



Green Entrepreneurial Opportunities in Wastewater Management: Implications for Sustainable Economic Growth in Nigeria

¹ANABARAONYE Benjamin *, ²ORJI Ijeoma Evelyn, ³EWA Beatrice.O, ⁴ARINZE, Chukwudi. P.

¹Institute of Climate Change Studies, Energy and Environment, University of Nigeria, Nsukka, Nigeria.

²Institute of Education University of Calabar, Calabar Nigeria

³Institute of Climate Change Studies, Energy and Environment, University of Nigeria, Nsukka, Nigeria.

⁴Department of Zoology and Environmental Biology, University of Nigeria, Nsukka, Nigeria

Correspondence email: benjaminshines@gmail.com

Received: 16.5.2023 Accepted: 21.6.2023

Date of Publication: June 2023

Abstract: The world's wastewater – about 80 percent of which is released into the environment without adequate treatment – is a valuable resource from which clean water, energy, nutrients, and other resources can be recovered. As population grows and urbanization increases, more wastewater is generated and there is need to create more awareness on the health, economic and environmental implications of poorly disposed wastewater. Climate change, global warming and other related environmental challenges such as water pollution presently pose as a threat to biodiversity and sustainable economic growth in Nigeria. However, within these environmental challenges are self-reliant opportunities, one of which is green entrepreneurship in wastewater management. Perceivably, this has implications for sustainable economic growth in Nigeria. This paper calls for smarter wastewater management, including reuse and resource recovery. It also examined wastewater management projects in Nigeria which have paid dividends for people, the environment, and economies in the short and long-term. This paper concludes by highlighting the economic, environmental and health benefits of wastewater management for sustainable development in Nigeria.

Keywords: Economic Growth, Green Entrepreneurship, Waste Water Management, Sustainable Development, Nigeria.

1. INTRODUCTION

Approximately 70% of the Earth's surface is covered with water thus it is the most abundant substance on the earth surface. Water is essential to human existence not only because of its biological roles but also its importance in our day to day socio-economic activities (UN Waters, 2022). The various application of water includes domestic activities (such as laundry, cooking, bathing), irrigation, industrial activities, health care services, food processing, etc. However, as a result of these processes, water is contaminated thereby generating wastewater. Hence, wastewater is a form of polluted water generated from human activities and rainwater runoff. Any water that has been adversely affected in quality due to human activities can be categorized as wastewater (Burton and Stense, 2003). According to Tchobanoglous et al. (2004), wastewater is water generated after the use of raw water in a variety of deliberate processes. Wastewater refers to any liquid waste or sewage that comes from households, hospitals, factories, and any other structure that uses water in its facilities. Wastewater contains wide range of pollutants such as microorganisms, pesticides, micro-plastics, fertilizers, oils, radioactive chemicals which are potentially toxic. These contaminants may be in liquid or solid state.

As reported by UN Waters (2022), the amount of wastewater produced and its overall pollutant load are rising globally as a result of population increase, rapid urbanization, and

economic development. Poor management of wastewater is a major environmental issue in developing countries, including Nigeria. The greatest increases in exposure to pollutants are expected to occur in low- and lower-middle income countries, primarily because of higher population and economic growth in these countries, especially those in Africa (United Nations Environment Programme (UNEP), 2016; UN Waters, 2017).

A significant amount of wastewater in urban areas with higher levels of poverty is dumped untreated into the nearest drainage channel or body of water (UN Waters, 2022). In typically highly populated residential zones with poor sewage system, wastewater generated from domestic activities and medical wastes are exposed to air resulting in air pollution. This study therefore discusses the concept of wastewater management, green entrepreneurship, negative impacts of poor wastewater management in Nigeria, and benefits of properly managed wastewater for sustainable economic growth in Nigeria.

2. MATERIALS AND METHODS

Data used for this study is derived from published works including academic articles, journals, conference papers, textbooks, and internet materials. This paper examined the "Green entrepreneurial opportunities in wastewater management in Nigeria and its implications on sustainable economic growth" through existing literature review and data collection from relevant agencies. The main purpose of this research work was to survey theoretical backgrounds and previous studies on the subject matter.

3. RESULTS AND DISCUSSION

In many African countries, there is a significant lack of proper wastewater treatment. 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). This is the reality in many Nigerian cities where collected wastewater are discharged into water bodies untreated. According to Odurukwe (2012), there is no central wastewater system and septic tanks for the collection domestic wastewater in Aba city. Odurukwe (2012) further revealed that wastewater from the large, medium and small scale industries in the commercial city of Aba in Nigeria are directly emptied into the Aba river. These untreated wastewater released into this river can potentially result in environmental and health hazards in the community.

Nigeria is ranked the poverty capital of the world with rising unemployment rate where many live in abject poverty (Ogunwale, Oladele, Adedeji, Nwokolo & Afolabi, 2020).

Oyewale (2023) identified "Nigeria as the leading headquarters of the world poverty, stressing that the inability of the policy makers to adopt the strategies to achieve conservation of natural resources for sustainable economic development and other goals has failed Nigerians". Some poverty alleviation programmes in Nigeria has not changed people's living standards (Orji, Attah & Adie, 2022). This is evident in the World Bank's report that Nigeria has again missed 2022 poverty reduction target as a result of rising inflation (Ikpot, 2022). In Nigeria, improper management of wastewater is one the major environmental challenges due to its potential of causing groundwater and surface water pollution leading to poverty in Nigeria. Domestic sewage and industrial wastewater are the major contributor of wastewater and are capable of introducing wide range of contaminants into natural water bodies (Eikelboom and Draaizer, 1999). Waste is wealth yet much of the waste products are disposed in dumpster. For example, more than 55 % of cassava waste are disposed as refuse (Olukanni & Olatunji, 2018), about 80% of the world's wastewater are released into the environment without adequate treatment. These untreated wastewater overtime has environmental implications which affect human beings negatively. In particular health and livelihoods are impacted. Opportunities in the agricultural value chain are not maximized. Waste management particularly that of wastewater is a potential area for sustainable economic growth yet it is not recognized as self-reliant initiatives or opportunities to be adopted (Orji, Attah & Adie, 2022). This paper's perception is that, for example, if wastewater is properly managed, valuable resources can be recovered. Such resources as clean water, energy and manure, provides sources of livelihoods for economic growth, which have implications for sustainable development.

4. WHAT IS WASTEWATER MANAGEMENT?

Wastewater management refers to the collection of wastewater for treatment and for reuse. It is an important approach for the protection of water resources (Roobahani, 2021). Waste are unwanted materials that are generally perceived as no longer useful or needed, hence are discarded away from where there are generated. Most times improperly discarded waste

constitutes nuisance and hazards to people and the environment. However, knowledge and technological breakthroughs have made it possible to recover valuable materials from waste for sustainable livelihoods and sustainable economic growth and development (Anabaraonye, Okafor & Hope, 2019). Example of such waste is wastewater. Its proper management should provide the much craved solution to environmental issues such as pollution of water habitats and biodiversity loss.

5. WHAT IS GREEN ENTREPRENEURSHIP?

Traditionally, Entrepreneurship refers to the totality of self-asserting attributes that enable a person to identify latent business opportunities together with capacity to organize needed resources with which to profitably take advantage of such opportunities in the face of calculated risks and uncertainty (Essien, 2006). An entrepreneur is that person that recognizes and pursues opportunities without regard to the resources he or she is currently controlling with confidence that he or she can succeed with the flexibility to change course as necessary and with the will to recover from setbacks (Envic & Langford, 2000). Green Entrepreneurship is the process of developing new products and technology to address environmental issues (York and Venkataraman, 2010). Green entrepreneurship refers to a special subset of entrepreneurship that aims at creating and implementing solutions to environmental problems and to promote social change so that the environment is not harmed (Saari and Joensuu-Salo, 2019). According to Anabaraonye et. al (2022), Green entrepreneurship is that entrepreneurship that seeks to solve environmental problems while generating income for sustainable economic growth. Green entrepreneurs are seizing business opportunities that can result in the improvement of ecological sustainability (Dean and McMullen, 2007). Green Entrepreneurs use their creative and business ability to solve environmental related issue (including wastewater management) for profitability or sustainability.

IMPACTS OF WASTEWATER MANAGEMENT ON NIGERIA'S SOCIO-ECONOMIC DEVELOPMENT

Reiteratingly, in June 2022, environmental leaders globally met to take stock of where we have been and where we are heading with the goal of galvanizing momentum for the United Nations Decade of Action for achieving the Sustainable Development Goals (SDGs). For instance, the sustainable development goal 6 (SDG 6) aimed at ensuring the availability and sustainable management of water and sanitation is one of the pressing needs of campuses, communities and cities in Nigeria. This is pertinent as climate change and industrialization, among other human activities is causing water shortage globally. In some areas in Nigeria, there is no proper drainage or sewage system for collection of wastewater but rather are released into open field resulting in severe air pollution (Idris-Nda et al, 2013). Giwa (2014) opined that 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. Idris-Nda

et al, 2013 reported that domestic wastewater management consists of the use of septic tanks. 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. According to Adesogan (2013), there is no adequate wastewater treatment plant in some states like Anambra, Ondo, Ebonyi, Kwara and hence wastewater are disposed into ground water. Many residents in some areas in Minna, Niger State resort to the use of improper channels to convey wastewater away from their residential areas leading to formation of stagnant pool with bad odour. In other areas where there is scarcity of water, untreated wastewater are reused. This is a detrimental wastewater management practice found usually in Northern Nigeria. This can result in outbreak of water borne disease (Idris-Nda et al, 2013). According to Mustapha (2013), most of the industries in Kano 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.

THE NEGATIVE IMPACTS OF POOR WASTEWATER MANAGEMENT IN NIGERIA

Wastewater management is seen as a critical approach to protect water resources from pollution from pollutants components of untreated wastewater generated from all the sources. However, not all wastewater are properly managed or treated before discharge into nearby rivers, streams and lakes as the case may be. On the other hand, poorly treated or poorly managed wastewater poses a lot of risks to life and livelihoods. The challenge to wastewater management in Nigeria, is that of poor investment in waste management, waste composition and generation analysis, and the unnecessary importation of waste equipment increased improper waste disposal schemes (Anabaraonye, Okafor & Hope, 2019). The following are the negative impacts that maybe associated with poor wastewater management:

1. **DANGER TO AQUATIC LIFE:** Toxic chemicals in effluents and thermal (heat) discharges cause mortality of aquatic organisms. For example, inorganic arsenic can produce acute and chronic effects in the respiratory organs, gastrointestinal tract, skin, cardiovascular system and the nervous system.
2. **DISRUPTION OF FOOD CHAIN:** Aquatic ecosystems may experience disruption that impact negatively on food chains.
3. **BIO-ACCUMULATION OF TOXICANTS:** Some aquatic organisms bio-accumulate toxic chemicals which become bio-concentrated or bio-magnified in food chains (Smith & Smith, 2001).
4. **REDUCED DISSOLVED OXYGEN LEVELS.** The dissolved oxygen content of the receiving water may become reduced. Biodegradable organic substances impact biological oxygen demand (BOD), while oxidizable organic and inorganic substances in the water impact a chemical oxygen demand (COD).

5. **EUTROPHICATION:** This is known as nutrient enrichment of aquatic ecosystems which results in chemical and environmental changes in the system and causes major shifts in plants growth whereby, phytoplankton become concentrated in the upper layer of the water, giving it a murky green cast (Smith & Smith, 2001).

6. **COLOURATION AND OBNOXIOUS ODOUR OF WATER BODIES.** Some effluents cause streams and water bodies to become coloured and exude obnoxious odours. Shell fish and fin fish may be tainted with the colours, thus reducing market quality.

7. **SHORTAGE OF PORTABLE WATER:** Water is an essential resource for all life on earth, however only three(3) per cent of it is fresh, while the other ninety- seven (97) is salt water. Of this three per cent less than one-third is available as ground water, a small portion as moisture and the remaining, over two-third is frozen in glaciers and Polaris. Poorly managed wastewater in Nigeria inevitably affects the availability of good drinking water.

9.**SHORTAGE OF WATER FOR AGRICULTURAL PRODUCTION:** Many people rely on subsistence farming. Water shortage for irrigation and other agricultural use as a result of poor wastewater management can lead to negative consequences. These consequences may include; widespread crop failure, loss of aqua culture (fish and sea life farming), mass starvation, displacement, induce social unrest and conflict, all may result to hardship and mental distress.

10. **DISEASE OUTBREAK AND POSSIBLE EPIDEMIC:** Pathogens constitute health hazards. Wastewater contain a substantial amount of these pathogens. For instance, sewage wastewater has a large amount of intestinal bacteria like *Escherichia coli* and *Clostridium perfringes*. These organisms are implicated in disease epidemic. For example cholera infections are spread by drinking water contaminated with *Vibrio cholera*. This disease is said to be widespread in areas with inadequate treatment of sewage and drinking water sources exposed to these pathogens from sewage and fecal materials. Other diseases caused by pathogens found in untreated wastewater include, dysentery, hepatitis, and typhoid fever.

THE POSITIVE IMPACTS OF PROPER WASTEWATER MANAGEMENT IN NIGERIA

Properly managed wastewater is one that have undergone treatment for the removal of either organic or inorganic compounds and heavy metal. Such treatments should ensure a pollutant and toxicant free effluents. The effluent should also be of improved quality free of solid materials, including pathogens. The treatment should make it available to be reusable for other purposes such as domestic, agricultural and industrial use. These are some of the immediate and direct benefits from proper wastewater management. Short and long term impacts are felt in the upward speed in self cleansing capacity of water bodies receiving these effluents. Mortality risk to water lives are reduced and spread of communicable diseases and unsafe drinking water less probable.

Akpan and Bassey (2020) maintain that wastewater reuse has become an integral part of Integrated Water Resources

Management, thus plays a role in securing the water needs for future generations. According to the observation of Kayode, Luethi & Rene (2018), adequately managed wastewater would achieve the following environmental benefits:

- i) Prevent contamination of water bodies (water supplies) by chemical and biological agents.
- ii) Prevent destruction of fish and other aquatic life.
- iii) Reduction of excessive addition of nutrients that would enhance eutrophication.
- iv) It would enhance community growth and development in the places where the regulated facilities are situated.
- iv) Externalities such as loss of livelihoods may be averted and psychological wellbeing enhanced.

RECOMMENDATIONS

Green entrepreneurial opportunities for sustainable development that could stem from proper wastewater management in Nigeria are listed as follows;

1. Agricultural production requiring heavy irrigation system.
2. Business in sewer services for recycling and reuse of treated water.
3. Water treatment entrepreneurship.e.g. water startups.
4. Manufacture of wastewater treatment solution and technology.
5. Energy generation through hydropower and gasification.
6. Software and Analytics to connect and design apps that facilitate the reuse, recycling and distribution of treated water even in areas of affected by drought.

CONCLUSION

Green entrepreneurship in wastewater management offers numerous opportunities for sustainable economic growth. By leveraging innovative technologies and promoting sustainable practices, entrepreneurs can not only improve the environment but also drive economic development. With the continued growth of the global population and the increasing demand for clean water, the need for sustainable wastewater management solutions will only continue to grow, providing entrepreneurs with new and exciting opportunities to create impactful and profitable businesses. In addition to technological advancements, sustainable practices are also essential for sustainable economic growth in wastewater management. Entrepreneurs can promote sustainable practices, such as reducing water usage and increasing the use of recycled water, by offering educational and outreach programs to communities. This can help raise awareness about the importance of water conservation, wastewater management and encourage more people to adopt sustainable practices.

REFERENCES

Adesogan, S.(2013).Sewage Technology in Nigeria: A Pragmatic Approach, Science Journal of Environmental Engineering Research, 10(7) 257-266

Akpan, V. E., Omole.O.D & Bassey,D.E.(2020). Assessing the public perceptions of treated wastewater reuse: opportunities and implications for urban communities in developing countries. Helion, 6(10).

DOI: [10.1016/j.heliyon.2020.e05246](https://doi.org/10.1016/j.heliyon.2020.e05246)

- Anabaraonye, B., Okon, O. E., Ewa, B.O., Adeniyi, T.F., and Nwaobu, E.A (2022). Green entrepreneurship education for sustainable development in Nigeria. *International Journal of Research in Civil Engineering and Technology*; 3(1): 16-19. <https://www.civilengineeringjournals.com/ijrcet/article/23/3-1-3-106.pdf>
- Anabaraonye.B, Okafor.J.C, & Hope.J(2019).The health and economic impacts of waste recycling for sustainability in Nigeria. *Journal of Public Health*. ISSN: 2641-8509. <http://article.scholarena.com/The-Health-and-Economic-Impacts-of-Waste-Recycling-for-Sustainability-in-Nigeria.pdf>
- Burton, F. and Stense, H. (2003), “Wastewater Engineering, Treatment and Reuse, 4th edition”, McGraw Hill, New York, USA.
- Dean, T. J., & McMullen, J. S. (2007). Toward a theory of sustainable entrepreneurship: Reducing environmental degradation through entrepreneurial action. *Journal of Business Venturing*, 22(1), 50–76.
- Eikelboom, D.H. and Draaijer, A. (1999), “Activated Sludge information System (ASIS)”, Available at <http://www.asissludge.com> (accessed 12 January 2013).
- Envick, B. R. & Langford, M (2000). The Five-Factor Model of Personality: Assessing Entrepreneurs and Managers. *Academy of entrepreneurship Journal*. Schematicscholar.org.
- Essien, E.E. (2006), *Entrepreneurship: Concept and Practice*. Uyo: Abaan Press.
- Giwa, A. (2014). Sustainable Wastewater Treatment- The way to go. Retrieved from www.thenigeriavoice.com/news/150573/sustainablewastewater-treatment-the-way-to-go.html
- Idris-Nda, A., Aliyu, H.K. and Dalil, M. (2013), “The challenges of domestic wastewater management in Nigeria: A case study of Minna, central Nigeria”, *International Journal of Development and Sustainability*, Vol. 2 No. 2, pp. 1169-1182.
- Ikpot, E (2022). 'Nigeria missed 2022 poverty reduction target-world Bank. [Punchng.com](https://punchng.com)
- Kayode,O.F, Luethi,C.& Rene,E.R (2018). Management recommendations for improving decentralised wastewater treatment by the food and beverage industries in Nigeria *Environments* 5(3):41
- Mustapha, H. B. (2013). Management of Industrial Effluents: A Review of the Experiences in Kano, Northern Nigeria, *International Journal of Advanced Research* 1 (4), 213-216.
- Odurukwe, N. S.(2012). Wastewater Non Management in Aba City, Nigeria, *Federal University of Technology Owerri Newsletter*, Imo State, Nigeria.
- Ogunwale, G., Oladele, B, Adedeji, T.& Nwokolo, E(2020). Petrol price protest in Oyo, Lagos, Ogun, Osun, Others. *The Nation (Nigeria)*.[pressreader.com](https://www.pressreader.com) (9th Sept 2020).
- Olukanni, D. O, & Olatunji, T.O.(2018).Cassava waste management and biogas generation potential in selected Local Government Areas of Ogun State, Nigeria. *Journals recycling*, 3(4); 50
- Omosa, I.B., Wang, H., Chewng, S. and Li, F. (2012). Sustainable Tertiary Wastewater Treatment Is Required For Water Resources Pollution Control in Africa, *Environmental Science and Technology*, 46 (10), 7065-7066.
- Orji, E. I, Attah, F & Adie, R U (2022). Effectiveness of psychosocial counseling on self-reliant initiatives towards poverty alleviation among women and youths in two rural communities of Cross River State, Nigeria. Paper presented at the 2022 Africa Evidence Summit at Lemigo Hotel, Kigali, Rwanda. June 29-30,2022.
- Oyewale.I.(2023) ‘Nigeria now headquarters of world poverty’.<https://www.thisdaylive.com/index.php/2023/03/31/nigeria-now-headquarters-of-world-poverty>.
- Petchet.T(2015) Turning Water Problems Into Business Opportunities. <https://techcrunch.com/2015/06/22/turning-water-problems-into-business-opportunities/>
- Roobahani, A. (2021). Application of Bayesian Networks Modelling in Wastewater Management(Elsevier). *Soft Computing Techniques in Solid Waste and Wastewater Management*, 2021, Pages 111-130. <https://doi.org/10.1016/B978-0-12-824463-0.00002-1>
- Saari U.A. & Joensuu-Salo, S. (2019). Green Entrepreneurship. In: Leal Filho W., Azul A., Brandli L., Özuyar P., Wall T. (eds) *Responsible Consumption and Production. Encyclopedia of the UN Sustainable Development Goals*. Springer, Cham. doi: 10.1007/978-3-319-71062-4_6-1
- Smith, R. L.& Smith, T. M.(2001). *Ecology and Field Biology*(Sixth edition). Benjamin Cummings. Addison Wesley Long management, Inc..
- Tchobanoglous, G., Burton, F.L., Stense, H. et al (2003). *Wastewater Engineering : Treatment and Reuse*. (4th ed.). Boston: McGraw-Hill. ISBN 0-07-041878-0. OCLC 48053912.
- United Nations Environment Programme (2016). *A Snapshot of the World’s Water Quality: Towards a global assessment*. Available at <http://www.unep.org/publications/>. Accessed on October 5th, 2022.
- UN Waters (2017). *UN World Water Development Report 2017*. Available at <https://www.unwater.org/publications/un-world-water-development-report-2017>. Accessed on October 7th, 2022.

UN Waters (2022). Water Quality and Wastewater. Available at <https://www.unwater.org/water-facts/water-quality-and-wastewater>. Accessed on October 6th, 2022.

York, J. G. and Venkataraman, S. (2010). The entrepreneur—Environment nexus: Uncertainty, innovation, and allocation, *Journal of Business Venture*; 25, 449–463.