



E-ISSN: 2707-8272
P-ISSN: 2707-8264
IJRCET 2023; 4(1): 20-23
Received: 18-10-2022
Accepted: 24-11-2022

Emma Afam Nwobu
Department of Quantity
Surveying, Faculty of
Environmental Sciences,
Nnamdi Azikiwe University,
Awka, Nigeria

Benjamin Anabaraonye
Department of Energy and
Environment, Institute of
Climate Change Studies,
University of Nigeria, Nsukka,
Nigeria

Beatrice O Ewa
Department of Energy and
Environment, Institute of
Climate Change Studies,
University of Nigeria, Nsukka,
Nigeria

Corresponding Author:
Emma Afam Nwobu
Department of Quantity
Surveying, Faculty of
Environmental Sciences,
Nnamdi Azikiwe University,
Awka, Nigeria

Sustainable construction in the built environment so as to mitigate the negative effects of climate change in Nigeria

Emma Afam Nwobu, Benjamin Anabaraonye and Beatrice O Ewa

Abstract

The effect of climate change is enormous and devastating in Nigeria to the extent that any effort that is meant to mitigate it is welcomed. Nigeria is a developing country and her construction industry is fledging and its potentials at solving problems such as the one posed by this paper should be harnessed. The study outlined the international best practices that make up sustainable construction practices and went ahead to proffer far reaching recommendations that will help to mitigate the negative effects of climate change in Nigeria.

Keywords: Climate change, sequestration, sustainable construction, waste capture

Introduction

Climate change is a global challenge which we must of necessity tackle with urgency for our sustainable development in Nigeria (Anabaraonye, Okafor & Hope, 2018) ^[2]. The Intergovernmental Panel on Climate Change (IPCC) defines climate change adaptation as the “adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation” (IPCC, 2001) ^[12]. The impacts of climate change in Nigeria are profound and tree planting has been discovered as one of the climate change adaptation strategies for sustainable development in Nigeria (Anabaraonye, Okafor, Ewa & Anukwonke, 2021) ^[4]. Construction work brings about the much needed developments such as roads, houses and housing, railroads, airports, etc. These are well meaning developments which are desirable but needed to be weighed in the scale of sustainability. Sustainability in the scale of such developments involves meeting up the aspiration of the present generations as well as that of the generation yet unborn and that of the environment. When these conditions are met, that is when we can say indeed that sustainable construction in the built environment is carried out. This litmus test is what the concept of environmental impact assessment is all about. The need to strike a balance between having the much-needed construction work in Nigeria as well as not exacerbate the negative effects of climate change necessitated this study.

Methodology

This paper examined the current progress made by practitioners and stakeholders in the built environment aimed at conserving biodiversity, a concept that we referred to as waste capture sequestration. The use of waste management hierarchy to effectively manage the built environment so to mitigate the effects of climate change was highlighted in this research work. These were done through review of existing literature and tapping from the first author’s experience as a chartered professional in the built environment for over 3 decades now both in the field and as an academician. The main purpose of the research work was to survey theoretical backgrounds and previous studies on sustainable construction activities in Nigeria towards ameliorating the negative effects of climate change. The overall aim was achieved through the objective of examining the role waste play in collection, treatment and disposal of fecal wastes in buildings and in the environment.

What is waste capture sequestration?

“Carbon sequestration is the process of capturing and storing atmospheric carbon dioxide. It is one method of reducing the amount of carbon dioxide in the atmosphere with the goal of reducing global climate change”(USGS,2023). “Plastic sequestration is a means of plastic waste management that secures used plastic out of industry and out of the environment into reusable building blocks made by manual compaction. Plastic sequestration is motivated by environmental protection and modeled on the Earth's process of carbon sequestration” (Wikipedia, 2023) ^[19]. The authors therefore define “waste capture sequestration” as the capturing and storing of waste products for the purpose of being recycled and reused to promote sustainability. “Waste capture sequestration” is identified as one of the veritable strategies for promoting environmental sustainability in Nigeria.

Preservation of biodiversity in Nigeria through sustainable construction

Climate change is plaguing the global environment and efforts are being made to find lasting solutions or measures to mitigate its effect on both man and its environment. There is a great need therefore, to adapt and mitigate the impacts of climate change on biodiversity in Nigeria to achieve sustainable development (Anabaraonye, Amaechi, Okolo, Adeniyi & Nwobu, 2022) ^[3]. The process of construction of developmental project can be a huge source of loss of biodiversity in Nigeria. While undertaking wide range of construction works, a greater portion of the earth's biodiversity is affected through habitat loss, degradation or fragmentation (Anwadike, 2020) ^[5]. There is great need therefore to preserve and conserve the biodiversity while construction is going on that the top soil of the average thickness of 150mm should be carefully dug up and deposit in safe distance from the site from where they can be reused or bagged and be taken of site and be reused as manure. With this achieved, most of the biodiversity in the soil will not be lost. Without this, you find out according to Anwadike (2020) ^[5], biodiversity in Nigeria is already under serious threat of extinction. Furthermore, the practice of covering most of the plot of land on which a building or a construction facility is situated is neither sustainable nor wise. The petroleum -based asphalt is a high -VOC (volatile organic compound) substance. As the product is converted to asphalt, significant quantities of harmful gases are released into the atmosphere. Likewise, the process of producing cement for concrete requires high levels of heat to generate substantial VOC emissions. The application and curing of the applied asphalt add even more harmful material to the air (Aexcel, 2017) ^[1]. Additionally, some companies still use high- VOC paints for striping roads and parking lots, adding another unsustainable element to the process of road and parking lot construction. What are the solutions and initiatives being taken in Nigeria to curb problems created by these practices? Asphalt and concrete are the widely adopted materials trusted globally for roads and parking lots. However, road construction engineers are currently working on sustainable alternatives. These alternatives according to Aexcel (2017) ^[1] include:

1. To minimize the depletion of the earth's resource, paving companies have developed technology to reuse and recycle asphalt and concrete materials. One system

allows the equipment to strip and rework existing pavement before reapplying it to the same roadbed.

2. As a partial solution to the water drainage issue, roadway engineers are developing and testing porous concrete and asphalt that allows water to drain through the materials into the ground below. The initial challenge with this technology was making the porous material sufficiently durable for mass roadway and parking, but this has been accomplished by recent innovations.
3. As for reduced atmosphere-damaging high-VOC, striping and marking paints, paints manufacturers now produce high quality from soybean oil which gives a sustainable line striping solution which minimizes negative environmental impact.

Sustainable construction need to be engaged in the following waste capture mechanisms in Nigeria

1. Pit toilet

It is also referred to as pit latrine or long drop. The pit collects human feces and urine. The pit toilet should be constructed with a concrete slab through which a hole about 250 mm diameter is found to prevent children falling in. This hole may be connected with a toilet seat or a squatting pan for the comfort of the user. Note that some pit toilets can be dry that is without water or they can have water seal (Tilley *et al.*, 2014) ^[17]. Francois (2003) ^[10] stated that the fecal management of pit toilet involves physical emptying the pit, transporting, treating and using the treated fecal sludge as manure for farming, Note that care should be taken in doing this to prevent water pollution and public health risks can occur(Strande *et al.*, 2014) ^[16]

2. VIP toilet

When the basic pit toilet is improved by the provision of ventilating pipes from the pit to above the structure. The ventilating pipe introduced improves the airflow thereby decreasing the smell of the toilet. This also can reduce the flies if the top of the pipe is covered with mesh (usually made out of fiberglass) (Francois, 2003) ^[10]. Most of the times the VIP toilet comes with a dividing compartment with two holes each for one compartment. One compartment is used at a time while the other is kept as a spare to be used when the one in use is filled up. When this happens, the spare compartment is open for use while the filled up one is sealed for the content to be biodegraded and evacuated to be used again. A VIP toilet can be a very clean, comfortable and well accepted sanitation option. However, some health concern exists such as:

- Leachate which can contaminate ground water,
- Pits are susceptible to failure, and overflowing during flooding.
- Health risks from flies if not completely removed by ventilation

3. Septic tank/soak away pit system

This the most popular waste capture and sequestration system in Nigeria. According to Odoko (2018) ^[14], “Septic tank and soak-away pit system are a combined system of a single hole excavated having concrete/masonry wall built to separate the two into chambers”. When the septic tank is well built with a baffle wall put in its rightful place, one need not pump or dislodge the content at regular intervals as opined by Carlowtanks (2016) ^[6]. The waste is restricted

until biodegraded by microorganisms present in the tank and the degraded sludge find its way into the soak-away pit and are soaked into the soil with little or no harm to the environment. Septic tanks and soak-away system should not be built near or around trees as the trees' roots will penetrate the system especially when the system is getting old.

Flooding due to heavy rainfall can cause water from septic tank to contaminate and pollute ground water around (Rasheed, 2014) [15]. In developed countries of the world, the system is popular among rural dwellers where land is in abundance though part of the disadvantage is its consumption of large area of land.

4. Cesspool

This is an underground container for the temporary storage of liquid waste and sewage. Tilley *et al.* (2014) [17] described it as an underground holding tank which can be used for the temporary collection and storage of feces, excreta or fecal sludge as part of an on-site sanitation system. It has some similarities with septic tank only that septic tank is fitted with a baffle wall which is absent in a cesspool. Also, septic tanks have an inlet pipe and outlet pipe, cesspool only have an inlet pipe. A well-constructed cesspool is made to be water tight to avoid leachates from polluting the ground water as well as effecting the environment adversely. In modern world where it is regarded as a holding tank, the tank has to be emptied frequently – on average of every 6 weeks. The frequency of evacuation depends on the population of users. In the United States, especially in New York City, most households still use cesspools for waste drainage (Derbyshire, 2011) [7]. The cesspool comes with a lot of problems that need to be looked into before consideration for use.

5. Sewage Treatment Plant

The sewage treatment plant is a type of wastewater treatment which has the capacity of removing contaminants from sewage to produce an effluent which is suitable for discharge to the environment, the effluent can be reused for other things. The main aim is to prevent polluted water from being discharged as raw sewage (Khokpar, 2004) [13]. Sewage contains wastewater from households and businesses such as from abattoirs and possibly pre-treated industrial wastewater and when this is the case we have sludge treatment. There are variety of sewage treatment processes depending on the available technology and resources. You can have decentralized systems which includes on-site treatment system. There are also large centralized systems involving a network of pipes and pump stations called sewerage which convey the sewage to a treatment plant. When used in the cities, it is not out place for the sewers to carry urban runoff or storm water to the treatment plant. In that case, sewage treatment involves two main stages of treatment called primary and secondary treatment. An advance treatment also incorporates a tertiary stage with polishing process and nutrient removal. The secondary treatment can reduce organic matters (measured as biological oxygen demand) from sewage, using aerobic or anaerobic biological processes. There are variety of sewage treatment processes depending on the available technology and resources. You can have decentralized systems which includes on-site treatment system. There are also large centralized systems involving a network of pipes

and pump stations called sewerage which convey the sewage to a treatment plant.

Waste management hierarchy

For any sustainable construction work that will mitigate the harsh effects of climate change to be meaningful, it has to be in conformity with the globally acclaimed waste management hierarchy. This has to start during the construction stage and run through the life cycle of the facility. Waste hierarchy is a tool used in the evaluation of processes that protect the environment alongside resource and energy consumption from unfavorable conditions (Hansen *et al.*, 2002) [11]. To be sustainable, waste management cannot be solved only with technical end-of-pipe solutions, thus, an integrated approach is necessary. The waste management hierarchy indicates an order of preference for action to reduce and manage waste, and is usually presented diagrammatically in the form of a pyramid. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste. The authors are of the opinion that proper application of the waste hierarchy can have several benefits. Such benefits as:

1. It can help prevent emissions of greenhouse gases,
2. Reduction of pollutants,
3. Save energy,
4. Conserve resources,
5. Create jobs and
6. Stimulate the development of green technologies

By the way, it has been proven by research that all products and services have environmental impacts, from the extraction of raw materials for production distribution, use and disposal. Following the waste hierarchy will generally lead to the most resource-efficient and environmentally sound choice but in some cases reefing decisions within the hierarchy or departing from it can lead to better environmental outcome (European Commission, 2016) [9].

Recommendations

Through sustainable construction, we can mitigate and ammoniate the effect of climate change in Nigeria by:

- Making effort to preserve and conserve the biodiversity of the soil by removing an average of 150mm of the top soil under the building or facility under construction
- Planting trees and grasses around the building and along the sides of the roads so as to beautify the area and to provide green plants that will trap some of the carbon dioxide that is released in the atmosphere.
- Make sure that through appropriate waste capture sequestration that the human waste in the built environment is adequately captured and properly sequestered with little or no harm to the environment.
- Where and whenever it is possible, practitioners and decision makers in the built environment should apply the waste management hierarchy in the overall management waste in the built environment.

Conclusion

Communities and organizations should have initiatives put in place for monitoring and mitigating their infrastructures' environmental impact so that at all time they will have eco-friendly products. Sustainable construction in the built environment which is construction practice that not only

take care of the desires of the present generation but also is mindful of the aspiration of generation yet unborn and at the same time, environmentally friendly. We believe that such construction practice if fully implemented will go a long way towards mitigating the adverse effect of climate change in Nigeria. With the proper use of human waste capture and sequestration (WCS) the issue of open defecation with all its ugly side will be a thing of the past. In fact, it is primitive and anti-social for anyone to be involved in open defecation at this age and time, whether in the rural or urban area. The least anyone could afford should be pit or VIP pit toilet. The government at all levels, local, state and federal level should make the building public toilet a priority. Non – governmental organizations, faith-based organizations as well as corporate bodies should make it their concern to provide the public where to obey the call of nature when seriously pressed. Construction professionals and stake holders as well as decision makers should apply waste management hierarchy in dealing with waste. We are of the opinion that if construction experts and practitioners as well as private and government home developers should adopt these internationally acclaimed best practices as outlined in this paper the much-needed sustainable construction that can mitigate the effects of climate change in Nigeria will be achieved.

References

1. Aexcel. 3 Ways Asphalt and Concrete are Affecting the Planet; c2017. <https://www.aexcelcorp.com/blog/eco-friendly-traffic-paint/3-ways-asphalt-and-concrete-are-affecting-the-planet>
2. Anabaraonye B, Okafor CJ, Hope J. Educating Farmers in Rural Areas on Climate Change Adaptation for Sustainability in Nigeria. Springer Nature Switzerland AG 2018. W. Leal Filho (ed.), Handbook of Climate Change Resilience; c2018. https://doi.org/10.1007/978-3-319-71025-9_184-1
3. Anabaraonye B, Amaechi M, Okolo NV, Adeniyi TF, Nwobu EA. The impacts of climate change on biodiversity in Nigeria. International Journal of Research in Civil Engineering and Technology 2022;3(2):01-05
4. Anabaraonye B, Okafor JC, Ewa BO, Anukwonke CC. The impacts of Climate Change on Soil Fertility in Nigeria. In D. K. Choudhary, A. Mishra, & A. Varma (Eds.), Climate Change and the Microbiome. Soil Biology Cham: Springer. 2021;63:607-621.
5. Anwadike BC. 'Biodiversity Conservation in Nigeria: Perception, Challenges and Possible Remedies'. National Open University of Nigeria/ College of Education Warri, Nigeria. 2020, 8(4).
6. Carlowtanks. How septic tanks are empty; c2016. [www.carlowtanks.ie/how-septic-tanks-are empty](http://www.carlowtanks.ie/how-septic-tanks-are-empty),
7. Derbyshire J. Shovel Ready Straggler, National Review. 2011;63(1):55, ISSN 0028-0038.
8. Emily Beach septic tank; c2017. <https://www.livestrong.com/article/131380-causesoverflowing-septic-tank>.
9. European Commission. Waste prevention and management; c2016. https://ec.europa.eu/environment/green-growth/waste-prevention-and-management/index_en.htm
10. Francois B. Linking Technology Choice with Operation and Maintenance in the Context of Community Water Supply and Sanitation (WHO); c2003. p. 108.
11. Hansen W, Christopher M, Verbuecheln M. EU waste policy and challenges for regional and local authorities. Ecological Institute for International and European Environmental Policy, Berlin; c2002.
12. IPCC Climate change the scientific basis. Contribution of working group I to the third assessment report of the intergovernmental panel on climate change. Published by the press syndicate of the University of Cambridge, The Pitt Building, Trumpington Street, Cambridge, United Kingdom. First published; c2001. https://www.ipcc.ch/ipccreports/tar/wg1/pdf/WGI_TAR_full_report.pdf
13. Khokpar SM. Environmental Pollution Monitoring and Control. New Delhi: New Age International; c2004. p. 299.
14. Odoko BA. Septic Tank/Soakaway Pit, Nigeria Choice for Sewage Disposal. Journal of Environmental Sciences and Resources Management. 2018, 10(3).
15. Rasheed Z. c2014. <https://Relietweb.nt/nolhivaranfaruground-water-contaminated-flooding-causes-septic-tankoverflow>
16. Strande L, Ronteltap M, Brdjanovic D. Faecal Sludge Management: Systems Approach for Implementation and Operation. IWA Publishing; c2014. p. 403.
17. Tilley E, Ulrich L, Luthi C, Remond Ph, Zurbrugg C. Compendium of Sanitation System and Technology. (2nd Revised ed.). Swiss Federal Institute of Aquatic Sciences and Technology (Eawag), Duebendorf, Switzerland; c2014. ISBN 978-3-906484-57-0.
18. USGS what is carbon sequestration; c2023. <https://www.usgs.gov/faqs/what-carbon-sequestration>
19. Wikipedia Plastic sequestration; c2023. https://en.wikipedia.org/wiki/Plastic_sequestration