HEALTH AND ENVIRONMENTAL IMPACT ASSESSMENT OF CERAMIC TILE USAGE FOR BUILDING:

A CASE STUDY OF EDO STATE, NIGERIA

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JANUARY, 2026.

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BEING A THESIS SUBMITTED TO DEPARTMENT OF PROCUREMENT MANAGEMENTT, UNIVERSITY OF BENIN,

BENIN CITY.

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE (PROCUREMENT MANAGEMENT) OF THE DEPARTMENT OF PROCUREMENT MANAGEMENT, FACULTY OF SUSTAINABLE PROCUREMENT, ENVIRONMENTAL AND SOCIAL STANDARDS ENHANCEMENT, (SPESSE), UNIVERSITY OF BENIN,

BENIN CITY.

JANUARY, 2026.

DECLARATION

I, **Kwemezi Osazuwa Godwin**, hereby declare that this thesis is the product of my own original research and effort. It has not been submitted, either in whole or in part, for any academic degree or qualification, nor is it currently under consideration for any other award. All sources of information and materials used in this study have been duly acknowledged and properly referenced.

……………………………………………. **………………………………….**

Kwemezi Osazuwa Godwin **Date**

CERTIFICATION

We certify that this project, **HEALTH AND ENVIRONMENTAL IMPACT ASSESSMENT OF CERAMIC TILE USAGE FOR BUILDING: A CASE STUDY OF EDO STATE, NIGERIA** was carried out by **KWEMEZI OSAZUWA GODWIN** in the Department of Procurement Management, Faculty of Sustainable Procurement, Environmental And Social Standards Enhancement, (Spesse), University of Benin, Benin City, Nigeria.

Dr. James Okweshine **Date**

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(Centre Leader.)

DEDICATION

This is dedicated to Almighty God, for His unrestrained mercy, love, and grace showered upon me as I continue striving in procurement practice.

ACKNOWLEDGEMENTS

I wish to express my heartfelt gratitude to my supervisor, **Dr. James Okweshine**, for his invaluable guidance, constructive criticism, unwavering support, and encouragement throughout the course of this research. I am equally indebted to **Professor D.E. Oriakhi**, **Professor Sylvester Osuji** and all the esteemed lecturers in the Department of Procurement Management. May God continue to bless and richly reward you all for the profound impact you have made on my academic journey.

I am also profoundly grateful to the team of procurement personnel at the **Ovia North East Local Government Council** notably are Mr coarege omuemu, whose expertise and support were instrumental to the successful completion of this study. My deepest appreciation is reserved for my benefactor and guardian angel, **Mrs. Hana Kwemezi**, whose magnanimous support and unwavering encouragement have enabled me to navigate the rigours of my academic pursuits with ease. I am further indebted to my family members for their steadfast emotional support and encouragement throughout the duration of this work.

Finally, I extend sincere thanks to my course mates most especially **Mr. Godwin Osazuwa Kwemezi** and mr Emmanuel obogai all well-wishers who, in one way or another, contributed to the successful realisation of this project.

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ABSTRACT

This study examines the life cycle assessment of health and environmental impact of ceramic tiles product in Edo State. The study examines the use and disposal stages of the life cycle of ceramic tiles. Primary data is used for the study, through the use of questionnaires distributed using the Google Form. The questionnaire form is sent to four hundred (400) individuals in Benin City via their phone numbers. This method of distribution helped in reaching many individuals. The logistic regression technique was used to analyse the data obtained from the field. The adoption of the logistic technique was as a result of the binary nature of the dependent variables used in the study. However, the study finds that the use and disposal stages have no significant impact on the bad health condition of individuals but the two stage have significant positive effect on the bad environmental condition on the state. However, the disposal stage is seen to have more significant effect on the bad environmental condition of the State. This means that there no proper ways of disposing the ceramic tiles waste in the State. As a result the study recommends that alternative method of flooring buildings and that more licenses should be given to more private waste disposal firms.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

As a result of the growing concern on the health and environment by different governments of the world and people, industries have begun to pay serious attention to the issues on illness of citizens, environmental pollution and resource depletion (Singh, Mittal, and Sangwan 2013). Today's globalised business environment allows the organisations to leverage their core competencies to maximum advantage and outsource the non-core work globally. This means the organisation's environmental footprint extends globally along the whole supply chain. Most of the research in LCA has been in the manufacturing and use phases. The other parts of the supply chain have been ignored in LCA studies which involve the use and disposal phase. However, the distribution phase phases of ceramic products may not have much environmental impact but their use and disposal phase may have substantial health and environmental impact. Therefore, organisations have to make sure that their all supply chain activities are health improving, environmental friendly and sustainable. Measurement of health and environmental impact along the whole supply chain is critical in improving sustainability because without measurement; control and improvement are impossible (Olugu, Wong, and Shaharoun 2011).

LCA can be used as a technical tool to measure or evaluate the health and environmental consequences of a product or service in their entire life cycle (Curran 2013; Ingarao et al. 2016). It is a method to evaluate environmental impact related with all the phases of a product or service life from cradle to grave (i.e. extraction of raw material with its processing, manufacturing of product, distribution to customer, use by customer, repair and maintenance while use, and end of life approaches after use) (Klöpffer 1997).

World ceramic tile production is 11,913 million m^2 and growing with the rate of 11%. Among all the ceramic products, the demand for ceramic tiles is increasing at a fast rate in the international market due to the growing population and government legislation (European Commission, 2007; Fonseca *et al*., 2016; El-Fadaly, 2015; Abadir *et al*., 2002). While Nigeria imports over 89% of ceramic tiles used in the country (Oaikhinan, 2015; Stock, 2015). The growing demand for ceramic tiles in the global market and their continued importation into Nigeria; despite the abundant availability and accessibility of the raw materials locally (Oaikhinan, 2015; Idowu, 2014; Adelabu, 2012), has made the health and environmental impacts a significant conserve to the society of today.

However, this rapidly growing industry is consuming large amount of natural resources and producing waste in large quantities. Every ceramic product has three main phases (i.e. pre-kiln, kiln and post-kiln operations) in production process. Defective product can be recycled before kiln operation but after firing in kiln product has to be discarded, which cause waste disposal problem and become the reason for wastage of 90% energy (Bhamu and Sangwan 2015).

Ibanez-Fores, Bovea, and Simo (2011) conducted a LCA study of ceramic tiles in direction to recognise the stages, materials and processes, which contribute maximum in environmental impact. They had collected yearly data for different stages of ceramic tile supply chain from organisations of Spain. This study shows environmental impact in five different midpoint category (i.e. global warming, ozone layer depletion, acidification, eutrophication, photochemical oxidation and human toxicity) for each organisation and each phase of the life cycle. Gabaldón-estevan, Criado, and Monfort (2014) analysed the effect of environmental issue and their interrelationship with innovation systems, throughout the industry value chain, for the Spanish ceramic tile industry.

The socio-economic and environmental impact of the industry has also been reported. Gupta et al. (2015) has discussed the driver and barrier of green and sustainable manufacturing and measured the effects of these paradigms on industrial performance. This paper concludes that ceramic tile industry put major impact on health and environment due to the use of resources and generation of waste in large quantity. Here, this study focuses on the use and disposal stages of ceramic tile supply chain in Nigeria, using Benin City in Edo. Also, in this study health and environmental impact have been measured in eight different endpoint categories and nine different midpoint categories. These impact categories will be helpful to clearly show the health and environmental damage made by the ceramic tile supply chain in each stage, material used and disposal.

1.2 STATEMENT OF PROBLEM

The rapid increase in ceramic tile production and inadequate recycling systems in Nigeria have pose significant environmental and health challenges. Environmentally, ceramic tiles waste accumulates in landfills and natural ecosystems, leading to soil and water contamination, threatening biodiversity, and clogging waterways, which increases flood risks in urban areas (Agwu *et al*., 2021). Additionally, ceramic tile production processes and improper waste disposal contribute to air pollution, releasing toxic chemicals such as dioxins and furans, which are harmful to both the environment and human health (Ikpe *et al*., 2020).

The informal nature of waste management in Nigeria, with a reliance on manual labourers and inadequate protective measures, exacerbates these health risks. Despite the growing recognition of these issues, there is a significant gap in understanding the full extent of environmental degradation and health implications caused by ceramic tiles production and recycling in Nigeria. This research aims to address this gap by evaluating these impacts comprehensively.

The increasing ceramic tiles production and poorly managed recycling systems in Nigeria have emerged as critical challenges for both the environment and public health. Ceramic tiles, being non-biodegradable, accumulate in landfills and natural ecosystems, leading to severe soil and water contamination, which threatens biodiversity and disrupts ecological balance. In urban areas, ceramic tiles waste often clogs drainage systems, exacerbating flood risks, particularly in coastal cities like Benin City, where waste management infrastructures are inadequate (Kehinde *et al*., 2020) .

From a health perspective, communities living near ceramic tiles production facilities or engaged in informal recycling operations face direct exposure to hazardous chemicals. These toxic substances are known to cause respiratory ailments and injury due to sleepy flow (Akan *et al*., 2021). The informal nature of waste management in Nigeria, characterized by the manual handling of waste without protective gear, leaves many vulnerable to severe health impacts. The combination of environmental contamination and health risks forms a complex issue, and despite growing recognition of these concerns, there is limited empirical data on the full extent of the degradation and health effects related to plastic production and recycling in Nigeria.

1.3 RESEARCH QUESTIONS

The study is guided by the following research questions:

1. What is the significant effect of ceramic tiles product on human health?
2. What is the significant effect of ceramic tiles product waste on the environment?
3. What is the significant effect of ceramic tiles product on human health?
4. What is the significant effect of ceramic tiles product waste on environment?

1.4 OBJECTIVES OF THE STUDY

The main objective is to assess the impacts of life cycle stages of ceramic tiles products on the health and environment conditions of Edo State while the specific objectives are to;

1. examine the impact of the use of ceramic tiles on the health individual.
2. examine the impact of the disposal of ceramic tiles on the environment.

1.5 HYPOTHESES OF THE STUDY

1. The impact of the use of ceramic tiles on health issues is not significantly different from zero.

2.,The impact of the disposal of ceramic tiles waste on environment is not significantly different from zero.

1.6. JUSTIFICATION OF THE STUDY

The escalating environmental impact of ceramic tiles products necessitates studies focusing on effective management and reduction of ceramic tiles products' ecological footprint. In Edo State, a developing City with rapidly growing industrial and consumer demand for ceramic tiles understanding the environmental ramifications through LCA can guide stakeholders in adopting sustainable practices. This research not only contributes to environmental protection efforts but also aligns with global goals for sustainable development, emphasizing resource efficiency, pollution reduction, and waste management

Ceramic tiles products, play a central role in modern life due to their versatility, durability, and cost-effectiveness, making them integral to industries such as healthcare and construction. However, the environmental impacts associated with the life cycle of these products—from raw material extraction to disposal—have led to increasing concern. Conducting a Life Cycle Assessment (LCA) for ceramic tiles products is essential, as it provides a holistic framework to assess their cumulative environmental burden and identify opportunities for sustainable management. By examining each stage in the life cycle, LCA reveals critical areas where improvements can be made to reduce the overall environmental footprint of ceramic tiles (Blanco, Ingrao, & Siracusa, 2020).

Given Edo State's limited recycling infrastructure and high dependency on single-use ceramic tiles, there is an urgent need to assess the life cycle impacts of ceramic tiles in the State. Studies show that a significant portion of Edo's ceramic tiles Products waste is mismanaged, leading to severe environmental consequences such as soil and water contamination. An LCA approach in this context would provide data on the environmental cost of ceramic tiles products across their life cycle, offering insights that are vital for shaping effective waste management policies. Moreover, by focusing on the specific conditions and challenges within the State, this research can contribute to regionally relevant solutions for reducing the ecological footprint of ceramic tiles products.

Incorporating LCA findings into industrial practices has become increasingly necessary as businesses and policymakers aim to meet global sustainability goals, such as those outlined in the United Nations Sustainable Development Goals (SDGs). The adoption of LCA methodologies aligns with goals targeting sustainable production, responsible consumption, and climate action, as they enable industries to understand and mitigate the impacts of their products (Walker & Rothman, 2020) . For ceramic tiles products, an LCA-driven approach can identify strategies to minimize emissions, reduce energy use, and lower waste, thereby aligning with broader efforts to transition toward a circular economy.

CHAPTER TWO

BACKGROUND TO THE STUDY

2.1 PRODUCTION OF CERAMIC TILES IN NIGERIA

The ceramic industry which was among the earliest achievements of Nigerian business was a strategic enabler for the growth, innovation and sustainability of the economy until the 1980s; but now, the nation values her ceramics tiles importation at over $600 million annually (Oaikhinan, 2015; Stock, 2015)**.** Today, the industry in Nigeria has not been able to continue to grow due to the disregard for the solid mineral sector, a lack of qualified labor, and a lack of industries to process the raw materials needed to make ceramic tiles (Idowu, 2014).

Collection, beneficiation, and processing of raw materials (milling, drying, and mixing) are a few of the processes involved in making ceramic tiles; shape formation; drying of products; surface treatment and decoration; Firing; and polishing (Idowu, 2014; Abiola *et al*., 2021). Apart from the raw materials needed for tiles production, some researchers have worked on developing equipment and machinery required to smooth operation in ceramic tiles production.

Golkar and Prabuwono (2013) developed an image processing algorithm with a view to determining the sizes of ceramic tiles in order to improve tiles classification in the industry. It was found that the algorithm has an accuracy of about ±2mm. Morakinyo *et al*. (2014) developed a ceramic tile molding machine from where different sizes of tiles were formed. The machine was designed to produce tiles using the method of extrusion from different blends of ceramic raw materials. Tiles produced from this machine were subjected to hardness, tensile, and impact resistance tests and the result revealed that the properties of these tiles are comparable to the unglazed floor tiles and other hard lining surfaces used in China. Fonseca *et al*. (2016) recognized that processing is a major factor in promoting innovative technology and improving industrial output. This is of concern in the ceramic industry where technologies such as laser sintering of tiles is been investigated. The application of laser sintering of tiles revealed that there are emissions of nanoparticles and the patterns of this emission have a strong link to the chemical composition of the tiles as well as the sintering temperature. In addition, Nano-sized particles and ultrafine airborne were also generated and released into the environment during the sintering process.

2.2 Types of Ceramic Tiles

The ceramic industry which was among the earliest achievements of Nigerian business was a strategic enabler Typically, ceramic tiles are inflexible, brittle, and hard. They have strong chemical resistance, are good electrical and thermal insulators, and have low shock resistance. (Lukkassen and Meidell, 2003). According to Bolton, (1998), Marcin and Jorge (2012), ceramic products can be grouped into the following categories:

2.2.1 Traditional or Domestic Ceramic

This is primarily made from clay, silica and feldspar (Marcin and Jorge, 2012). It is usually used in floor and wall tiling. It depends mostly on the material's composition, usage and properties of the product.

(a**) Porcelain tile**

It is a type of vitrified ceramic material that is widely used for wall covering and floor paving in both indoor and outdoor applications (Martn-Márquez et al., 2010). Porcelain tile is described as a nearly waterproof, high-density, stain-resistant, and smooth product by the American National Standard Specifications for Ceramic Tile (Ece and Nakagawa, 2002). Porcelain is a vitrified product made of clay, quartz, and feldspar mixtures with grain and bond type microstructures. Large filler particles (often quartz) are held together by a finer matrix that is almost entirely dense and made of mullite crystals and a glassy phase. It is a type of ceramic tile that is widely prized for its beauty and strength. Fiandre, one of the top Italian porcelain tile makers, debuted it towards the end of the 1980s, and in recent years it has become the most popular ceramic tile on the global market (El- Fadaly, 2015; Abadir et al., 2002). It is a durable, white, typically translucent, and nearly impermeable material that is typically manufactured from a triaxial dry-pressed composition of kaolin, quartz, and feldspar and fired at a temperature between 1200 and 1400 oC (Ece and Nakagawa, 2002; Griese, 2007). To encourage high mullite production, porcelain is fired over a period of time (24 hours or more) (Martn- Márquez et al., 2008). It is classified by the American tile industry as either glazed or unglazed ceramic tile with minimal water absorption (0.5%). (ISO 10545,1996). It is a very popular product among tile products due to its great technical qualities (zero or almost zero apparent porosity, high mechanical strength and frost resistance, high hardness, chemical and stain resistance, etc.) and wide range of aesthetic options (Amoros *et al*., 2007).

b) Stoneware tile

It is one of the most common forms of ceramic tile and is often fired to a dense body at a temperature of about 1200 0C. They are heavier, darker and opaquer than Porcelain (Reed, 1988)). Stoneware is typically thought of as a non-equilibrium material and is created using a quicker firing cycle, during which the tiles are only heated for 60 to 90 minutes. (Martín-Márquez *et al*., 2008).

c) Terracotta tile

It is known as Mexican tiles. It is traditionally fired at lower temperatures (between 600 to 1000 0C) and has more natural variation in the individual tiles (Martin, 2011). Modern terracotta tiles come in both glazed and unglazed varieties, and they occasionally need surface treatment to be sealed after installation. They frequently produce a less formal, more rural feel.

d) Quarry tile

On industrial and commercial floors, quarry tiles are frequently used as flooring. Instead of being pressed, like other ceramic tiles, it is extruded. This results in a little more uneven finish, a relatively high porosity, and more shape variability. Although quarry tiles are often reddish-brown, they can also be found in a variety of colors grey and black. (Quirion *et al*.2008).

e) Mosaics

It is made up of many product types and can be either unglazed or glazed. These product types include vitrified or earthenware ceramic, porcelain, natural stone and glass, which are all formed from individual tesserae (Friendly, 2001).

2.4.2 Natural Ceramic

The ceramic raw materials are generally referred to as natural ceramics (Heinrich and Gomes, 2017). This includes rocks, stones and minerals as well as bones and ice.

2.4.3 Amorphous Ceramics (Glass)

Glass and glass-ceramic materials come under this category. Although the amorphous state is conceivable, ceramics are typically crystalline. If silica is cooled very slowly while still molten, it will crystallize at the freezing point. However, if the molten silica is cooled more quickly, it will not be possible to arrange all of its atoms in the way that a crystal requires, leading to the formation of a glass, which is a chaotic solid. There is also a category known as ceramic glass. The controlled crystallization of glasses yields these fine-grained polycrystalline materials (Andreola *et al*., 2012).

2.4.4 Advanced Ceramic

Among these are engineering ceramics (oxides, carbides borides, nitrides and silicates). Engineering frequently uses such materials for products like furnace components, combustion tubes, tooltips, and grinding tools. (piezoelectric, ferrites, ferroelectric, semiconductors and superconductor ceramics); electro-optical; biocompatible (hydroxyapatite); and zirconia-based ceramics.

CHAPTER THREE

LITERATURE REVIEW

3.1 Life Cycle Assessment (LCA)

Life Cycle Assessment (LCA) is a systematic approach used to evaluate the environmental impacts associated with all stages of a product's life from raw material extraction, manufacturing, and use, to disposal or recycling. The International Organization for Standardization (ISO) has formalized LCA methodology under standards such as ISO 14040 and ISO 14044, emphasizing four key phases: goal and scope definition, inventory analysis, impact assessment, and interpretation (ISO, 2006) . Initially developed in the 1960s by the U.S. defense industry, LCA became a critical tool for evaluating product impacts, starting with Coca-Cola's pioneering study on the environmental effects of packaging .

The structure of LCA enables it to serve as an essential analytical tool for comparing environmental impacts between alternative products and processes. In polymeric products, LCA helps to quantify pollution and resource depletion, thus facilitating informed decision-making for reducing adverse effects (Blanco, Ingrao, & Siracusa, 2020) . In the polymeric industry, LCA can offer insights into stages where emissions, energy consumption, and waste generation are most intense, guiding strategies for mitigation.

3.1.1 Application of LCA in the Ceramic Tiles Sector

The Ceramic tiles sector extensively utilizes LCA to assess the environmental footprint of materials, particularly given the environmental challenges associated with traditional ceramic tiles products are predominantly derived from clay, contributing significantly to carbon emissions, especially during raw material extraction and manufacturing phases (Walker & Rothman, 2020) . Studies have shown that each kilogram of ceramic tiles one of the most commonly used produces around 1.5 to 3 kilograms of CO_2-equivalent emissions throughout its life cycle (Ingrao *et al.,* 2018) .

Additionally, LCA has been instrumental in comparing traditional ceramic tiles with bio-based alternatives, assessing whether materials like polylactic acid (PLA) offer a sustainable reduction in environmental impact. Results suggest that bio-based ceramic tiles, while reducing fossil fuel dependency, may still involve considerable environmental costs, including land use changes and high energy requirements for production, necessitating a balanced perspective when advocating for their use (La Rosa et al., 2020) .

3.1.2 Environmental Impacts of Ceramic tiles Products

Ceramic tiles products, particularly plastics, have diverse environmental impacts spanning soil, water, and air pollution. Plastics account for a substantial portion of global waste, with millions of tons discarded annually, often ending up in landfills or the ocean. Once in the environment, plastics degrade very slowly, releasing microplastics that accumulate in ecosystems and potentially enter the food chain, posing risks to wildlife and humans (Blanco et al., 2020) .

In Nigeria, the mismanagement of ceramic tiles waste exacerbates injury and flooding, especially in urban areas where drainage systems are often clogged by plastic debris. This not only increases flood risk but also amplifies waterborne diseases and health hazards for nearby communities (Ingrao et al., 2018) . An LCA-focused study can provide valuable data to illustrate how each stage of the polymer life cycle contributes to these issues, thus highlighting targeted solutions for waste management.

3.1.3 Health Impacts Associated with Ceramic tiles Products

The health impacts of ceramic tiles products, are of growing concern. Exposure to ceramic tiles can occur through inhalation of airborne microplastics, ingestion of contaminated food and water, or through direct contact with plastic products. Studies have linked plastic exposure to respiratory issues, skin allergies, and endocrine disruption, especially in cases where plastics are used for cooking or food packaging (Walker & Rothman, 2020) . In developing countries like Nigeria, where regulatory standards for safe plastic use may be inconsistent, the health risks associated with plastics are heightened.

In the context of food packaging and cooking, there is significant concern about the leaching of chemicals such as phthalates and bisphenol A (BPA), which are commonly found in plastics and have been associated with hormonal imbalances and reproductive health issues. Understanding the health impacts through LCA could facilitate stricter regulations and awareness campaigns to minimize exposure, particularly for high-risk groups .

3.1.4 Waste Management and Recycling of Ceramic tiles Products

Efficient waste management is critical in minimizing the environmental impact of ceramic tiles products. LCA reveals that the end-of-life stage comprising recycling, incineration, and disposal is a major contributor to environmental degradation. Recycling is widely considered a sustainable alternative to incineration and landfill disposal, as it conserves resources and reduces energy usage (Blanco et al., 2020) . However, in Nigeria, recycling infrastructure is still underdeveloped, resulting in a heavy reliance on landfilling and open dumping, which pose environmental and public health risks.

LCA studies show that recycling polymeric materials can reduce greenhouse gas emissions by 30-80% compared to the production of virgin materials (ISO, 2006) . Initiatives to improve plastic recycling and waste management in Nigeria could benefit from LCA insights, which can identify the most resource-intensive stages of the recycling process and suggest improvements in material recovery and processing efficiency.

3.1.6 Methodological Advances in LCA

Over the years, LCA methodologies have evolved to become more robust and flexible, with standards and guidelines introduced to refine and standardize its applications. The ISO 14040 and ISO 14044 standards provide a structured framework for LCA, encompassing four primary phases: defining the goal and scope, conducting inventory analysis, assessing impacts, and interpreting results. In recent years, advancements in software tools like SimaPro, GaBi, and Open LCA have enabled practitioners to handle complex data and conduct more sophisticated analyses, making LCA an accessible tool for companies across different industries.

A critical aspect of LCA is Goal and Scope Definition, where boundaries are set to determine the life cycle stages and environmental impact categories to be included. Setting clear boundaries is crucial to maintaining focus on relevant stages, especially when assessing complex products. Inventory Analysis, the most data-intensive phase, involves collecting quantitative data on material flows and emissions, a process that has been greatly improved by the development of expansive global databases like ecoinvent. Lastly, Impact Assessment translates inventory data into potential environmental impacts using models for categories like global warming potential, eutrophication, and toxicity.

3.1.7 Applications of LCA Across Sectors

LCA is widely applicable across diverse sectors, including construction, manufacturing, agriculture, and energy. In the construction industry, LCA helps assess building materials, energy consumption, and emissions associated with different phases of a building's life cycle, from design and construction to demolition. The integration of LCA in sustainable construction has led to greener designs and energy-efficient building materials, reducing overall environmental footprints.

In manufacturing, LCA aids companies in understanding and mitigating the environmental impacts of various production processes, particularly in sectors like automotive, electronics, and textiles. For example, automotive manufacturers use LCA to evaluate the environmental effects of materials like aluminum and steel and to explore alternatives such as lightweight composites and bio-based plastics.

The agricultural sector also benefits from LCA by examining the impacts of agricultural inputs, water use, fertilizer applications, and land management practices on ecosystems. This allows farmers and policymakers to optimize resource use and reduce emissions, as demonstrated by studies on crop-based biofuels, which assess the life cycle emissions of biofuel production against fossil fuel counterparts .

3.1.8 Challenges in Implementing LCA

Despite its broad utility, implementing LCA poses several challenges. One significant issue is data availability and quality, as LCA relies on comprehensive data to accurately measure environmental impacts. High-quality data for each life cycle stage is often unavailable, especially in developing regions where local data collection and monitoring infrastructures are limited. System boundary setting is another challenge, as the choice of boundaries can affect results and comparability between studies. For example, choosing different boundaries cradle-to-grave versus cradle-to-gate may yield differing results that are not always directly comparable.

Additionally, allocation issues arise when a product or process produces multiple outputs. Determining how to allocate environmental burdens among these outputs can be complex and may affect the accuracy of the results. Standard methods, like economic allocation or physical allocation, can help address this issue, though each has its limitations. Another challenge in LCA is impact assessment uncertainty. Environmental impacts are complex and interconnected, and the methods for quantifying certain impacts, such as biodiversity loss or water scarcity, are still evolving. This limits LCA's ability to provide a complete picture of certain environmental impacts and calls for more refined methods and impact assessment models.

3.1.9 Emerging Trends in LCA

As environmental concerns increase globally, LCA methodologies are expanding to incorporate new impact categories and innovations in data collection and modeling. One emerging trend is Social Life Cycle Assessment (S-LCA), which integrates social and socio-economic aspects into the traditional LCA framework. S-LCA assesses social impacts associated with a product's life cycle, such as labour conditions, community well-being, and fair trade practices, offering a holistic view of sustainability.

Another innovation is the development of dynamic LCA, which considers the temporal aspects of environmental impacts, such as how carbon sequestration and release vary over time. Dynamic LCA allows for a more accurate representation of certain environmental impacts by integrating time as a factor, making it particularly useful in sectors like forestry and agriculture where time-dependent impacts are significant.

With the advancement of big data and artificial intelligence (AI), data collection and analysis in LCA are becoming more efficient. AI algorithms are now capable of processing large datasets and identifying patterns that would be difficult to detect manually. This enhances the precision of impact assessments and enables real-time environmental monitoring, allowing companies to adapt their practices more responsively to environmental regulations and goals.

Lastly, Life Cycle Sustainability Assessment (LCSA) represents an integrated approach that combines environmental, social, and economic life cycle assessments to provide a comprehensive evaluation of sustainability. LCSA is increasingly seen as the future of LCA, as it aligns with the triple bottom line framework of sustainable development. This integrated methodology is essential for industries and governments committed to achieving Sustainable Development Goals (SDGs), as it allows decision-makers to consider environmental, social, and economic dimensions concurrently.

3.1.10 Usage Patterns of Ceramic Tiles and Polymeric Products

Polymeric materials, particularly used in ceramics and plastics, have become ubiquitous due to their versatility, durability, and low cost. These materials are widely used in household products, packaging, and even cooking applications, as they provide convenience and maintain food safety. For instance, plastic bags, wraps, and containers are commonly used for food storage and cooking, particularly in developing countries, where other packaging alternatives may be costly (Andrady & Neal, 2009). However, this widespread usage also raises concerns about the environmental and health implications of prolonged exposure to plastics, especially when heated or exposed to certain food items.

Studies show that single-use plastics, such as those used for packaging and short-term storage, are most commonly disposed of after use, contributing significantly to the overall plastic waste problem (Geyer, Jambeck, & Law, 2017). In Nigeria, the prevalence of plastic products is high, with limited infrastructure for managing the disposal or recycling of these materials, resulting in frequent improper disposal practices like open burning or dumping in waterways (Awopetu et al., 2019). This improper disposal exacerbates pollution and hinders effective waste management, highlighting the need for public awareness and sustainable alternatives to reduce plastic dependency in everyday usage.

3.1.11 Health Impacts of Ceramic Tiles and Polymeric Products

The health impacts associated with polymeric products used in ceramic tiles products have been increasingly studied, particularly regarding the potential release of harmful substances during their usage. When plastics are exposed to high temperatures, as in cooking, they may release chemicals like phthalates and bisphenol A (BPA), which have been linked to endocrine disruption, respiratory issues, and other health problems (Rochman et al., 2015). BPA and phthalates are commonly used in plastic production to increase flexibility, but they can leach into food or beverages under certain conditions, posing risks to human health (Talsness et al., 2009).

Research indicates that communities with high plastic use, particularly in cooking and food storage, may experience an increase in symptoms like headaches, respiratory difficulties, and allergies, potentially attributable to prolonged chemical exposure (Halden, 2010). Developing regions, including parts of Africa and Asia, where regulatory oversight on plastic safety may be limited, are at a higher risk due to the unrestricted sale and use of non-food-grade plastics in food applications (Sajid, Ilyas, Basheer, & Tariq, 2020). This underscores the importance of public education and stricter regulations on the types of plastics used in food-related applications.

3.1.12 Environmental Impacts of Polymeric Products

The environmental impacts of plastic products are well-documented, particularly in relation to pollution in terrestrial and marine ecosystems. Plastics are highly durable and resistant to degradation, meaning they persist in the environment for hundreds of years, contributing to pollution and ecological harm (Jambeck et al., 2015). In urban areas, plastic waste often clogs drainage systems, leading to flooding and increased public health risks, especially during heavy rains. For example, studies show that plastic waste can obstruct drainage channels, exacerbating flooding in densely populated regions (Lebreton et al., 2017).

In Edo State, plastic waste has become a significant issue due to inadequate waste management systems and the high prevalence of single-use plastics. A study by Auta, Emenike, and Fauziah (2017) highlights that in many Nigerian cities, plastic waste is improperly disposed of, contributing to drainage blockages and an increase in urban flooding incidents. This environmental hazard not only disrupts urban infrastructure but also impacts local biodiversity and threatens marine life as plastic waste accumulates in rivers and coastal areas.

3.1.13 Waste Management and Recycling of Ceramic Tiles and Polymeric Products

Effective waste management, particularly recycling, is essential in reducing the environmental footprint of polymeric products. Recycling offers a pathway to reduce the demand for virgin plastic production, conserve resources, and lower greenhouse gas emissions (Hopewell, Dvorak, & Kosior, 2009). In developed countries, advanced recycling infrastructure has enabled high recovery rates for certain types of plastics, though recycling rates remain relatively low worldwide due to technical, economic, and policy-related challenges (PlasticsEurope, 2020).

In developing countries like Nigeria, however, recycling infrastructure is underdeveloped, and plastic waste is often managed through open burning, landfilling, or informal recycling sectors that lack efficiency and environmental safeguards (Awopetu et al., 2019). This inefficient waste management system not only contributes to environmental pollution but also undermines efforts to create a circular economy. Studies recommend improving recycling infrastructure and implementing community-based waste management programs to enhance waste segregation and recovery rates (Schyns & Shaver, 2021).

There is also a growing emphasis on creating sustainable waste management policies that encourage the reduction, reuse, and recycling of plastics. For example, community-level initiatives and government policies that promote the use of recyclable plastics and biodegradable alternatives have shown potential in reducing plastic waste in urban environments. However, these approaches require public engagement and collaboration across industries to create sustainable and long-lasting waste management solutions (Nkwachukwu, Chima, Ikenna, & Albert, 2013).

3.2 Theoretical Literature

3.2.1 Attributional LCI Theory

Attributional LCI modelling was initially the common practice when LCA development caught pace in the early-mid nineties. The overall aim of attributional modelling is to represent a product system in isolation from the rest of the technosphere or economy. The question addressed by attributional LCA can be said to be "what environmental impact can be attributed to product X?" or "what environmental impact is product X responsible for?" As hinted by these questions, there is an element of subjectivity involved in attributing impacts to a product system or deciding the impact responsibility of a product system. This subjectivity arises in the act of artificially separating the studied product system from the rest of the economy. This separation is artificial because many, if not most, product systems interact with other products systems through multifunctional processes, meaning that they cannot be described as physical entities in isolation. For example, from a strict physical perspective, the product system of a bottle of milk cannot be described in isolation and the assignment of processes that the product system is seen as "responsible for" therefore involves choices. Before the ILCD guidelines came into place attributional modelling was generally associated with allocation as the approach to solving the issue of multifunctional processes, provided that subdivision (the preferred solution of the ISO hierarchy) was not possible. By contrast, ILCD in some cases recommends solving multifunctionality by system expansion within an attributional modelling framework (Hauschild, Rosenbaum, & Olsen, 2018).

Besides the issue of multifunctionality, attributional LCA is also associated with the use of average processes in the background system, which reflects the modeling of an average supply chain. In practice, this means that a market mix is used. This could be for the global aluminium market or the electricity market of a nation. The former is composed of a range of bauxite mines with different ore grades and processing facilities that employ different production technologies, while the latter is composed of different energy conversion technologies, such as the combustion of coal, natural gas, oil and biomass, the harvesting of wind and solar power and the use of nuclear power (Hauschild, Rosenbaum, & Olsen, 2018)

3.2.2 Consequential LCI Theory

Consequential LCI modelling was developed around the year 2000 to eliminate the weakness inherent in the attributional LCA modelling framework due to the attempt to artificially separate a product from the rest of the economy. Its overall aim is to describe the changes to the economy caused by the introduction of the studied product system, i.e. the product system's consequence. Consequential LCI modelling thus aims to answer the question "What are the environmental consequences of consuming X?" For example, a consequential LCA of a bottle of milk would attempt to model how the market responds to the change in demand for milk represented by the functional unit of the study (e.g. involving a milk volume of 1 L or a specified nutritional value). This is a very different approach than attributional modelling because the change in the economy can look very different than the representation of the isolated bottle of milk system. For example, the increased demand for milk may lead to an increase in the capacity for milk production (i.e. the numbers of cows giving milk), which in turn may lead to a reduction in the production of some meat (e.g. beef from raising cattle) due to the increasing supply of meat from dairy cows. This corresponds to handling the multifunctional process of milk production by system expansion.

A consequence of increased consumption of milk may therefore be a reduction in environmental impacts from the avoided production of beef from cattle, which is somewhat counterintuitive. The market may also be influenced by an increased demand for a product in other cases than multifunctionality. For example, if an additional kg is demanded of a fish species that is already fished at its maximum level permitted by regulation (a production constraint) a consequence may be an increase in the production of another protein source that is not constrained, such as chicken, and the environmental impacts following this increase. The examples show that consequential modelling to a large extent relies on a good understanding of and ability to model the dynamics of the economic system, which requires a markedly different way of thinking than the engineering perspective on product supply chains that historically has been in the core of LCA. Contrary to attributional LCA, consequential LCA is not associated with the use of average processes for modelling the background system, but instead with the use of marginal processes. These are the processes that are employed or taken out of use as a response to an increase or decrease in the demand for a product, respectively. In the example of the Danish electricity system, the short-term marginal process will never be solar or wind, because solar irradiance or the wind are natural processes that cannot be "turned up or down" in response to a short-term change in electricity demand. Instead, the short-term marginal process in this example is a combustion process because it is possible to quickly adjust the rate at which something (e.g. coal or natural gas) is combusted in response to a change in electricity demand. The short-term marginal is often the combustion of natural gas, because this is a more expensive way of generating electricity than coal and thus sensitive to changes in electricity prices caused by changes in electricity demand (often, natural gas is only used during peak demand when a relatively high electricity price makes this technology economically viable). However, the relevant marginal processes to include in an LCI model are not always the ones that are affected as an immediate consequence of a decision, i.e. short-term marginal processes. Long-term marginal processes may be more relevant if a decision leads to large changes in supply or demand. Long-term marginal processes represent changes in the installed production capacity in response to the projected development of electricity demand. Often it is difficult to identify a single long-term marginal process, which is why a mix of potential long-term marginal processes is often used. It can be seen that fewer electricity production processes are part of the mix for consequential modelling than the mix for attributional modelling. For example, waste as an electricity source is not part of the consequential mix and this is because the long-term planning of waste incineration is thought to consider projections in future waste volumes (the primary function of waste incineration is to "get rid of" solid waste) rather than projections in future electricity demand. On the other hand, the construction of new wind turbines and coal-fired power plants (and to a very small extent, hydropower plants and rooftop photovoltaic panels) are thought to consider projections in future Danish electricity demand. When to consider short- versus long-term marginal processes in consequential LCA and how to identify these are still being debated in the LCA community. Note that while the background system is modelled differently in attributional and consequential LCA, the foreground system is overall modelled in the same way, the only exception being the handling of multifunctional processes.

CHAPTER FOUR

THEORETICAL FRAMEWORK, MODEL SPECIFICATION AND METHODOLOGY

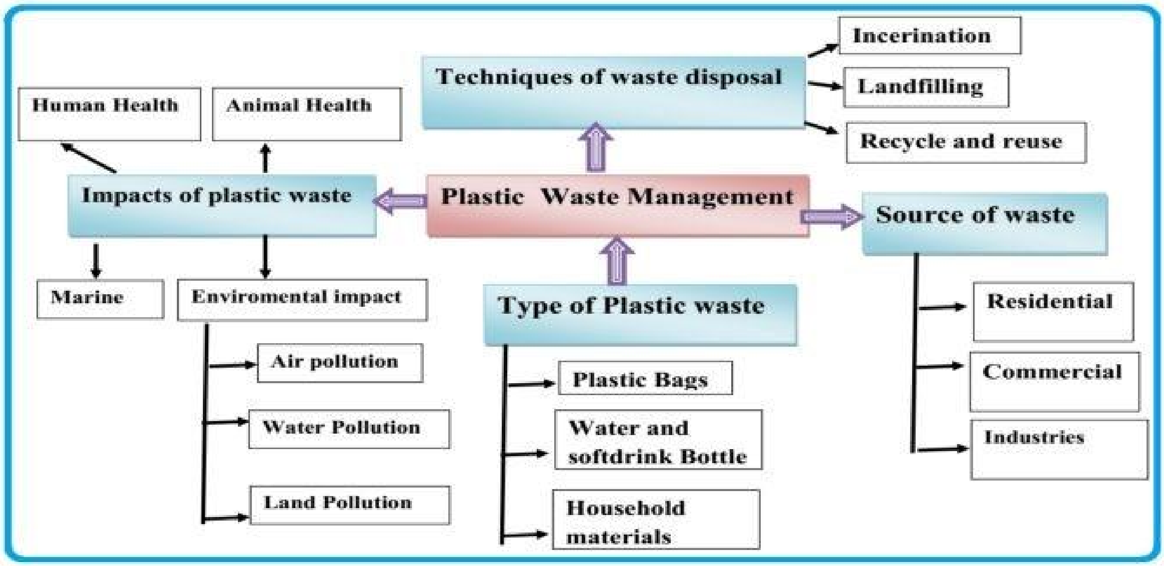
4.1 Theoretical Framework

Drawing from the consequential LCI theory, which provides a holistic view of products, materials, or processes by evaluating their environmental impacts throughout their life cycle from raw material extraction, production, and use to disposal or recycling (Curran, 2015). This theory underpins Life Cycle Assessment (LCA) by promoting a "cradle-to-grave" approach, ensuring that every stage of a product's life is analyzed for environmental burdens. Originating from the environmental management field, this theory aligns with the International Organization for Standardization (ISO) standards, particularly ISO 14040 and ISO 14044, which outline standardized LCA methodologies (ISO, 2006).

By applying this theory, the study can capture the entire environmental and health impacts associated with Ceramic tiles products in Nigeria. This aligns with the study's objective of evaluating Ceramic Tiles products' impact at every stage of their life cycle to inform sustainable practices and waste management strategies.

4.1.1 Conceptual Framework

The conceptual framework serves to outline the key concepts and variables that will guide the investigation of the life cycle and environmental impacts of ceramic tiles and polymetric products. This framework is essential for linking theoretical perspectives with the empirical analysis of ceramic tiles use and its consequences in Edo State.



Source: Beshir et al (2021)

4.2 Model Specification

From the idea of the theoretical framework the study develops the following model;

HEALT = f(USETIL, DISPOSAL)

HEALT = $\alpha_0 + \alpha_1$USETIL + α_2DISPOSAL + u…………………... …………………..4.1

ENVDRAG = f(USTIL, DISPOSAL)

ENVDRAG = $\beta_0 + \beta_1$USETIL + β_2DISPOSAL + u.…………………………….……..….4.2

Where

α_1, and α_2, β_1 and β_2, >0

HEALT (Frequency in experiencing bodily injuries irritation or allergies)

Slight often = 0

Not Often = 0

Often = 1

Very Often = 1

ENVDRAG (Frequency of ceramic tiles blockage of drainage systems)

Slight often = 0

Not Often = 0

Often = 1

Very Often = 1

USETILS(High use of ceramic tiles and polymetric products in building constructions)

Very Often = 1

Often =1

Slightly often = 0

Not often =0

DISPOSAL (High Open dumping)

Moderate = 0

Low = 0

High = 1

Very High = 1

4.3 METHODOLOGY

This study employs a **descriptive and econometrics cross-sectional survey design** to assess the environmental and health impacts of ceramic tiles and polymeric products in Nigeria. The cross-sectional approach allows for the collection of data at a single point in time, providing a snapshot of the usage patterns, health symptoms, and environmental effects associated with ceramic tiles and polymeric materials like nylon bags. Descriptive research design is chosen as it enables detailed documentation of the variables of interest, such as frequency of ceramic tiles use, reported health symptoms, and perceptions of environmental impact.

4.3.1 Population of the Study

The target population for this study includes residents of urban and semi-urban areas in Oredo Local Government Area in Edo State Benin City. The basis for selecting these local is as a result of high population in Edo State, who are likely to use ceramic tiles and polymeric products regularly especially plastic bag with a projected population of about 553,300 according to National population Commission of Nigeria (Thomas Brinkhoff, 2022),. The focus on this demographic group is justified by the widespread usage of ceramics in urban households and the high likelihood of environmental impact in densely populated regions.

Table 4.1 Distribution of Respondent

Respondent	Total population
Residents in area	553,300

Source: Thomas Brinkhoff 2022

4.3.2 Sample Size

To obtain a sample for this study, the Yamane (1967) formula was used to determine the appropriate sample size for the study, it was calculated as follows

n = N / 1 + N [e]^2

Where

n = sample size

N = population size

e = percentage level of significance

Where

Population size [N] = 553,300

Percentage level of significance [e] =0.05

Substituting into the formula

n = 553,300 / 1 + 553,300 [0.05]^2

n = 553,300 / 1 + [553,300 * 0.0025]

n = 553,300 / 1 + 1383.25

n = 553,300 / 1384.25

n = 399.7110

n = 400

4.3.3 Sampling Technique and Sample Size

A simple random sampling technique will be used to ensure representation from different socioeconomic backgrounds and geographic locations. This technique allows the study to capture variations in plastic use and its impacts.

The sample size was determined using the Yamen's formular (1967).

4.3.4 Instrument for Data Collection

Data will be collected through a structured questionnaire designed to capture quantitative responses on the frequency of polymeric product use, associated health symptoms, and perceived environmental impact.

Sections of the Questionnaire

Section A: Demographic information (age, gender, occupation, etc.).

Section B: Usage patterns of ceramic tiles and polymeric products (e.g., frequency of ceramic tiles, ceramic products disposal habits).

Section C: Health impact assessment, including frequency of bodily injuries related to ceramic tiles use.

Section D: Environmental impact assessment, covering questions on drainage blockage, flooding, and general waste management practices.

The questionnaire will be validated by experts in environmental health and public health to ensure clarity, relevance, and alignment with the study objectives.

4.3.5 Validity and Reliability of the Instrument

Validity: Content validity will be established by consulting experts in environmental science and health studies. Construct validity will be tested through a pilot survey with a small subset of respondents to ensure that questions effectively measure the intended constructs (e.g., health symptoms, environmental perception).

Reliability: The reliability of the questionnaire will be assessed using **Cronbach's alpha** to ensure internal consistency. A Cronbach's alpha value above 0.70 will indicate acceptable reliability (Nunnally, 1978).

4.3.6 Data Collection Procedure

Data collection will be carried out through face-to-face surveys to maximize respondent participation.

Face-to-face surveys: Trained research assistants will administer the questionnaire to respondents in selected urban and semi-urban areas without reliable internet access.

Participants will be informed about the study's purpose, assured of their anonymity, and given the option to withdraw at any time. Ethical approval will be sought from a recognized ethics committee before data collection.

4.3.7 Data Analysis Techniques

Data will be analyzed using quantitative statistical methods with the aid of statistical software such as STATA 13.

Descriptive Statistics: Frequency distributions, percentages, and means will summarize demographic information, polymer usage patterns, and reported health and environmental impacts.

Inferential Statistics: Hypotheses will be tested using **Chi-square tests** to determine relationships between ceramic tiles usage and health symptoms and between ceramic tiles disposal practices and environmental impacts. The significance level will be set at 0.05.

Regression Analysis: Logistic regression will be used to predict the likelihood of health impacts based on ceramic tiles usage patterns and to assess the contribution of ceramic tiles waste to environmental issues like drainage blockage and flooding.

CHAPTER FIVE

EMPIRICAL ANALYSIS

5.1 Descriptive Analysis

Table 5.1: Distribution of Gender

Gender	Frequency	Percentage
Female	175	44
Male	225	56
Total	400	100

Source: Field Survey 2025 October

Table 5.1 shows the distribution of gender, the table shows that about 56% of respondents are male while 44% are female. The result is not surprising as male are the major users of ceramic tiles materials since most of them are involve in building construction. Therefore, the information to be obtained from the study will highly be accurate

Table 5.2: Distribution those having Knowledge of Harmfulness of Ceramic Tiles

Knowledge of Harmfulness	Frequency	Percentage
No	155	39
Yes	245	61
Total	400	100

Source: Field Survey 2025 October

Table 5.2 shows the distribution of respondents who have knowledge of the harmfulness of ceramic tiles. The table shows that about 60% of the total respondents have adequate knowledge of the health and environmental harmfulness ceramic tiles in their environment, while only about 39% have little knowledge of the harmfulness of ceramic tiles.

Table 5.3: Distribution of Reasons for the Preference of ceramic tiles

Preference of Plastic Products	Frequency	Percentage
Cheap	110	28
Easily available	188	47
Light in Weight	53	13
Easy to Dispose	49	12
Total	400	100

Source: Field Survey 2025 October

Table 5.3 shows the distribution of respondents who gave reasons why they prefer the use of tiles products. The table shows that about 46% of the total respondents say ceramic tiles are easily available while about 29% of the respondents say ceramic tiles are very cheap to afford. About 13% of the total respondents say tiles products are light in weight while 12% says it is very easy to dispose.

5.2 Regression Analysis

5.2.3 Summary Statistic

Table 5.4: Summary Statistics of the Variables

Variable	**Observation**	**Mean**	**Std. Dev.**	**Minimum**	**Maximum**
USEBAG	400	0.536946	0.499248	0	1
USECONT	400	0.544335	0.498645	0	1
HEALT	400	0.179803	0.384497	0	1
ENVDRAG	400	0.778325	0.415886	0	1
HIGHUSP	400	0.416256	0.493545	0	1
HOWDYD	400	0.859606	0.347824	0	1

Source: Author's Estimations

Table 5.3 shows the summary statistics of all the variables use in the study. The minimum values of all the variables are zero (0) while the maximum values are one (1). The variable with the lowest standard deviation of about 0.35 and highest mean values of 0.86 is HOWDYD. HEALT with the lowest mean value of 0.18 is next variable with the lowest standard deviation value of 0.38 followed by ENVDRAG with a standard deviation of 0.42. USECONT and HIGHUSP have standard deviations of 0.50 and 0.49 respectively.

5.2.1 Empirical Model

Table 5.5: Ceramic Tiles Usage and Disposal on Health Model

HEALTH	COEFRICIENCT	Z	P VALUE	ODDS RATIO
CONSTANT	-1.563	-7.21	0	
USEBAG	-0.289	-0.77	0.444	0.749
USECONT	0.011	0.03	0.977	1.011
DISPOSAL	0.425	1.6	0.11	1.529

Source: Author's Estimations

HEALTH= -1.56 - 0.29USEBAG + 0.01USCONT + 0.43HIGHUP ……………. 5.1

P value (0.00) (0.44) (0.98) (0.11)

LR chi2 (4) = 3.29

Pseudo R2 = 0.009

The study will be interpreting the odd ratio and not the logistic coefficents shown in Equation 5.1. For each unit increase in the use tile, the odd of having bad health condition decreases by a factor of 0.7, and a unit increase in the use of tiles increases the odd of a bad health condition by 1.01. Also, a unit increase in tile disposal increases the odd of a bad health condition by 1.5.

Table 5.6: Ceramic Tiles Usage and Disposal on Environment Model

ENDDRANG	COEFRICIENCT	Z	P VALUE	ODDS RATIO
CONSTANT	0.080	0.44	0.659	
USEBAG	0.463	1.21	0.225	1.589
USECONT	0.861	2.24	0.025	2.365
DISPOSAL	2.232	5.69	0.000	9.318

Source: Author's Estimations

ENVDRAG = 0.08 + 0.46USEBAG + 0.86USCONT + 2.23DISPOSAL …5.2

P value (0.66) (0.23) (0.03) (0.00)

LR chi2 (4) = 81.2

Pseudo R2 = 0.19

The study will be interpreting the odd ratio and not the logistic coefficents shown in Equation 5.1. For each unit increase in the use Ceramic tiles, the odd of having bad environmental condition increases by a factor of 1.6, and a unit increase in the use of tiles increases the odd of a bad environmental condition by 2.4. Also, a unit increase in plastic disposal increases the odd of a bad environmental condition by 9.3.

CHAPTER SIX

SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

6.1 Summary of Findings

The study has able to come out with the following findings which are as follows;

1. the usage of Ceramic tiles for building does not have a significant impact on the bad health conditions of individuals.
2. the disposal stage of Ceramic tiles for building do not have a significant impact on the bad health conditions of individuals
3. the usage of Ceramic tiles for building has a significant impact on the bad environmental conditions of the area.
4. the disposal stage of Ceramic tiles for building does not have any significant impact on the bad environmental conditions of the area.

6.2 Recommendations

As a result of the above finding the following recommendations are made by the study are as follows:

1. Alternative method of flooring buildings should be developed or encourage by the government. One of the alternative could be ply wood
2. Recycling of these Ceramic tiles for building should be encouraged by government so as to reduce the quantities going into drainages.
3. The government should increase the services of waste managers, because they are very few in numbers. Therefore more licenses should be given to more firms.

6.3 Conclusion

In conclusion, the study has been able to extensively examine the life cycle assessment of health and environmental impact of Ceramic tiles for building in Edo State. The study looked at the use and disposal life cycle stages of Ceramic tiles products. This enabled the study to be able to identify which of these stages has significant impact on the environment and the health of individuals. The study is able the find that the use and disposal stage have no significant impact on the bad health condition on individuals but the two stage have significant positive effect on the bad environmental condition on the state. However, the disposal stage is seen to have more significant effect on the environment. This means that there no proper ways of disposing the Ceramic tiles waste in the State. As a result the study recommends that alternative method of flooring buildings should be developed or encourage by the government and that more licenses should be given to more private waste disposal firms in the State.

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APPENDIX

UNIVERSITY OF BENIN, UGBOWO, BENIN CITY.

Research Questionnaire

Research Title: Health and Environmental Impact of Ceramic Tiles Supply Chain in Edo State, Nigeria

Researcher: Kwemezi Osazuwa Godwin

Program: MSc, Faculty of Sustainable Procurement, Environment, and Social Standards Enhancement,

Department of Procurement Management, University of Benin (UNIBEN)

DATE: ……………………………….

INTRODUCTION

Dear Respondent,

I am a postgraduate student at the University of Benin working on research about the health and environmental impact of the ceramic tile supply chain in Edo State, Nigeria. This questionnaire aims to gather information about the use, disposal, health, and environmental effects of ceramic tiles in Edo State.

Your answers will be kept confidential and used only for academic purposes. Please respond to all questions as honestly as you can.

Instructions:

• Tick (✓) the option that best fits or rate on the scale provided.

• For Likert-scale items, use:

1 = Strongly Disagree | 2 = Disagree | 3 = Neutral | 4 = Agree | 5 = Strongly Agree

Section A: Demographic Information

1. Gender: ☐ Male ☐ Female

2. Age: ☐ 18–25 ☐ 26–35 ☐ 36–45 ☐ 46–55 ☐ 56+

3. Educational Qualification: ☐ No formal education ☐ Primary ☐ Secondary ☐ Tertiary ☐ Postgraduate

4. Occupation: ☐ Student ☐ Civil Servant ☐ Private Sector ☐ Self-Employed ☐ Other __________

5. Residential Area: ☐ Urban ☐ Semi-urban ☐ Rural

Section B: Usage of Ceramic Tiles

(Please indicate your responses.)

6. I use ceramic tiles in my home or workplace.

☐ Yes ☐ No

7. Where are ceramic tiles mostly used in your household/workplace?

☐ Floor ☐ Wall ☐ Kitchen ☐ Bathroom ☐ Other __________

8. The use of ceramic tiles in my environment has improved cleanliness and appearance.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

9. The demand for ceramic tiles is increasing in my community.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Section C: Health Impacts of Ceramic Tiles

10. People in my household/community experience health issues related to ceramic tile use.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

11. Broken or damaged ceramic tiles cause injuries in my environment.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

12. Dust from cutting or installing ceramic tiles causes respiratory problems.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

13. Long-term exposure to ceramic tile waste negatively affects human health.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Section D: Environmental Impacts of Ceramic Tile Waste

14. Ceramic tile waste is usually disposed of through open dumping in my area.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

15. Ceramic tile waste contributes to drainage blockage and flooding in my community.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

16. Ceramic tile waste leads to soil contamination in my environment.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

17. Disposal of ceramic tile waste negatively affects water quality.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

18. Recycling of ceramic tiles is not effectively practiced in Edo State.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Section E: General Perception and Recommendations

19. The health and environmental impacts of ceramic tiles in Edo State are significant.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

20. Better waste management and recycling systems will reduce the negative impacts of ceramic tiles.

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

21. What do you consider the greatest impact of ceramic tiles in Edo State?

☐ Health impact ☐ Environmental impact ☐ Both equally ☐ No impact

22. Please suggest measures that can reduce the health and environmental impacts of ceramic tiles in Edo State: ……………………………………………………………………………………………

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