, processing, recycling or disposal of waste materials. Mekala, Davidson, Samad, and Boland (2008) described wastewater management system to include a network used to bring wastewater to treatment plant. The system also includes the source of wastewater in the home, technologies for treating the wastewater, and technologies and processes for returning the processed wastewater to the environment.

Wastewater management involves the determination of wastewater (source), its threat to the environment, collection systems, treatment and reuse. An improperly managed wastewater has the potential to negatively impact on the natural environment, on human health as wastewater contains disease producing microorganism and chemicals and on the economic environment.

**3.3. Wastewater Treatment Methods**

The aim of treatment is to reduce the level of pollutants in the wastewater before reuse or disposal into the environment (UN Water, 2014). The standard of treatment required for wastewater is usually location and use-specific. There are different wastewater treatment methods available, these methods can be simply grouped as aerobic, anaerobic and physico-chemical processes.

**3.3.1. Aerobic Treatment of Wastewater**

In aerobic wastewater treatment systems, aerobic organisms in the presence of oxygen convert organics in the wastewater into carbon dioxide and new biomass. Oklahoma Department of Environmental Quality in explaining aerobic treatment puts it as the use of air to treat wastewater. Treatment of the wastewater occurs in the aeration chamber. Air is bubbled through the wastewater allowing the natural bacteria to flourish. These bacteria feed on and breakdown the organic material found in the wastewater. The wastewater then flows to the clarifier where the solids are separated from the liquids. In a similar explanation, Gustafson, Anderson, and Christopherson (2001) said aerobic treatment pre-treats wastewater by adding air to break down organic matter, reduce pathogens, and transform nutrients.

Compared to conventional septic tanks, aerobic treatment break down organic matter more efficiently, achieve quicker decomposition of organic solids, and reduce the concentration of

pathogens in the wastewater.

**3.3.2 Anaerobic Treatment of Wastewater**

Wright (2008) and Jhansi and Mishra (2013) described anaerobic method of treatment as a process where anaerobic bacteria degrade organic materials in the absence of oxygen and produce methane and carbon dioxide. The produced methane can be reused as an alternative energy source (biogas). Anaerobic wastewater treatment differs from conventional aerobic treatment. The absence of oxygen leads to controlled conversion of complex organic pollutants, mainly to carbon dioxide and methane. Anaerobic treatment has favorable effects like removal of higher organic loading, low sludge production, high pathogen removal, biogas production and low energy consumption (Mrowiec and Suschka, 2009).

**3.3.3 Physico-Chemical Treatment of Wastewater**

Physicochemical wastewater treatment is a frequently used technique in the area of wastewater treatment. Physicochemical wastewater treatment techniques are applied for the removal of heavy metals, oils and greases, suspended matter and dissolved organic substances, organic and inorganic components, difficult to decompose, toxic pollutants or high salt concentrations, phosphorus and so on. The physicochemical wastewater treatment techniques are used as pre-treatment, final treatment as well as specific treatment for wastewater reuse as process water. Dhameja (2006) included dilution, sedimentation and filtration as being part of the physical processes. According to Cruden (2015) Physicochemical treatment of wastewater focuses primarily on the separation of colloidal particles.

This is achieved through the addition of chemicals (called coagulants and flocculants). This

changes the physical state of the colloids allowing them to remain in an indefinitely stable

form and therefore form into particles or flocs with settling properties. In addition to the

processes stated by Dhameja (2006), Cruden (2015) further added coagulation (rapid mixing)

and flocculation as physico-chemical process.

**3.4. Wastewater Treatment Stages**

The aim of wastewater treatment is the removal of contaminants from the water which is either reused or discharged into the environment without fear of causing long or short term environmental degradation. The wastewater treatment process is carried out in three stages. Dhameja (2006), Sincero and Sincero (2008), and Evanylo (2009) put the three stages of wastewater treatment as: Primary treatment, Secondary treatment and Tertiary treatment.

**3.4.1 Primary Treatment of Wastewater**

Primary treatment involves the removal of a portion of the suspended solids and organic matter from the wastewater. Wastewater contains a wide variety of solids of various shapes, sizes and densities (Dhameja, 2006). The purpose of primary treatment is the removal of the suspended solids, scum, grit, oil and grease, the removal is done by use of bar screens, skimming tanks, grit chamber, and floatation/sedimentation unit respectively. Sincero and Sincero (2008) noted that preliminary treatment also constitutes part of the primary treatment.

**3.4.2 Secondary Treatment of Wastewater**

According to Dhameja (2006), secondary treatment involves removing, stabilizing, andrendering harmless very fine suspended matter. Sincero and Sincero (2008) added that secondary treatment involves removing leftovers from the primary treatment. These leftovers are composed of colloidal and dissolved organic matters which cannot be removed in the primary treatment stage. Asano et al. (1985), Dhameja (2006), Sincero and Sincero (2008), and Jhansi & Mishra (2013) have all highlighted various methods for achieving secondary treatment to include:

1. Constructed wetland
2. Activated sludge system
3. Aerobic granulation
4. Aerated lagoon
5. Rotating biological contactor
6. Membrane bioreactor
7. Sequencing batch reactor
8. Trickling filter
9. Bio-towers

**3.4.3 Tertiary Treatment of Wastewater**

Tertiary treatment which is also called advanced wastewater treatment is required when reclaimed water is to be put to direct use, (Dhameja, 2006). Tertiary treatment is initiated after secondary treatment for further purification and decontamination. The goal of tertiary treatment is to reduce unwanted elements such as Suspended Solids, Chemical Oxygen Demand (COD) (solid and colloidal), Biological Oxygen Demand (BOD), phosphorus and specific compounds (pesticides, metals, detergents, and so on), this is in accordance with Dhameja (2006). Kamyotra and Bhardwaj (2011) further explained that tertiary wastewater treatment is employed when specific wastewater constituents which cannot be removed by secondary treatment must be removed. The treatment processes are necessary to remove nitrogen, phosphorus, additional suspended solids, refractory organics, heavy metals, and

dissolved solids. It is designed to improve the quality of purified water so that it can be

discharged into the natural environment or re-used.

**CAPTER THREE**

**3.1. Planning of Wastewater Management Projects**

Planning of wastewater Management projects involves a multidisciplinary approach that incorporates the triple bottom line aspects of sustainability. A thorough feasibility study required a multidisciplinary approach by considering several diverse aspects of the proposed project such as technical (e.g. operational efficiency), economic (e.g. life cycle costs), environmental (including public health and safety), and social (public acceptability and legislation) issues. These factors contribute to the final decision that could lead to the success or failure of a dual water reticulation project, and their due consideration should reliably lead to correct decisions. A detailed decision support tool to evaluate the technical, economic, environmental, and social issues has been developed in Adewumi et al., (2010 b) and its application is present in Adewumi et al. (2013).

**3.2. Recommendations for Establishing a Wastewater Management Programme in Nigeria**

In planning a wastewater management program in Nigeria, the first step is the implementation of a sound research program directed and funded by the Federal Ministry of Water Resources. Universities, polytechnics, and research institutions, including private organizations, can take part in such nation-wide projects through which the base data survey of wastewater generation, collection, treatment, and storage can be undertaken in the urban areas of the country.

There is a need for total water supply inventory from which the volume of wastewater produced per capita per day can be established. Research programs will also establish accurate knowledge of the various wastewater pollutants in our environment. The data obtained will be most useful in the formulation of the appropriate policies in the disposal of wastewater and the planning for reuse after different levels of treatment.

As wastewater treatment is relatively expensive (far more than water supply treatment) pilot programs and projects must first be established after detailed feasibility studies are conducted in selected locations to determine the efficacy of nation-wide programs for wastewater reuse. Starting point could be in the Northern parts of Nigeria where there exist vast arable lands for irrigation due to low annual rainfall (< 700mm) and high atmospheric temperatures (>35oC). This will enable farmers to increase their output and cultivate year-round rather than seasonally during raining season (maximum of 7 months per of the year). This will boost the national agricultural output and enhance food security. It will also create employment for the teeming population while at the same time increasing the national GDP and improving the economy.

It is also necessary that the government formulate policies targeted at stiffening water permits for industrial and agricultural use to encourage wastewater reuse. Water tariff for the industrial, agricultural, and commercial sectors can also be increased to encourage reuse.

For any new program or policy, there is a need for enlightenment of the populace. Wastewater reuse programs are even more acute as they will involve some potential conflicts with cultural practices, even though most people do not know that the water they use is seriously contaminated by wastewater in various forms.

Any reuse program must involve the related ministries, departments, and agencies dealing with the environment such as the Federal Environmental Protection Agency (FEPA), the Federal Ministry of Environment, Housing and Urban Development, State Water Corporations, and Sewage Disposal Agencies to increase levels of success.

**3.3. Conclusion**

It is therefore expedient that necessary steps be taken by developing countries like Nigeria by using the most appropriate technology for wastewater management. Considerations should be made to the Environmental, Social and Economic benefits of the technology and method to be used. There is no doubt that Nigeria has little or nothing to show in wastewater management and recycling. This has been proven by the investigation of Adesogan (2013) who made an inventory of domestic wastewater treatment plants across Nigeria.

Elika (2013) believes that Nigerian cities can achieve centralized wastewater management through proper Government policies, public-private sector partnership investment and could succeed in turning wastewater to potable water as many developed nations have done. This research therefore suggests that centralized treatment of domestic wastewater in Awka should be initiated in the light of sustainable development. This can be achieved by the government or through public private partnership. Wise investments in wastewater management will generate significant returns, as addressing wastewater is a key step in reducing poverty and sustaining ecosystem services. Instead of being a source of problem, well-managed wastewater will be a positive addition to the environment which in turn will lead to improved food security, health and functioning of the bio-system. The sludge from the treatment process can and should be utilized in improving agriculture in the state. The reclaimed/recycled water can also be used for irrigation purposes and other non-potable uses like firefighting, Park watering and so on. Public enlightenment can also be organized to educate on the safety and use of properly treated domestic wastewater.