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# Effects of Wastewater Management on the Environment: A Case Study of Selected Shopping Malls in Ota, Ogun State, Nigeria

B. J. Oyelami<sup>1</sup>, A. B. Sholanke<sup>2</sup>, O. N. E. Ekhaese<sup>3</sup> and S. P. Olusore

Department of Architecture, Covenant University, Ota, Ogun State. Nigeria.

Authors emails: <sup>1</sup>blessing.oyelamipgs@stu.cu.edu.ng;

<sup>2</sup>anthony.sholanke@covenantuniversity.edu.ng

<sup>3</sup>noel.ekhaese@covenantuniversity.edu.ng

**Abstract:** The study investigated wastewater management in selected shopping malls in Ota, Ogun State, Nigeria and the effects on the environment, towards identifying areas for possible improvement. The study adopted a qualitative methodology. Data was collected from both primary and secondary sources. Primary fieldwork data were collected using structured observation and interview guide, while secondary data were gathered from both published and unpublished literature by textual analysis. The study discovered that the wastewater management system employed by the shopping malls investigated were mainly on-site wastewater management systems that were not effective as a result of the way they were poorly managed. The shopping malls were found to release greywater into the environment that is leading to environmental degradation of the study environs. The study recommended that relevant government waste management authorities need to do more to ensure that shopping malls and other commercial public facilities, manage their wastes in line with standard best practices, to avoid degrading the environment. The authorities are to check and approve the design of wastewater management systems, as well as conduct routine checks to ascertain that the systems are functioning as expected, towards achieving a better wastewater management effective and sustainable environment.

**Keywords:** Wastewater, Management, Environment, Shopping Malls, Nigeria.

## 1. Introduction

Shopping malls are one of the most socially and societally influential forms of real estate in this age. For example, shopping malls are increasingly seen as a natural meeting place for people, with a variety of public and private services as well as retail stores. As a result of the various daily operations of shopping malls such as baking and food production, shopping malls consume a lot of water and therefore generate a large volume of wastewater. Due to the volume of wastewater being generated, some shopping malls have developed means of managing it to reduce its influence on the environment. Wastewater has been one of the day-to-day concerns of humans and the environment in general, due to its impact on the environment. This is because of the presence of various contaminants that are involved in wastewater [1]. Shopping centres have practiced a code called corporate environmental governance over the years. "Good environmental management makes good business sense" is the underlying philosophy. This principle encompasses technology and best management practices that improve business operations and productivity leading to sustainable business operations. Managing wastewater needs a cost-effective approach alongside sustainable funding models according to Sustainable Development Goal (SDG) six. Some retail owners implement this practice to a noticeable degree [2].

According to the SDG six, in an increasingly urban world, industrial and agricultural pollution, urban stormwater and human sewage create acute health and pollution problems. Shopping centres being a major part of the commercial industry has contributed to this [3]. However, there has been growing pressure on regional and community retail shopping centres business to act responsibly and comprehensively to manage their wastewater in a sustainable way in the past decades. Furthermore, the practical importance of complying with waste directives and environmental credentials has made the delivery of services to most



businesses of high value. In order to succeed, the effort requires a creative act and dedication to turn retail shopping malls wastewater into meaningful resources.

Previous studies, [4] & [2] emphasized the importance of wastewater management in shopping malls, but little attempt has been made to assess the existing wastewater management employed and their effects on the environment particularly in Ota, Ogun State, Nigeria. There is therefore a need for such studies in order to examine the impact of wastewater management on the environment towards finding ways of achieving a more sustainable and desirable environment.

Consequently, the aim of the study is to investigate wastewater management in selected shopping malls in Ota, Ogun State, Nigeria and the effects on the environment towards identifying areas for improvement. The objectives of the study were to: identify the wastewater management strategies employed by the selected shopping malls in Ota, Ogun State, Nigeria; determine how the existing wastewater management strategies impacts the environment; and examine the conformity of existing wastewater management strategies employed by the shopping malls to best practices.

As previously stated, earlier studies discussed the need for waste water management in shopping malls as well as various technologies involved in the process. Conversely, this study sought to discover possible areas for improvement of wastewater management strategies in shopping malls recycling operations. This investigation provides useful information for the benefit of developers, retail owners and occupiers toward achieving wastewater management methods in shopping malls as well as a useful reference material to consult for students, educators and researchers.

This study focused on two shopping malls in Ota, Ogun State. The main criterion used in the selection was the year the shopping malls were commissioned. This was to allow for the choices to represent malls that were built in more recent years and those that were built over 10 years ago, to allow for a comparative analysis that will provide information on how much has changed over the years. Out of all the shopping malls that fell within the criterion set, only two of them gave permission for data to be collected from their establishments, limiting the study investigation to two shopping malls within the study area. The study was conducted between December 2019 and January 2021.

## 2. Literature Review

### 2.1. Wastewater Management

Wastewater is water whose characteristics have been changed (physical, chemical or biological) as a result of the addition of certain chemicals that make it unsafe for certain uses such as drinking [5]. The daily activities of man require water consumption and therefore generate effluents. [6] explained that wastewater is a mixture of one or more of the following components: household effluent composed of blackwater (excreta, faeces and faecal sludge) and greywater (cooking and bathing wastewater); water from commercial facilities and organizations, including hospitals, hotels, shopping centres, etc.; agricultural effluent, stormwater (i.e. drainage runoff obtained from roads, building, etc.) and other urban run-offs; and effluent from agriculture, horticulture and aquaculture, dissolved or suspended. The amount of wastewater generated from this component needs to be controlled because of its detrimental effects on the environment and human health [7]. This control strategy has resulted in the need for wastewater management, hence the wastewater management goal is to clean and preserve water. This entails that the water is reasonably safe for people to use it for drinking and bathing, and for commercial purposes in industries. According to [8], the need for a more sustainable approach is essential because of the poor state of wastewater management in Ogun State, Nigeria.

There are effectively two basic wastewater management systems: On-site (or non-sewered) and off-site (generally sewerred with centralized treatment. Throughout sewerred systems, the sewer performs removal transport part of the service chain; water washes the waste through a pipe system. This may include the use of pumping stations to make sure the waste reaches the point of treatment or disposal. There are two forms of sewerage networks built and implemented over time which include the 'combined' system, and the 'separate' system. In the combined system, both surface run-off and foul sewage are transported in the same pipe, while different pipes are used in the separate system to transport sewage and surface run-

off. The separate system is most successful when properly installed, operated and managed, as it decreases the amount of sewage to be handled, avoids the problems of discharges from combined sewer overflows (CSOs) and deals more efficiently with regular and potentially large amounts of urban runoff that occur under storm conditions [7].

Waste accumulates in on-site systems in a pit or septic tank which requires periodic emptying or re-siting. Waste is taken by road for treatment and/or disposal when emptying. The private sector mostly provides pit emptying and transport services for most buildings in cities because the local governments rarely provides such. In many low- and middle-income countries, regular practice is the disposal of untreated septic tank and pit waste into water bodies. There is a general lack of equipment for handling the sludge. These are usually combined with sewage treatment where treatment facilities do exist. Sludge is often simply dumped into an existing wastewater treatment plant, which can have a negative impact on the water-borne sewage treatment [9].

### *2.2. Effects of Wastewater on the Environment*

The health consequences of wastewater treatment systems are becoming enormous [10]. Ignoring wastewater management results in two fundamental impacts on water quality, namely chemical (and explicitly nutrient) degradation and microbial pollution [7]. These can cause health and environmental issues, and can have economic/financial impacts (e.g. increased treatment costs to make water usable for certain purposes) when unsuccessful or untreated wastewater is released into the environment. Nutrient contamination is explained as the ejection of excess nutrients into water bodies that can stimulate excessive plant growth and release toxins into the water, leading to oxygen depletion, decreased biodiversity and reduction in water quality. Microbial water pollution includes wastewater (especially domestic wastewater) which can contain high levels of excreted pathogens, particularly in countries where diarrheal diseases and intestinal parasites are prevalent. About 2.2 million people are estimated to die globally each year from diarrheal disease. At least 1.8 million children under the age of five die each year from water-related illness, or one every 20 seconds [11].

### *2.3 Wastewater Management in Shopping Malls*

As previously explained, commercial establishments and institutions is one of the components of wastewater [6]. Commercial establishment can be defined as any premises used to carry on or conduct any trade, business, occupation, vocation or commercial or charitable operation, including, but not limited to, laundries, hospitals, hotels, shopping malls, motels and restaurants [12]. For the purpose of this study, emphasis shall be on shopping centres (especially shopping malls). According to [2] shopping malls consume a lot of water and generate a big volume of waste water. The presence of kitchenettes and food courts implies that food wastes are generated. However, this wastes cannot be disposed into the environment because of the harm it poses to the environment. They need to be properly treated, hence the need for wastewater management [13]. Furthermore, in order for shopping malls to sustain their business all year round, waste water is reused and recycled for use in refrigeration systems, landscaping, floor and machinery washing, and toilet flushing [2]. The need for a sustainable approach to managing wastewater in shopping malls is critical to building and sustaining a green environment. This in turn increases the green building rating of shopping malls. The initial reason behind the green building movement, involves the environmental or ecological problems that have been identified in recent decades. Consequently, environmental benefits such as enhanced and protected ecosystems and biodiversity, improved air and water quality, reduced waste and natural resource conservation are fundamental to green development.

The need for wastewater management in shopping malls have been comprehensively discussed over the years. Furthermore, shopping centres built in the past decades have adopted the concept of wastewater management as a corporate environmental responsibility. However, the evolution of technology and improved innovations towards addressing environmental problems necessitates the need to evaluate existing solutions to this problem and introduce new ways (i.e. new technologies and improved strategies) to achieve a green environment. This includes wastewater management in shopping malls, as a result of their ecological impact in the urban environment.

### 3. Methodology

As earlier mentioned, the aim of the study is to investigate wastewater management in selected shopping malls in Ota, Ogun State, Nigeria and the effects on the environment towards identifying areas for improvement. In order to achieve the aim, several stages were undertaken as to gather relevant information. Firstly, a thorough literature review on the subject matter was conducted. Information concerning shopping malls and wastewater management, in terms of the definition, associated benefits and sustainable requirements, and processes involved in wastewater management have primarily been obtained from research papers and other relevant literature [14]. The second step was to choose shopping malls purposely based on their size and the year they were commissioned in order to survey and assemble data based on the field survey carried out. The purpose was to get a broad picture of the wastewater management strategies been implemented by the shopping malls. Due to the qualitative approach of the study, the information gathering process was based on semi-structured face-to-face interviews with the shopping center operators in order to be open and flexible. Data was also gotten from observations during the field survey. The semi-structured interview allowed the respondents to express their thoughts unreservedly with the questions acting as a guide during interviews [14]. The field data were gathered between December 11, 2019 and January 30, 2020.

The first section of the interview guide was to gain basic information on the shopping malls. The second section were questions asked in order to understand the level of the respondents' knowledge regarding wastewater management and also to know how their wastewater management was being carried out on site. The observation guide was prepared to contain information that gave opportunity to document was found on the sites with regards to wastewater management. Through the use of the interview and observation guide, responses that helped to understand wastewater management strategies in relation to the following were provided: knowledge of wastewater management and if considered from the design stage; management of the various types of wastewater (greywater, blackwater and stormwater) and their process; how the strategies being used interact with the environment; and comparing their level of effectiveness to the criteria developed for the study.

### 4. Results, Analysis and Discussion

This section is a presentation of the results and discussion of the findings from the two interviews in conjunction with the four categories listed in the previous chapter. The two shopping malls selected for the study were Justrite Mall and Grocery Bazaar Mall. The Justrite mall was commissioned in the year 2000. It is the headquarter building of Justrite and the organization has other branches of shopping malls across Lagos and Ogun State in Nigeria. Grocery Bazaar is a newly commissioned shopping mall in Ota, Ogun State. It was opened to the public in September, 2019. Two respondents from both shopping malls were interviewed and the results obtained are as follows:

#### 4.1. Knowledge of Wastewater Management in the Shopping Malls

The interview session started by asking the respondents from the shopping malls if they knew about wastewater management, from their responses we were able to find out that the level of knowledge varies. The respondent from Grocery Bazaar mall has a little knowledge and could explain the process of wastewater management like the on-site and off-site management systems briefly. However, the respondent could not provide a detailed explanation of the process compared to the respondent from Justrite mall. The respondent from Justrite was able to give a thorough explanation of wastewater management in a more technical and detailed form.

From this finding, the level of knowledge of wastewater management by the respondents is considered fair, as concepts such as reuse of greywater, storage and use of stormwater were not implemented. If the concept of greywater reuse is incorporated into the shopping malls, it would help to reduce the load on water supply and demand.



#### 4.2. Management of Wastewater Systems Employed by the Shopping Malls

From the opinions of the respondents, we were able to understand that even though there were different sites, the same processes were followed for the management of wastewater.

- Grocery Bazaar mall
  - The shopping mall separate the greywater from blackwater. Greywater from toilet sanitary wares and from the bakery within the building are channelled out into public drainage system with a few collected to allow for evaporation.
  - The blackwater generated is channelled into a septic tank which is allowed to fill-up, after which it is emptied by sucking into a waste truck and cart away from site.
  - As for the stormwater, little or no disposal provision was made for it, as it is allowed to flow into the environment.
- Justrite mall
  - Greywater generated from the building is channelled into a chamber which is then allowed to seep into the ground over time.
  - Blackwater is channelled into a septic tank, after which a wastewater truck is used to drain the tank and transport it to a wastewater treatment plant.
  - Stormwater disposal was also not provided for, as stormwater is channelled into the environment.

#### 4.3. How the Wastewater Management Methods Affect the Environment

After the interview with the respondent from Grocery Bazaar, a visual inspection of greywater outlets into the existing public drainage was conducted. It was observed that the public drainage is blocked and not in a functioning state. Basically, the greywater flows into a side of the road beside the shopping mall's fence. The stench emanating from the greywater pollutes the environment. However, the respondent informed that an improvised method was being used to dispose some of the greywater. This include collecting it in a chamber and allowed to evaporate into the air. The respondent argued that the method was being used to reduce the stench from the greywater. There was no planned management system for their stormwater, as stormwater is allowed to flow around the premises and outside the perimeter fence. It was observed that erosion due to lack of control of stormwater runoff from the premises has removed part of the topsoil of the road beside the shopping mall, resulting in exposing part of the fence substructure. This is considered detrimental to the shopping mall. The removal of topsoil of the road is a source of inconvenience for road users.

Justrite mall has a planned system for disposing greywater which is to allow the water flow into a chamber and seep into the earth. However, this method is damaging plant growth in the area. But, similar to Grocery Bazaar mall, there was no conscious disposal system made for the management of stormwater. This indicates that the system employed is not sustainable or environmental friendly. Images of the situation found at the premises of both shopping malls are shown in Plates 1, 2, 3 and 4.



Figure 1. The premises of Grocery Bazeer mall with no drainage system for stormwater



Figure 2. A greywater outlet pipe from Grocery Bazeer mall opening into the adjacent road



Figure 3. The approach of Justrite mall showing a covered stormwater channel at the carpark



Figure 4. Stormwater pipe connected to a surface drainage at Justrite mall

#### 4.4 Conformity of the Wastewater Management Systems Employed in the Shopping Malls to Best Practices

The two respondents from the shopping malls had no knowledge of the best practices of wastewater management most especially for greywater and stormwater. From the method of wastewater management being engaged by the shopping malls for the disposal of greywater and stormwater, it is observed that they are detrimental to the ecosystem and do not meet-up with the SDG six requirement. [10] argued that the provision of management systems in organizations is a key intervention to promote human's right to health and clean environment. The method engaged by the shopping malls for the treatment of their blackwater which is on-site treatment is commendable, but the progression is not complete without the proper treatment of the other two components which are greywater and stormwater. As previously explained, wastewater is to be collected and treated before reuse or disposal into the environment [7]. The shopping malls investigated did not meet-up with this standard. To make matters worse, the two respondents were unaware of the dangers the situations found on site pose to the environment.

#### 4.5 Discussion

The outcome of the study indicates that the respondents are privy to the knowledge of wastewater management. However, the practice of standard wastewater management is not adequately carried out in the shopping malls. It was observed that the shopping malls only made provision for the conventional on-

site management system for wastewater. To argue that wastewater management systems were not considered in the design of the shopping malls would be far from the reality. But, although it was considered, it was discovered to be inadequate, considering the commercial nature of the buildings.

Furthermore, Grocery Bazaar being recently commissioned was expected to have adopted a standard and more effective wastewater management, especially for greywater and stormwater. The contrary was however the case. The findings suggest that the waste management agencies that are expected to inspect and regulate the management of waste in such buildings are not effective.

In addition, the shopping malls are not aware of the danger they pose to their surrounding environment in connection to the wastewater generated. As previously stated, wastewater has been a challenge in the city of Ota, Ogun State [8], which has led to blockages in drainage system and thus leading to air pollution and environmental degradation. The need for sustainable approach to the environment are being overlooked in the shopping malls investigated. A step towards the use of better and sustainable systems in the management of wastewater in the shopping malls will result in the reduction in water and air pollution in the study environ.

## 5. Conclusion and Recommendations

As water is highly important to survival by man and limited in supply, people are finding better ways of how to use and manage water in relation to how wastewater is contained, treated, reused and disposed, which in turn affects the environment around us. Due to the importance of water to mankind, water and sanitation is the sixth of the seventeen sustainable development goals [7]. This study revealed how wastewater is being managed in shopping malls by investigating wastewater management in two shopping malls (Justrite and Grocery Bazaar) in Ota, Ogun State, Nigeria and the effects they have on the environment, towards identifying areas for possible improvement. The study found that both malls made use of identical systems to manage their wastewater. Unfortunately, the systems employed were not in conformity with best practices as they exhibited various levels of inadequacies that were not environmentally friendly or sustainable. To this end, the management of the shopping malls need to incorporate sustainable wastewater management systems that were found to be lacking in their buildings and premises. Such systems include, wastewater reuse, stormwater storage and rainwater harvesting, among others. In addition, waste management agencies need to be more effective by conducting regular routine checks on such commercial establishments to ensure that their waste management systems are functioning effectively, do not constitute health hazards and are environmentally friendly. In particular, shopping malls should be encouraged to treat their wastewater for reuse where possible as a way of conserving potable water. The treated water can be used to flush toilets or stored in tanks for firefighting safety purposes. Researchers should also be encouraged to develop potable and efficient wastewater treatment systems that can be used on-site. The International Council of Shopping Centres classifies shopping malls based on their sizes [15]. The quantity of wastewater generated in shopping malls depend on their sizes. Therefore, further researches can investigate shopping malls of different sizes to find out if there is a relationship between the size of shopping malls and the effectiveness and type of wastewater management systems they make use of.

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