ASSESSMENT OF FEACAL WASTE MANAGEMENT IN RURAL COMMUNITIES (EKOSODIN) IN BENIN CITY AND ITS IMPACT ON WATER SOURCES

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BENIN CITY

EDO STATE, NIGERIA

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AN UNDERGRADUATE DISSERTATION SUBMITTED TO THE DEPARTMENT OF ENVIRONMENTAL MANAGEMENT AND TOXICOLOGY, FACULTY OF LIFE SCIENCES, UNIVERSITY OF BENIN, BENIN CITY, EDO STATE, NIGERIA; IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR AWARD OF BACHELOR OF SCIENCE (B.Sc) DEGREE IN ENVIRONMENTAL MANAGEMENT AND TOXICOLOGY.

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CERTIFICATION

This is to certify that this research titled **"ASSESSMENT OF FECAL WASTE MANAGEMENT IN RURAL COMMUNITIES (EKOSODIN) IN BENIN CITY AND ITS IMPACT ON WATER SOURCES"** was carried out by **"HANNAH EDIDIONG ETIMENSI'** and presented to the Department of Environmental Management and Toxicology, Faculty of Life Sciences, University of Benin, Benin City; in partial fulfillment of the requirements for the award of Bachelor of Science (B.Sc) in Environmental Management and Toxicology. It was conducted under suitable conditions, was carefully supervised and subsequently approved as having met the requirements for the award of Bachelor of Science degree in Environmental Management and Toxicology.

……. ……

Dr. OSARENOTOR **Date**
Project Supervisor

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PROF. ALEX ENUNEKU **Date**
Head of Department

DECLARATION

I **"HANNAH EDIDIONG ETIMENSI"** declare that **"ASSESSMENT OF FECAL WASTE MANAGEMENT IN RURAL COMMUNITIES (EKOSODIN) IN BENIN CITY AND ITS IMPACT ON WATER SOURCES"** is my own work and that all sources that I have used or quoted have been acknowledged by means of complete references and that this work has not been submitted before for any other degree at any other University.

_____ _____

HANNAH EDIDIONG ETIMENSI
Date

DEDICATION

I dedicate this project to God Almighty for seeing me through the entire way and also to my parents for their moral and financial support and encouraging me when I needed it the most.

ACKNOWLEDGEMENT

I wish to express my profound gratitude to God Almighty, the giver of life, for giving me the knowledge, wisdom and understanding during this time.

I sincerely want to acknowledge my parents, Mr. Sunday Etimensi and Mrs. Promise Etimensi for their unwavering support, love and financial assistance throughout this journey and my siblings, Israel and Joel for their love and support during this period.

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ABSTRACT

This project investigates the assessment of fecal waste management in rural community of Ekosodin, located in Benin City, Nigeria and its implications on local water sources. The rapid population growth and inadequate waste management systems in rural areas have led to serious environmental challenges, especially concerning the management of fecal waste. This study explores the current waste management practices in the area, including open defecation, the use of pit latrines and the challenges faced by residents in waste disposal. Data collection for this assessment involves field surveys and interviews with local residents to understand the extent of the problem. Additionally, water samples from key local sources such as boreholes and reservoirs are tested for contamination levels, with a particular focus on fecal coliforms and physio-chemical parameters to evaluate the direct impact of fecal waste on water quality. The study also examines the relationship between poor waste management practices and the prevalence of waterborne diseases, such as cholera, dysentery and typhoid, which are common in rural communities with inadequate sanitation systems. The findings from this research highlight critical gaps in sanitation infrastructure and the urgent need for intervention. The research advocates for the development of policies that encourage the provision of affordable, hygienic sanitation facilities in rural communities to ensure both environmental sustainability and health of residents. In conclusion, the implication of inadequate fecal waste management in Ekosodin are far-reaching, affecting not only water quality but also overall public health and environmental integrity. Effective management of fecal waste is crucial for safeguarding water resources and preventing the spread of

waterborne diseases, ensuring a healthier and more sustainable future for rural communities like Ekosodin.

CHAPTER ONE

1.0 INTRODUCTION

1.1Background of Study

The management of fecal waste is an essential aspect of maintaining environmental health and preventing disease outbreaks. Fecal waste management is a cornerstone of public health and environmental sustainability. Inadequate management of human excreta contributes significantly to environmental degradation and the spread of waterborne diseases. Effective fecal waste management ensures that human excreta is safely collected, treated, and disposed of in a manner that protects water sources, air quality, and soil health. Globally, over 2 billion people lack access to safely managed sanitation facilities, with rural communities being disproportionately affected (UNICEF, 2022). However, in many rural communities, particularly in sub-Saharan Africa, challenges such as poor infrastructure, inadequate funding, and cultural practices hinder the implementation of effective waste management systems (WHO, 2021).

In Nigeria, rural communities face unique challenges in fecal waste management. Traditional methods such as open defecation and the use of unimproved latrines are widespread, leading to the contamination of water sources like rivers, wells, and streams. According to the World Health Organization (WHO, 2021), approximately 30% of Nigeria's rural population practices open defecation, a major contributor to water pollution and disease outbreaks. Contaminated water sources not only pose immediate health risks but can also affect agriculture, particularly in communities that

depend on irrigation. According to Nigerian Bureau of Statistics (NBS), water borne diseases such as cholera, dysentery and typhoid fever remain one of the leading causes of morbidity and mortality in rural Nigeria, particularly in areas where sanitation practices are inadequate (NBS, 2020). These practices are often a result of socio-economic factors, including poverty and a lack of access to improved sanitation facilities. The contamination of water sources due to improper waste disposal has led to increased incidences of waterborne diseases, with children being the most affected demographic (UNICEF, 2022).

Efforts to address these issues are critical, not only for improving health outcomes but also for achieving global goals such as the Sustainable Development Goal 6 (SDG 6), which seeks to ensure availability and sustainable management of water and sanitation for all. However, these efforts are often undermined by socio-cultural beliefs, limited governmental intervention, and poor enforcement of sanitation policies. This disparity highlights the need for localized strategies to address sanitation challenges and protect vital water resources.

1.2 Statement of Research Problem

Rural communities depend heavily on natural water sources for drinking, cooking, and other domestic activities. The contamination of water sources in rural communities due to improper fecal waste management has significant implications for public health and environmental sustainability. Despite efforts by government agencies and non-governmental organizations (NGOs), the problem persists due to

inadequate infrastructure, cultural barriers, and limited community participation in waste management initiatives. A study by the United Nations Development Program (UNDP) highlighted that over 20% of rural Nigerian households engage in open defecation, a practice that poses a serious threat to water quality (UNDP, 2019). Rivers, wells, and other water sources, which are crucial for daily activities such as drinking, cooking, and irrigation, are often contaminated with fecal matter, leading to the proliferation of waterborne diseases.

Research by Ahmed *et al.,* (2020) highlights the direct relationship between inadequate sanitation and the spread of diseases like cholera, dysentery, and typhoid in rural communities across Nigeria. These diseases place a heavy burden on the healthcare system and often result in preventable deaths, particularly among children under five. In Benin City, the situation is compounded by population growth, urbanization, and the failure of sanitation policies to effectively reach rural areas. Thus, there is a need to examine the fecal waste management practices in these communities and explore their implications on water sources.

Despite various initiatives aimed at improving sanitation, the lack of context-specific strategies has hindered significant progress in these communities. There is also limited research that specifically examines the link between fecal waste management practices and water source contamination in rural Benin City. This gap in knowledge underscores the need for a comprehensive study to assess current practices, identify challenges, and propose sustainable solutions.

1.3 Aim and Objectives of Study

The aim of this study is to assess the fecal waste management practices in rural communities of Benin City and investigate their implications on water sources, public health, and the environment.

Specific objectives of the study are:

1. To evaluate the types of fecal waste management methods employed by rural households in Benin City.

2. To assess the impact of these practices on the contamination of local water sources.

3. To identify the socio-cultural, economic, and environmental factors influencing waste disposal practices.

4. To investigate the relationship between poor waste management practices and the incidence of waterborne diseases in these communities.

5. To propose actionable recommendations for improving fecal waste management and water source protection.

1.4 Justification

Fecal waste management is a critical public health issue that directly impacts water quality, sanitation, and overall environmental sustainability. Proper fecal waste management is not only a health imperative but also an environmental and

socio-economic priority. Waterborne diseases caused by fecal contamination place a significant strain on healthcare systems and contribute to high mortality rates, especially among vulnerable populations. Contaminated water sources in rural communities have far-reaching impacts, including the proliferation of preventable diseases, increased healthcare costs, reduced agricultural productivity, and stunted economic development.

This research is crucial because it will provide data-driven insights into the specific challenges faced by rural communities in managing fecal waste and its impact on water sources. Rural communities often lack the resources and infrastructure needed to adopt modern sanitation systems. By identifying the factors that contribute to poor waste management practices, this study will inform the development of targeted interventions that are both culturally appropriate and financially feasible. Furthermore, the findings will contribute to the global efforts to achieve SDG 6 by addressing the sanitation gap in rural Nigeria and promoting the protection of water resources.

Improving fecal waste management in rural Benin City has the potential to reduce the prevalence of waterborne diseases, improve the quality of water resources, and enhance the overall well-being of the community. The results of this study will be valuable for policymakers, development agencies, and local authorities who are working to improve rural sanitation systems and protect water sources. By proposing sustainable and community-driven interventions, this study will contribute to improving health outcomes, reducing environmental degradation, and advancing the broader goals of sustainable development.

Addressing fecal waste management in rural communities is particularly timely, given the growing awareness of climate change and its impact on water resources. Poor waste management exacerbates water scarcity and pollution, undermining efforts to build climate-resilient communities. By tackling this issue, this research seeks to promote not only immediate health benefits but also long-term environmental sustainability and economic resilience.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Definitions and Overview of Subject Area with Reference to Previous Case Studies

Fecal waste management involves the collection, treatment, and disposal of human excreta in a manner that prevents harm to human health and the environment (WHO, 2021). Proper waste management is essential for reducing the transmission of waterborne diseases, conserving water resources, and promoting overall environmental sustainability. In rural communities, where sanitation infrastructure is often inadequate, open defecation and the use of unimproved latrines are common. These practices lead to the contamination of water sources, causing severe public health risks.

A study conducted by Nwankwo *et al.,* (2019) in southern Nigeria found that over 60% of rural households lacked access to improved sanitation, and many continued to engage in open defecation. The study also observed a strong link between open defecation and the contamination of local water sources with fecal pathogens. In Benin City, the rivers and wells used by rural communities for drinking and other domestic purposes are frequently polluted by fecal waste, leading to outbreaks of cholera, dysentery, and other gastrointestinal diseases.

Similarly, research by Ahmed *et al.,* (2020) examined the impact of poor waste management practices on public health in rural sub-Saharan Africa. The study revealed that improper disposal of fecal waste contributed to high rates of waterborne

diseases, especially in communities that relied on untreated surface water for consumption. The authors emphasized the need for sustainable sanitation systems and community-led initiatives to mitigate these risks.

In contrast, a case study by Kar *et al.,* (2019) in rural India demonstrated the effectiveness of the Community-Led Total Sanitation (CLTS) approach in promoting behavioral change and reducing open defecation. The CLTS model has been widely adopted in several developing countries, as it encourages communities to take ownership of their sanitation needs and promotes hygienic practices through collective action.

In a related study, Kanyike *et al.,* (2021) examined rural sanitation challenges in Uganda and emphasized the role of education and community engagement in reducing waste-related water contamination. These findings underscore the need for sustainable interventions tailored to the socio-economic realities of rural populations.

Climate change exacerbates the challenges of fecal waste management and water source contamination in rural communities. Changes in rainfall patterns, increased frequency of flooding, and rising temperatures can lead to the overflow of latrines and the spread of fecal waste into nearby water bodies. In a study on the effects of climate change in rural Nigeria, Nwachukwu and Ofoegbu (2020) found that flooding significantly increased the risk of water contamination during the rainy season, especially in areas with inadequate sanitation infrastructure. The impact of climate change on sanitation and water quality emphasizes the need for resilient waste

management systems that can withstand extreme weather events and prevent waterborne disease outbreaks (Ajayi *et al.,* 2018).

2.2 Open Defecation Practices and Their Environmental Impact

Open defecation is a widespread practice in rural communities where sanitation infrastructure is lacking or poorly maintained. According to UNICEF (2022), approximately 25% of rural populations in sub-Saharan Africa continue to practice open defecation. This behavior is prevalent in rural Benin City, where many residents still use riversides and open fields as defecation sites. The practice not only exposes individuals to harmful pathogens but also leads to the contamination of water sources that other community members rely on for drinking and other uses.

A study by Onah *et al.,* (2018) found that waterborne pathogens such as Escherichia coli and Salmonella spp. are commonly found in water sources that have been contaminated by open defecation. These pathogens are associated with a range of gastrointestinal diseases, including diarrhea and cholera. The contamination of water sources due to open defecation is particularly dangerous during the rainy season when runoff exacerbates the spread of contaminants. The study recommended the adoption of affordable, community-based sanitation systems to mitigate this issue. Furthermore, the environmental impact of open defecation extends to soil degradation and reduced agricultural productivity, as untreated fecal matter alters soil pH and microbial balance.

The environmental impact of open defecation extends beyond water contamination. The improper disposal of human waste also contributes to soil degradation and the spread of pathogens, which can negatively affect agriculture and local ecosystems. A study by Kanyike *et al.,* (2021) in Uganda found that open defecation led to reduced agricultural yields, as contaminated water used for irrigation affected crop health and soil fertility.

2.3 Challenges in Implementing Sustainable Waste Management Systems

Implementing effective fecal waste management systems in rural communities faces numerous challenges. One of the primary barriers is financial: the cost of constructing and maintaining improved latrines and waste treatment facilities is often prohibitive for low-income households (UNICEF, 2022). Financial constraints often limit the construction of improved sanitation facilities, while a lack of awareness hinders community participation in waste management initiatives (Ahmed *et al.,* 2020). Additionally, poor road infrastructure, limited access to markets for sanitation products, and a lack of skilled labor further complicate waste management efforts in rural areas.

Cultural resistance to modern sanitation practices also plays a significant role in the persistence of open defecation and the underutilization of improved latrines. In many rural communities, there is a deep-rooted belief that open defecation is a natural and culturally acceptable practice. According to a study by Banda *et al.,* (2020), some rural communities in sub-Saharan Africa view communal latrines and sanitation

facilities as unhygienic, preferring instead to use the open spaces they have traditionally used. Overcoming these cultural barriers requires targeted community engagement and education to demonstrate the benefits of improved sanitation systems.

A case study conducted by Okonkwo *et al.,* (2021) in rural Nigeria highlighted the technical and logistical difficulties of waste collection in areas with poor road networks. Additionally, cultural resistance to modern sanitation practices poses a significant barrier. In Benin City, traditional beliefs often discourage the use of communal latrines, further complicating waste management efforts (UNICEF, 2022).

Additionally, governmental policies often fail to address the specific needs of rural populations. A report by the Federal Ministry of Water Resources (2020) noted that Nigeria's National Water, Sanitation, and Hygiene (WASH) policy focuses primarily on urban areas, leaving rural communities without sufficient resources and support.

2.4 Case Studies of Successful Waste Management Interventions

While the challenges are significant, there have been several successful case studies of fecal waste management interventions in rural areas. One such case is the introduction of affordable, eco-friendly pit latrines in Malawi. A study by Banda *et al.,* (2020) found that these latrines, which were built using locally sourced materials, significantly reduced open defecation rates and improved water quality in the affected communities.

Another successful model is the Community-Led Total Sanitation (CLTS) approach, which has been widely implemented across several countries, including India, Uganda, and Indonesia. A study by Kar *et al.,* (2019) found that CLTS initiatives led to a significant reduction in open defecation, as communities took collective responsibility for building and maintaining their own sanitation facilities. This approach has proven effective in rural settings where top-down interventions may struggle due to cultural resistance and resource constraints.

2.5 The Role of Policy and Governance

Effective governance is essential for addressing the fecal waste management challenges in rural communities. In Benin City, inadequate implementation of sanitation policies has resulted in the persistence of open defecation and poor waste management. The Nigerian government's National Water, Sanitation, and Hygiene (WASH) policy, launched in 2020, aims to eliminate open defecation by 2030 (Federal Ministry of Water Resources, 2020), but the policy faces implementation challenges, particularly in rural areas.

A report by WHO (2021) highlighted the importance of integrating sanitation programs with health and education initiatives. By promoting awareness about the links between sanitation and health, these programs can empower communities to take ownership of their sanitation needs and adopt safer waste disposal practices. Effective

governance, coupled with robust monitoring and evaluation systems, is essential for the long-term success of waste management interventions.

CHAPTER THREE

3.0 METHODOLOGY

3.1 MATERIALS AND METHODS

Study Area

Ekosodin community is situated east of Isihor in Ovia North-East Local Government Area (LGA) of Edo State (see Figure 1). Ovia North-East LGA has its headquarters in Okada town; it has an area of 2,301 square kilometers. It is located along the longitude 5° 45¹ and 6° 15¹ east and latitude 5° 15¹ and 6° 45¹ north of the central province of Edo state. The main river, Ovia River flows through all the communities in the LGA. Ovia North East is situated in Benin City and Benin City is located within the rainforest zone of Nigeria with mean annual rainfall of between 1500mm to 2500mm and the mean monthly temperature varying from 25°C to 28°C. The Benin Region is underlain by sedimentary formation of the South Sedimentary Basin and it constitute part of the Benin formation which is made up of over 90% massive, porous, coarse sand with thick clay/shale interbeds having high groundwater retention capacity. The geology is generally marked by top reddish earth, composed of ferruginized or literalized clay sand. Benin City has two distinct seasons. These are the wet (rainy) season and the dry season. The rainy season occurs between the months of March and October with a short break in August. The dry season on the other hand lasts from November to February with dry harmattan winds between December and February, but with the effect of global warming and climate change, rains have been observed to fall irregularly almost in every month of the year with double peak periods in July and September. Ekosodin community has an estimated

population of 7000 as estimated by 2006 census by National Population Commission. This population was projected by 543.2% using geometric method to year 2022 to be 45,000 people.

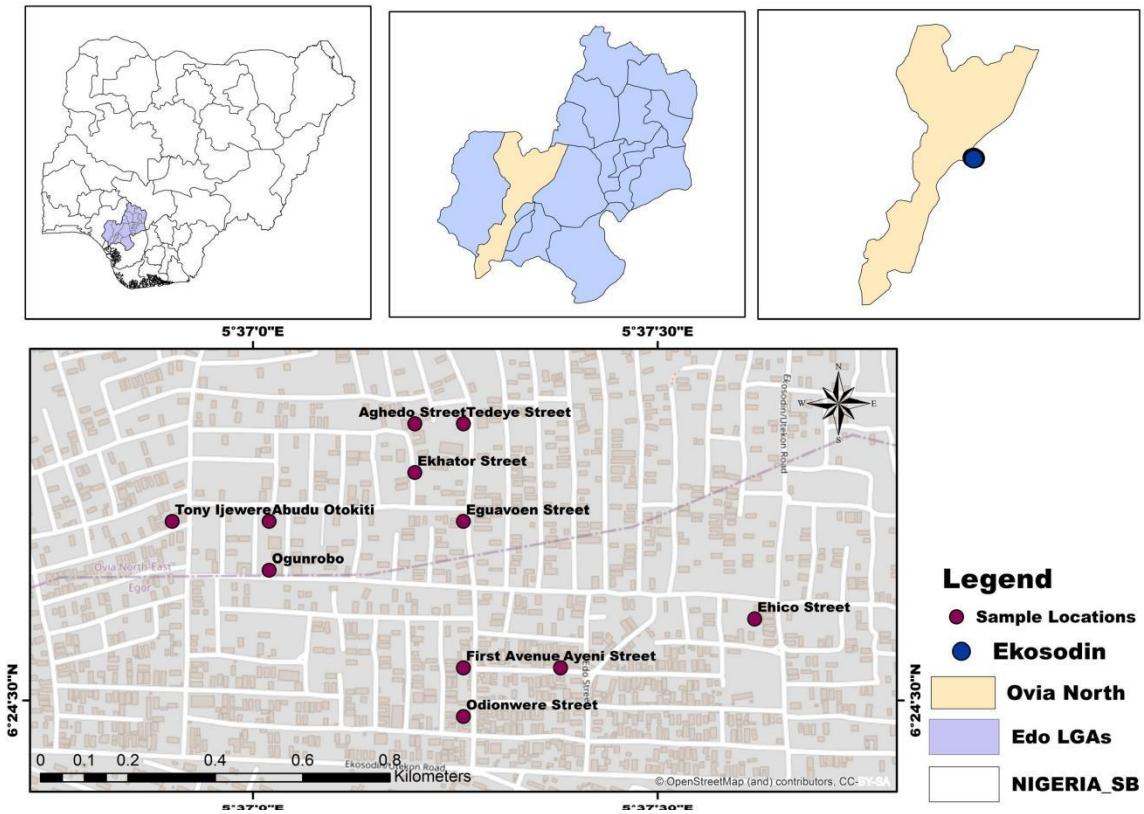

Figure 3.1: Map showing studied area

3.2 Data Collection and Analysis

The Data used for this study were collected via questionnaires using a cross sectional descriptive survey method and an observational checklist. A multi-stage sampling technique was used to constructively administer a total of 77 technically designed, pre-tested, semi structured questionnaires to households in Ekosodin community.

CHAPTER FOUR

4.0 RESULTS

4.1 Socio-Demographics of Participants

The age distribution of participants shows that the largest group of individuals falls within the 18-25 years (59.74%) range, followed by those aged 26-35 years (23.38%) and 46-55 years (11.68%). The age group with least representation is 56 and above years, comprising only 5.20%. This shows that the majority of respondents are middle-aged or younger (Table 4.1).

Gender distribution shows that females constitute 57.14% of the participants, while males make up 42.86%. The study showed that 71.43% of the respondents have tertiary education, 18.18% completed secondary school, 10.39% attained primary education and none having no formal education according to the survey.

Knowledge about guidelines for siting toilet facilities is moderate as 51.95% of participants understand proper siting practices while 48.05% lack awareness.

Table 4.1: Socio-demographic of participants

PARAMETER	OPINIONS	FREQUENCY OF PARTICIPANTS (n=77)	PERCENTAGE OF PARTICIPANTS (%)
Age Range	18-25	46	59.74
	26-35	18	23.38
	46-55	9	11.68
	56-Above	4	5.20
Gender	Male	33	42.86
	Female	44	57.14
Level of Education	No Formal Education	0	0
	Primary	8	10.39
	Secondary	14	18.18
	Tertiary	55	71.43
Compliance with sanitary guidelines	Yes	51	66.23
	No	26	33.77
Knowledge about guidelines for siting toilet facilities	Yes	40	51.95
	No	37	48.05

4.2 Participants' responses to National Environmental Standards and Regulations Enforcement Agency (NESERA) Regulations Checklist

The number of toilets in households ranges from a total of 1-50 toilets because the area is densely packed with students from the residing University. In the Table 4.2, houses with ranges 0-10 (70.13%) toilets, 11-20 (6.49%) toilets, 21-30 (15.58%) toilets and 41-50 (6.49%) toilets respectively.

The toilet types indicates that 94.81% use flush to septic tank toilet facilities while only 3.9% use flush to pit latrine toilet facilities. Only one participant reports having on toilet.

All participants meet with the NESERA Regulations Checklist Standard. The distance of septic tanks from water sources is one of the major concerns. 85.71% of participants have their septic tanks sited below the recommended 15 meters, increasing the tendency of groundwater contamination (Blake and Gruber, 2018). Only 14.29% of participants adhere to the proper siting distance.

The distance between the septic tanks and the foundation walls is another major concern. 87.01% sited their septic tanks not up to the required 2 meters, bringing about structural instability (Journal of Geotechnical and Environmental Engineering, 2014).

The distance between septic tank and boundary walls is also another issue. 93.51% of respondents had their boundary placed below the recommended 4 meters while only 6.49% met with the standard.

Accessibility for sludge removal seen by 41.56% of the respondents while 58.44% will experience difficulties in accessing their septic tanks for removal.

Overall compliance with NESERA Regulatory guideline for siting sanitation facility is low with only 44.16% of respondents having high compliance, 31.17% showing

medium compliance and 24.68% resorting low compliance. These results show that regulatory enforcement and awareness needs to be strengthened.

Table 4.2: Participants responses to NESERA Regulations Checklist

PARAMETER	OPINIONS	FREQUENCY OF PARTICIPANTS (n=77)	PERCENTAGE OF PARTICIPANTS (%)	NESERA Regulations Checklist Standard
Number of Toilets	0-10	54	70.13	
	11-20	5	6.49	
	21-30	12	15.58	
	31-40	1	1.30	
	41-50	5	6.49	
Toilet type	Flush to septic tank	73	94.81	
	Flush to pit latrine	3	3.9	
	None	1	1.3	
Number of toilets per person	1-10: 1Toilet	77	100	
	11-20: 1 Toilet	0	0	
Septic tank-water source	Below the recommended value	66	85.71	15m
	Above the recommended value	11	14.29	15m
Septic tank-Foundation wall	Below the recommended value	67	87.01	2m
	Above the recommended value	10	12.99	2m
Septic tank-Boundary wall	Below the recommended value	72	93.51	4m
	Above the recommended value	5	6.49	4m
Accessibility to septic tank for sludge removal	Yes	32	41.56	

	No	45	58.44
Compliance	Low	19	24.68
	Medium	24	31.17
	High	34	44.16

4.3. Participants Responses to World Health Organization (WHO) Checklist

The removal of sludge was highly difficult for 55.84% of houses, 18.18% showed medium difficulty while 25.97% reported low difficulty.

Groundwater contamination tendency is perceived as high by 67.53% of respondents, 22.08% have medium level and low by 10.39%.

Water supply insufficiency is reported to be high (84.42%) by all respondents, 15.58% report medium water supply while 0% experience water supply sufficiency due to inefficient power supply to the area and most residents have to stress just to have access to efficient water supply.

Flood frequency and severity showed that 100% respondents experience severe flooding, 0% medium flooding and 0%experience low flooding.

Soil impermeability reports that 100% of respondents have low soil impermeability, 0% medium and 0% high.

Availability of sufficient land area for sanitation infrastructure was low with 70.13%, 14.29% medium and 15.58% available.

The type of toilet facility showed that 93.51% use flush to septic tank, 3.9% use flush to pit latrine and 2.6% have no toilet facility.

The condition of toilet superstructures is intact for 93.51% of houses, 3.9% of houses had damages and 2.6 % of the houses have no toilet facility.

Toilet privacy is available for 96.1% of the respondents and 3.9% do not have toilet privacy.

Toilet security is adequate for 93.51% of respondents, while 6.49% report security concerns, showing a need for better toilet infrastructure.

Handwashing facilities are present in 83.12% of households, while 16.88% lack the facilities, which may contribute to poor hygiene practices.

Flies and insect infestations are shown by 3.9% of households, indicating that most homes have proper fecal waste disposal.

Cracks, leakages, or deformation of septic tanks are reported in 12.99% of cases, while 87.01% report no structural defects.

Table 4. 3: Participants responses to WHO Guidelines Checklist

PARAMETER	OPINIONS	FREQUENCY OF PARTICIPANTS (n=77)	PERCENTAGE OF PARTICIPANTS (%)
Difficulty of sludge removal	Low	20	25.97
	Medium	14	18.18
	High	43	55.84
Potential of groundwater contamination	Low	8	10.39
	Medium	17	22.08
	High	52	67.53
Degree of insufficient water supply	Low	0	0
	Medium	12	15.58
	High	65	84.42
Degree of frequent and severe floods	Low	0	0
	Medium	0	0
	High	77	100
Soil impermeability	Low	77	100
	Medium	0	0
	High	0	0
Lack of sufficient land area	Low	12	15.58
	Medium	11	14.29
	High	54	70.13
Type of sanitation facility	Flush to septic tank	72	93.51
	Flush to pit latrine	3	3.90
	No facility	2	2.60
Condition of toilet superstructure	Absent or missing	2	2.60
	Damaged	3	3.90
	Incomplete	0	0
	No problems observed	72	93.51
Toilet privacy	Yes	74	96.10
	No	3	3.90
Toilet security	Yes	72	93.51

	No	5	6.49
Handwashing facility	Yes	64	83.12
	No	13	16.88
Flies and insects	Yes	3	3.90
	No	74	96.10
Cracks/Leakage/Deformation of septic tank	Yes	10	12.99
	No	67	87.01

4.4. Physiochemical Parameters Taken Selected Households

The pH of the sampled water ranges from 4.3 to 6.75, which is below the WHO standard of 6.5 to 8.5, indicating that the water is acidic.

Electrical conductivity values range from 20 to 222 µS/cm, which is slightly within the acceptable range of 30 to 2000 µS/cm, suggesting low salinity.

Total dissolved solids (TDS) levels range from 10 to 111 mg/L, which is below the standard range of 50 to 150 mg/L, indicating low mineral content.

Water temperature ranges from 28.87°C to 30.23°C, which is relatively high and may promote microbial growth.

Table 4. 4: Physiochemical Parameters Taken at selected Houses

STREETS	DISTANCES(m)	pH	Electrical Conductivity	Total Dissolved Solids	Temperature
Tedeye	15.7	6.75	188	93	29.03
	2.34	5.78	145	73	29.37
Eguavoen	19.8	4.55	20	10	29.97
	3.5	4.88	25	12	29.57
Ekhator	23.03	4.30	38	19	28.87
	6.74	4.35	222	111	30.23
Tony Ijewere	21.02	5.87	65	32	29.20
	5.48	4.85	23	10	29.53

CHAPTER FIVE

5.0. DISCUSSION, RECOMMEDATION AND CONCLUSION

5.1. DISCUSSION

The findings of this study highlight significant issues related to fecal waste management, adherence to sanitation standards, and the quality of borehole water in Ekosodin. The data indicate widespread failure to comply with NESREA and WHO guidelines, inadequate hygiene practices, and contamination risks that may result in negative health outcomes. The discussion explores each parameter evaluated in the study, connecting the data to potential environmental and public health impacts, and suggesting required interventions.

5.1.1 Socio-Demographic Factors and Their Influence on Sanitation Practices

The age distribution of participants indicates that the majority fall within the 18-25 years range (59.74%), followed by 26-35 years (23.38%), 46-35 years (11.68%) and the least category being 56 and above years (5.20%). This indicates that the working-age population should possess a stronger understanding and adherence to sanitation regulations. However, the low levels of compliance demonstrate that awareness and actual practice are not always in sync.

Gender distribution shows that 57.14% of respondents are female, while 42.86% are male. However, research indicates that while women are often responsible for sanitation tasks within households, men typically hold decision-making power

regarding sanitation infrastructure and policies. This imbalance can lead to sanitation solutions that do not fully address the needs and preferences of women (GOR, 2018).

Educational levels indicate that 71.43% of participants have tertiary education, 18.18% have completed secondary education, 10.39% have only primary education, and 0% have no formal education. Despite the high percentage of respondents with tertiary education, sanitation compliance remains low. This suggests that formal education alone does not guarantee adherence to sanitation regulations, and there may be other barriers, such as economic constraints, lack of enforcement, or deeply rooted cultural habits influencing waste management practices (Ashraf *et al.,* 2023).

Compliance with sanitary guidelines is moderate, with 66.23% of participants adhering to proper sanitation regulations, while only 33.77% report non- compliance. Knowledge about the guidelines for siting toilet facilities is also limited, as 48.05% of respondents lack awareness, while only 51.95% understand proper siting practices. The findings indicated that inadequate knowledge about sanitation guidelines led to improper siting and maintenance of sanitation facilities, resulting in contamination and health hazards (Chandran and Suresh, 2016; Zhang et al., 2023).

5.1.2 NESREA Regulations Compliance and Environmental Risks

NESREA regulations set sanitation standards aimed at preventing groundwater contamination, encouraging proper waste disposal, and ensuring the structural integrity of buildings. The study reveals significant non-compliance with these regulations in Ekosodin, especially in areas such as septic tank placement, sludge removal, and the siting of toilet facilities.

The placement of septic tanks in relation to water sources is a major issue. A total of 85.71% of respondents have their septic tanks positioned below the recommended 15 meters, significantly increasing the risk of groundwater contamination. Septic tank effluent can contain bacteria, viruses, and other pathogens that pose risks to public health. When septic systems are too close to water sources, these pathogens can contaminate drinking water supplies, leading to waterborne diseases (USGS, 2016).

Another issue is the proximity of septic tanks to building foundations. A total of 87.01% of septic tanks are less than the required 2 meters from buildings. It explains that improper installation or positioning too close to a foundation can lead to structural damage due to shifting soil or water intrusion.

Boundary wall distances are also not maintained. A total of 93.51% of respondents have septic tanks positioned less than 4 meters from their boundary walls, which increases the risk of seepage into neighboring properties.

Septic tank accessibility for sludge removal is another challenge, with 58.44% of respondents experiencing difficulties in desludging. This can affect the environment and cause overflow. This situation has led to environmental justice issues, with untreated wastewater affecting the local environment and public health (Duke University Nicholas School of the Environment, 2023).

Overall compliance with NESREA regulations is low to moderate, with only 44.16% of respondents demonstrating high compliance, 31.17% showing medium compliance, and 24.68% having low compliance. The low compliance levels indicate the need for stronger enforcement of environmental sanitation laws and better awareness programs to encourage proper waste management practices.

5.1.3 WHO Guidelines Compliance and Hygiene Conditions

The World Health Organization (WHO) sets global standards for sanitation infrastructure, hygiene, and water safety to help minimize the spread of infectious diseases (WHO, 2024). The data reveals both positive aspects and areas of concern in sanitation management in Ekosodin, with some households adhering to basic standards, while others still face inadequate hygiene conditions.

Sludge removal difficulty remains a challenge, with 55.84% of respondents reporting high difficulty, 18.18% indicating medium difficulty, and 25.95% experiencing low difficulty. This confirms that many septic tanks are poorly designed, making waste evacuation difficult.

Groundwater contamination potential is perceived as low by 67.53% of respondents, medium by 22.08%, and high by 10.39%.

Toilet infrastructure conditions are varied. While 93.51% of households have flush toilets connected to septic tanks, 2.6% still lack any sanitation facility. This indicates that open defecation may still be practiced in some areas. Additionally, 3.9% of toilets have damaged superstructures, exposing users to unsanitary conditions and increasing the spread of infections.

Handwashing facilities, which are essential for preventing disease transmission, are absent in 16.88% of households. The presence of flies and insects is reported in 3.9% of sanitation areas, suggesting poor waste management, open defecation practices, or leaking septic tanks. Septic tank structural integrity is also a concern, with 12.99% of

respondents reporting cracks, leakages, or deformations, further increasing the risk of waste seepage into groundwater sources.

5.1.4. Physiochemical Properties of Borehole Water

The pH values of borehole water range from 4.3 to 6.75, far below the WHO standard of 6.5 to 8.5. This makes the water acidic, which can corrode pipes and leach toxic metals such as lead and copper into the water supply.

Electrical conductivity levels range from 20 to 222 µS/cm, staying within the WHO safety range of 30 to 2000 µS/cm, indicating low dissolved ion concentration.

Total dissolved solids (TDS) levels are between 10 and 111 mg/L, which is below the WHO range of 50 to 150 mg/L, suggesting minimal mineral content. While this does not pose a direct health risk, it may affect the water's nutritional quality.

Water temperatures between 29.3°C and 31.2°C exceed WHO's recommended safe limits 10°C to 22°C.

5.2. Recommendations for Improved Fecal Waste Management and Water Safety in Ekosodin community

The findings indicate that a number of interventions are required.

1. Strengthening Sanitation Infrastructure: Ensure that existing septic tanks, latrines, and sewage systems are properly maintained and regularly emptied. Invest in upgrading old, poorly functioning systems to modern, more efficient waste treatment technologies.

2. Improving Accessibility and Maintenance of Sanitation Systems: Design septic systems and waste disposal facilities that are easily accessible for regular maintenance and emptying. This reduces the chances of system failure and contamination of nearby environments.

3. Water Quality Monitoring and Protection: Implement regular testing of local water sources for microbial contamination, particularly for fecal coliforms and other pathogens that can cause waterborne diseases.

4. Community Education and Awareness: Launch targeted education campaigns to raise awareness about proper sanitation practices, the importance of handwashing, and safe water use. These campaigns can focus on the benefits of using toilets, avoiding open defecation, and keeping water sources clean.

5. Policy Implementation and Governance: Strengthen the enforcement of sanitation regulations, such as those set by the National Environmental Standards and Regulations Enforcement Agency (NESREA) and the World Health Organization (WHO), to ensure that sanitation standards are met.

6. Monitoring and Evaluation: Set up systems to track the progress of sanitation and water safety initiatives. Regular monitoring and evaluation will help identify gaps in service delivery, assess the impact of interventions, and adjust policies or practices as needed.

5.3. Conclusion

The study identifies major issues in fecal waste management in Ekosodin, such as non-compliance with NESREA and WHO sanitation standards, incorrect placement of septic tanks, and insufficient sludge removal. Analysis of borehole water quality shows potential contamination, with ammonia indicating waste infiltration. The water's acidic pH further threatens safety, and elevated temperatures heighten microbial risks. Although a large portion of respondents have tertiary education, awareness and adherence to sanitation practices remain poor. To reduce environmental contamination and safeguard public health, it's essential to strengthen regulatory enforcement, enhance sanitation infrastructure, and promote hygiene education.

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