FACTORS AFFECTING LONG-TERM ADOPTION OF IMPROVED SANITATION THROUGH COMMUNITY LED TOTAL SANITATION IN MAGARINI SUB-COUNTY, KILIFI COUNTY

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other institution.

EG407/201527/21

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DECLARATION BY SUPERVISORS

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DEDICATION

I dedicate this thesis to my parents, Mr. and Mrs. Simiyu, who always cherished me wholeheartedly and set a positive example by working hard to attain my goals. Thank you for everything; it is impossible to quantify. God bless you.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ABBREVIATIONS AND ACRONYMS

ASCL	Adequate Space to Construct Latrines
CDC	Centre for Disease Control
CHWs	Community Health Workers
CLTS	Community Led Total Sanitation
CPHOs	Chief of Public Health
CIDA	Canadian International Development Agency
FRAI.CLTS	Financial resources available for Implementing CLTS practices
GLAAS	Global Analysis and Assessment of Sanitation and Drinking Water
GSF	Global Sanitation Fund
IDS	Institute of Development Studies
ILO	International Labor Organization
JMP	Joint Monitoring Programme
JSR	Joint Sector Review
JWSR	Joint Water Sector Review
KDHS	Kenya Demographics Health Survey
KESHP	Kenya Environmental Sanitation and Hygiene Policy
MDGs	Millennium Development Goals xi
MoH	Ministry of Health
NII.CLTS	Necessary Infrastructure to Implement CLTS practices
NGOs	Non- Governmental Organizations
NL	Natural leaders
ODF	Open Defecation Free
OHCR	Human Rights Office of the High Commissioner
PHOs	Public Health Officers

SDGs	Sustainable Development Goals
TSC	Total Sanitation Campaign
UN	United Nations
UNDP	United Nations Development program
UNICEF	United Nations Children's Fund
VHC	Volunteer Health Committees
WASH	Water Sanitation & Hygiene

OPERATIONAL DEFINITIONS OF TERMS

Certification	Official confirmation and recognition of Open Defecation Free (ODF) status.
CLTS	A comprehensive strategy for attaining and maintaining open defecation-free (ODF) status involves guiding the community through an analysis of their sanitation practices, defecation habits, and the associated impacts. This process encourages collective action to achieve ODF.
Latrine	A direct pit and a pit latrine generally include a water seal arrangement. In this thesis, the term "latrine" is occasionally used to refer to both.
Pit-latrine	A pit latrine is utilized in areas where a water seal is more prevalent than a direct pit.
Natural Leaders	They are activists and enthusiasts who emerge and take the lead during CLTS processes.
Open Defecation	Defecating outdoors and leaving the waste uncovered
Open Defecation Free	When feces are not openly exposed to the air
Recommended CLTS	This outcome variable will characterize the successful achievement of a village certified as Open Defecation Free (ODF).

ABSTRACT

The disease burden related to fecal-oral infections in Magarini Sub County is a significant public health concern. The study sought to identify and analyze the primary drivers influencing sustained adherence to Community-Led Total Sanitation (CLTS)-driven sanitation improvements within the community. Open defecation refers to the practice of defecating in open spaces such as fields, forests, bushes, or bodies of water. Globally, approximately 1 billion people engaged in open defecation, with sub-Saharan Africa, where about 215 million individuals practiced open defecation, experiencing particularly high rates. In Kenya, an estimated 5.6 million people were reported to practice open defecation. Despite the introduction of the Community-Led Total Sanitation strategy by the Ministry of Health in Magarini Sub-County, the goal of achieving improved sanitation and hygiene had not been realized due to inadequate implementation. This study aimed to identify the factors contributing to the sustained adoption of community-driven sanitation enhancements through CLTS in Magarini Sub-County, Kilifi County. The specific objectives included determining the demographic characteristics of study respondents in Magarini Sub-County, identifying socio-economic factors influencing long-term adoption of improved sanitation through CLTS, and assessing existing sanitation infrastructure crucial for successful CLTS implementation in the area. The study sampled 388 households and utilized a cross-sectional study design, which provides a snapshot of a population's characteristics and behaviors at a specific point in time, to gather data about the target population. A proportional sample technique was used, which involved picking a reasonable number of households from each of the six administrative wards based on their individual sizes. To ensure a representative sample of households, 388 were randomly selected from household registers across the villages using a simple random sampling method. This approach guaranteed that every household in the population had an equal chance of being included in the sample, thereby minimizing bias and enhancing the generalizability of the findings. The questionnaire was the major tool for data collection, with participants educated on its significance and contents. The researcher used simple random sampling to collect household-level data from all wards in the Sub County. The collection of this data used both qualitative and quantitative methodologies, utilizing their strengths to arrive at a complete comprehension of the issue. Quantitative data underwent cleaning, coding, and analysis using SPSS version 24.0, R, and Microsoft Excel for graphical representation. Findings highlighted on the critical roles of community cohesion, local leadership, cultural practices, and resource availability in CLTS approaches. Personal savings constituted 33.5% of funding sources, indicating strong commitment but posing sustainability challenges for lower-income groups. Agricultural products and livestock contributed 19.9%, subject to weather and market fluctuations. Diverse and sustainable funding strategies are essential for the long-term success of CLTS initiatives in the Sub County. Furthermore, respondents' locations and religious affiliations significantly correlated with CLTS participation, whereas socio-economic factors did not exhibit a significant relationship with availability for CLTS.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Open defecation remains widespread in sub-Saharan Africa, where approximately 250 million individuals, according to Graham (2020), practice this behavior. From 2010 to 2015, only Angola, Ethiopia, and Sao Tome and Principe experienced a more than 10% drop in open defecation, with Angola making significant progress toward eradication by 2015. In Kenya, an estimated 5.7 million people practice open defecation (Water and Sanitation Program, 2014), contaminating water and food with feces and causing diarrhea and other fecal-oral infections.

Each year, approximately 17,100 children under the age of five in Kenya die from diarrheal diseases, with about 90% of these deaths attributed to inadequate water, sanitation, and hygiene (Tsimpo *et al*., 2019). Additionally, open defecation is directly linked to helminth soil infections (Spears *et al*., 2013), leading to environmental enteropathy, which hinders nutrient absorption and causes stunted growth in children (Wasonga *et al*., 2021).

Improved sanitation measures can reduce diarrhea cases by 32% to 37% (Waddington, 2014). In response to open defecation, the Kenyan government initiated the Open Defecation Free (ODF) campaign in rural areas in late 2013 (MOH, 2011). However, by 2014, only 15% of rural villages had implemented Community-Led Total Sanitation (CLTS), and just 7% had achieved ODF status (MOH, 2014). Notably, Busia, Kisumu, and Siaya Counties had the highest percentages of villages achieving ODF status, at 33%, 30%, and 29% respectively (MoH, 2014). In contrast, Magadi Ward in Kajiado County had not achieved ODF status by that time, despite similar interventions elsewhere.

The Kenyan government has incurred significant costs due to poor sanitation, estimated at about US$ 324 million, with open defecation alone costing approximately US$ 88

million annually (Odongo *et al*., 2017). Of this, US$ 244 million is attributed to premature deaths from diseases related to poor sanitation and diarrhea. Healthcare and hospitalization costs amount to around US$ 51 million, and about US$ 26 million is lost in productivity as people spend time finding suitable defecation sites (Jenkinsa *et al*., 2014).

Open defecation also brings social costs, such as the loss of privacy and dignity, especially affecting women, girls, and people with disabilities. Females are at increased risk when seeking secluded defecation spots, often accompanying their children, particularly at night. Poverty exacerbates open defecation, with the poorest being 270 times more likely to practice it compared to wealthier individuals in Kenya (Amoah *et al*., 2018).

The significant public health issue of fecal-oral infections in Kenya arises from consuming contaminated water or food, containing pathogens like bacteria, viruses, and parasites. This is mainly due to inadequate sanitation facilities, poor hygiene, and limited access to clean water. Diarrheal diseases are particularly widespread among these infections and severely affect children, causing dehydration, malnutrition, and potentially death if not promptly treated. These diseases can also hinder children's growth and cognitive development, leading to sustained health problems and reduced economic productivity. An important intervention aimed at curbing open defecation is Community-Led Total Sanitation (CLTS), pioneered by Kamal Kar in Bangladesh in 2000. This grassroots initiative promotes collective action to eradicate open defecation and emphasizes health as a communal benefit. Unlike government subsidies for toilet facilities, CLTS has demonstrated effectiveness across diverse cultural settings, encouraging latrine construction in countries such as Mali and Tanzania (Mehta, 2017; Kar *et al*., 2020). However, in Kenya, the outcomes have been less promising. Pendley *et*

al. (2013) noted that 24% of communities did not adopt latrine construction post-CLTS, while Godfrey *et al*. (2014) reported a 29% regression from open defecation-free status. While many build latrines after CLTS participation, a significant proportion still does not. Identifying the conditions and motivations for latrine construction could enhance CLTS's effectiveness. The RANAS (Risks, Attitudes, Norms, Abilities, and Self-regulation) model of behavior change, as outlined by Morris *et al*. (2020), can be used to understand these decisions. This model examines psychosocial factors, with the risk factors block focusing on individuals' awareness of health risks posed by open defecation.

In many regions of South Asia, Africa, and Latin America, poor sanitation practices, such as inadequate toilet use, unsafe water consumption, and improper waste disposal, contribute to the spread of diseases and environmental damage, significantly affecting vulnerable populations in these areas. Furthermore, Southeast Asia is confronted with a pervasive sanitation crisis. In areas of Bangladesh, both urban and rural, unsanitary defecation practices persist due to inadequate awareness of hygiene. These practices contaminate drinking water sources and the environment, impacting water bodies and agricultural land. Research indicates that such behaviors contribute to the spread of diseases like diarrhea, typhoid, and cholera epidemics (Village Educational Resource Centre VERC, 2017).

Various international development organizations, such as UNICEF, UNDP, and the World Bank, have invested significantly in sanitation initiatives across Asia, Africa, and Latin America. National and international NGOs, along with donor agencies, collaborate on addressing water and sanitation challenges. Despite these efforts, many projects primarily focus on promoting latrine construction with different subsidies. In Bangladesh, despite years of intervention, open defecation remains widespread, and the adoption and use of latrines, even with subsidies and incentives, remain low (Well, 2018).

In 2018, latrine coverage in Bangladesh was below 15%, despite international agencies and NGOs' involvement in sanitation projects (BBS, 2021; Kar *et al*., 2019). The shortfall prompted the creation of the Community-Led Total Sanitation (CLTS) approach, a joint effort by Kamal Kar, Village Education Resource Centre (VERC), Water Aid in Bangladesh, and others (Bajrachanja *et al*., 2020).

Community led total sanitation is designed to empower communities to assess environmental contamination from improper waste disposal and poor hygiene. Consequently, communities were motivated to change their hygiene practices, build, and use latrines independently (Bajrachanja *et al*., 2020).

This initiative led to significant results, with household latrine access rising from 15% to nearly 80% (Bangladesh Bureau of Statistics, 2015). Furthermore, CLTS shifted focus from merely counting latrines to changing behaviors, tackling issues like ending open defecation, safe solid waste disposal, and proper water usage. CLTS has led to tangible improvements, increasing latrine coverage and usage in rural communities, significantly contributing to disease control and reduction (Venkataramanan *et al*., 2018).

This progress has resulted in many villages being designated as "ODF villages," indicating Open Defecation Free status. It is crucial to highlight that alongside expanding sanitation efforts through CLTS, maintaining hygiene through proper hand washing and ensuring safe water availability remains essential. Community-Led Total Sanitation (CLTS) represents a significant shift from conventional top-down sanitation approaches, offering hope for achieving the Millennium Development Goals (Kar and Chambers, 2018). This relatively new approach, pioneered by Kamal Kar in Bangladesh in 2019, has since expanded to other countries in Asia and Africa (Kar and Bongartz, 2016; Kar and Pasteur, 2016).

Unlike state-led initiatives that focus on hardware and subsidies, CLTS emphasizes community action and behavior change as key elements to better sanitation. CLTS enables local communities to analyze the problems of fecal-oral disease transmission and find locally appropriate solutions rather than relying on externally prescribed solutions. The goal is the complete elimination of open defecation, based on the assumption that if even a few individuals continue the practice, community health improvements will be compromised. This method empowers communities to identify and address their sanitation issues, leading to more sustainable and effective outcomes in public health (Kar and Chambers, 2018; Kar and Bongartz, 2016; Kar and Pasteur, 2016).

Defecating openly poses a significant community-wide risk (Bongartz & Movik, 2019; Geist, 2018; Kar & Chambers, 2018; Kar & Bongartz, 2016; Kar & Pasteur, 2015). The absence of improved sanitation facilities, such as enhanced pit latrines, coupled with unhygienic practices like open defecation (OD), are major contributors to these health risks (Pruss-Ustun *et al*., 2018). By 2016, an estimated 1 billion people still practiced OD (WHO & UNICEF, 2014). United Nations Millennium Development Goals (MDGs), particularly Target 7C, aimed to halve the proportion of people without access to safe water and improved sanitation by 2015 (UN, 2016). While significant strides have been made in providing access to drinking water, the sanitation target is projected to miss by more than half a billion people if current trends persist (WHO and UNICEF, 2014). Since the introduction of community-led total sanitation (CLTS) in Bangladesh in the late 1990s, this approach has gained broad acceptance and adoption. Studies indicate that CLTS effectively empowers communities to achieve open defecation-free (ODF) status (Chambers, 2019; Harvey & Mukosha, 2019).

Despite Kenya's commitment to the Millennium Development Goals on water and sanitation, the targets remain unmet. Kenya aimed to reduce by 63% the proportion of

people lacking improved sanitation by 2015 and ultimately achieve universal coverage as outlined in Kenya Vision 2030. To achieve these goals, Kenya needs to accelerate its progress from the current rate of 0.75% to between 3% and 5% annually. At the current pace, universal access would take over 133 years to achieve. The National ODF Kenya (NOK) 2020 Campaign Framework proposes adopting India's Maharashtra approach, wherein local governments incentivize and reward communities for achieving ODF status, as a model for Kenyan counties.

1.2 Statement of the Problem

As per the World Health Organization (WHO) Global Health Observatory, improving drinking water, sanitation, hygiene, and water resource management could decrease the global disease burden by nearly 10% (WHO, 2020). Diarrhea is the predominant health issue associated with insufficient water, sanitation, and hygiene (WASH). In Sub-Saharan Africa, WASH coverage is generally low, particularly in rural areas, with urban areas demonstrating marginally better results. However, even within urban settings, there is unequal access, with poorer areas being particularly underserved. Unsafe WASH is responsible for approximately 7.75% of diarrheal disease deaths in Sub-Saharan Africa, with a risk factor attribution of 95.93%.

In Kenya, approximately 17,100 children under five die from diarrhea annually, with 90% of these fatalities attributed to inadequate sanitation and hygiene (Water and Sanitation Program, 2019). In Kilifi County, the crude death rate stands at 40.9 per 1000, while the infant mortality rate (IMR) and under-five mortality rate (U5MR) are 47.9 per 1000 and 80 per 1000, respectively, largely due to diarrheal diseases in the region. Open defecation is notably prevalent nationwide at around 14%, but in Northern and coastal counties like Kilifi, rates soar to 73.4%. The county, predominantly home to farmers, fishermen, and pastoralists, confronts significant sanitation challenges. The

implementation of Community-Led Total Sanitation (CLTS) in Magarini Sub-County remains incomplete, prompting efforts from the Department of Public Health, county government, and partners to advance a comprehensive CLTS initiative to address escalating diarrheal diseases (MoH, 2020).

In Magarini Sub-County, children's feces are frequently disposed of unsafely, as parents fear accidents when children use latrines or assume their waste is harmless. This practice contributes to high contamination levels, undermining CLTS objectives of eliminating open defecation. Adults also engage in open defecation at night and during the rainy season due to poor infrastructure and accessibility challenges, reflecting gaps in sustained behavioral change. Approximately 60% of villages in Magarini practice open defecation, and the area has not attained Open Defecation Free (ODF) status, unlike other regions with comparable interventions.

This study therefore aims to investigate the specific socio-economic, cultural, infrastructural, and behavioral factors influencing the long-term adoption of improved sanitation practices under the CLTS framework in Magarini Sub-County. While previous studies have largely emphasized initial uptake and short-term impacts, limited research has examined sustainability, especially the relationship between unsafe disposal of children's feces, persistent open defecation practices, and CLTS adoption. Addressing these factors will provide insights that inform policies and targeted interventions to strengthen the long-term sustainability of sanitation programs both locally and globally.

1.3 Justification

Improved sanitation is critical to public health and community well-being. The SDG 6.2 goal to 'achieve access to adequate and equitable sanitation and hygiene for all and eradicate open defecation, giving special attention to the needs of women, girls, and

those in vulnerable situations' provides a new chance to go beyond short-term ODF targets.

Extending strategies to include sustainability and post-ODF plans is vital. Insufficient sanitation infrastructure can lead to the spread of waterborne diseases and other health issues, especially in populated areas of Magarini. Therefore, understanding the factors that contribute to the sustained adoption of improved sanitation practices is essential to enhance the overall health status of the community.

Investigating the factors enabling long-term adoption of CLTS in Magarini can offer valuable insights into its effectiveness, identifying barriers and facilitators for successful implementation in similar contexts.

Furthermore, Magarini Sub-County might have specific socio-economic, cultural, and environmental dynamics that can influence sanitation practices. By studying these factors, research can tailor interventions and strategies to suit the local context, thereby increasing the likelihood of successful and lasting adoption of improved sanitation practices. Additionally, the study's findings could contribute to the existing body of knowledge on sanitation behavior change and community engagement.

The findings of this study could be useful to governments, non-governmental organizations, and other stakeholders working on sanitation development. They might apply these lessons to future sanitation programs, improving their efficacy and sustainability. Finally, the study on factors determining over time adoption of improved sanitation through CLTS in Magarini Sub-County, Kilifi County, has the potential to boost both sanitation and public health in general because of its focus on community-driven approaches, relevance to the local context, and contribution to the larger field of sanitation development.

1.4 Research Questions

i. What social-economic factors contribute to the long-term adoption of improved sanitation through CLTS?
ii. What is the extent of available sanitation infrastructure that can facilitate the successful implementation of CLTS in Magarini Sub-County?

1.5 Objectives

1.5.1 General objective

The research aims to assess the factors that affect long-term adoption of improved sanitation through Community Lead Total Sanitation in Magarini, Sub-County in Kilifi County.

1.5.2 Specific objectives

Specific objectives are;

i. To assess the social-economic factors contributing to long term adoption of improved sanitation Through CLTS.
ii. To evaluate the available sanitation infrastructure that can lead to successful implementation of CLTS in Magarini Sub-County.

1.6 Significant of the Study

The study's findings have been useful in health research and development efforts to improve CLTS implementation in Magarini Sub County. These findings provide timely and relevant information for addressing the region's high baby and under-five death rates due to poor sanitation and hygiene. Data obtained from the study has served as a foundation for directing future interventions and research endeavors. The study's outcomes and its discoveries have been disseminated to partners, stakeholders, as well as national and county governments to facilitate their assessment and revision of sanitation policies and hygiene standards in practice. Improved sanitation practices are crucial for

reducing the prevalence of waterborne diseases and enhancing overall well-being in communities. In the specific context of Magarini Sub-County in Kilifi County, the study addressed a pressing need for sustained adoption of improved sanitation practices, particularly through the Community-Led Total Sanitation approach.

This study has had the potential to uncover insights into the factors that either facilitated or hindered the long-term adoption of CLTS methods in the target area. By investigating these factors, the study could shed light on the effectiveness of CLTS in achieving lasting sanitation outcomes. It could identify community-specific barriers, such as cultural norms, socioeconomic conditions, and infrastructural limitations, which might have impeded the successful continuation of CLTS practices beyond initial implementation phases. Furthermore, the study's findings could enhance the development of CLTS programs, ensuring they are more flexible and enduring within the distinct socio-cultural and environmental setting of Magarini.

1.7 Limitation of the Study

While the study provides useful insights into the elements influencing long-term sanitation adoption via CLTS in Magarini Sub-County, it is important to acknowledge its limitations in terms of scope, methodology, cultural context, temporal dynamics, sample size, and data collecting timeframe. Addressing these shortcomings may improve the study's robustness and usefulness to broader contexts and periods.

CHAPTER TWO: LITERATURE REVIEW

2.1 Characteristic and the Long-term Sustainability of Improved Sanitation Initiatives

Sanitation programs are critical for public health and environmental sustainability, with access to clean sanitation facilities acknowledged as both a fundamental human right and an important global development goal. Recognizing the impact of demographic parameters like age, gender, education level, and income on program results is critical for maintaining long-term success. This literature analysis delves into recent studies from the last decade to find significant correlations and trends in how demographic factors influence the sustainability of sanitation projects.

In most nations, particularly in low- and middle-income countries, access to sanitation services remains a significant issue. According to Sahoo et al. (2018), demographic factors influence sanitation access in rural India, with a clear link between household income, education level, and access to better sanitation facilities. Higher-income and education levels increase the likelihood of accessing these services, emphasizing the significance of socioeconomic factors. Age is an important element in sanitation behavior and initiative sustainability.

According to Kaliyaperumal *et al*. (2017), age influences sanitation practices in rural Tamil Nadu, India, with younger individuals more inclined to adopt improved sanitation practices such as using properly equipped toilets. This suggests that targeting sanitation awareness campaigns at younger demographics could enhance sustainable practices.

Gender also significantly affects sanitation access and sustainability, with women often responsible for sanitation-related tasks in many households. Jenkins *et al*. (2019) explored gender dynamics in sanitation access in urban Kenyan slums, revealing that women encounter greater challenges in accessing sanitation facilities. Addressing these

gender disparities is essential for the enduring sustainability of sanitation efforts, given the pivotal role of women in sanitation decision-making processes.

Education level is a crucial demographic factor affecting sanitation knowledge and practices. Dreibelbis *et al*. (2018) examined sanitation behaviors in rural Bangladesh and found that individuals with higher education levels possessed superior knowledge and were more inclined to adopt hygienic practices, underscoring the necessity for educational interventions in sanitation initiatives. Generally, the Sub County is in the triggering phase, as depicted in the table below.

Table 1. 1

Certification per sub-county

#	Sub-County	Villages	Triggered	Claimed	Verified	Certified
1	Rabai	174	174	174	174	174
2	Kilifi North	280	280	280	280	280
3	Kilifi South	174	174	174	174	174
4	Malindi	323	323	172	155	147
5	Ganze	498	373	122	122	122
6	Kaloleni	221	192	28	28	28
7	Magarini	425	346	0	0	0
	Total	2095	1865	950	933	925

Source: Researcher (2024)

Household income has a significant and far-reaching impact on both the affordability and the quality of sanitation infrastructure. Income levels shape the ability of households to access improved sanitation, maintain existing facilities, and invest in better infrastructure over time.

According to Tumwebaze et al. (2019), a study conducted in urban Uganda established a clear correlation between household income and the quality of sanitation infrastructure.

The findings revealed that households with higher incomes had better access to improved sanitation facilities, while lower-income households struggled with inadequate or poorly maintained infrastructure. These results highlight the importance of economic capacity as a decisive factor in accessing sanitation services. In other words, while sanitation is a fundamental human right, its realization often hinges on household income and economic power.

Households are therefore encouraged to invest in robust and sustainable sanitation infrastructure to enhance the long-term viability of sanitation services. Stronger infrastructure ensures resilience to environmental and demographic pressures, such as population growth or urban expansion. However, in many regions, open defecation remains a major public health problem. This practice not only exposes populations to sanitation-related diseases but also undermines community dignity and development. The persistence of open defecation is influenced by several demographic factors, including age, gender, education, and income. Routray et al. (2015), in their study in rural Odisha, India, found that lower education levels and widespread poverty were strongly linked to higher open defecation rates. These findings underscore the critical role of demographic and socioeconomic factors in determining sanitation practices. Crafting effective interventions therefore requires recognizing and addressing these demographic influences. For example, targeted interventions in low-income and low-literacy populations could focus on behavior change communication, awareness creation, and subsidies to reduce open defecation and promote sustainable sanitation behaviors.

Beyond individual household demographics, community-level factors also exert a powerful influence on sanitation sustainability. Pattanayak et al. (2017) investigated community characteristics in rural India and discovered that both community income levels and education collectively shaped the availability and use of sanitation facilities.

Communities with higher socioeconomic status typically enjoyed better access to improved sanitation, while poorer communities experienced persistent deficiencies. This shows that sanitation outcomes cannot be fully understood by looking at households in isolation larger demographic and socioeconomic issues at the community level also play a decisive role. Stronger community structures, social cohesion, and shared investments in sanitation lead to more sustainable results compared to fragmented individual efforts.

Urbanization further complicates sanitation planning and management. As urban populations continue to grow rapidly, the demand for sanitation services rises sharply, particularly in informal settlements and slums where infrastructure is limited. Tumwebaze et al. (2020) examined the challenges of sustaining sanitation in Ugandan slums and emphasized the complexities of planning for rapidly growing populations. They highlighted that income disparities, high population density, and inadequate infrastructure are significant obstacles to effective urban sanitation. This suggests that urbanization introduces unique demographic challenges that require innovative approaches, such as decentralized sanitation systems, low-cost technologies, and community-driven models. Planning for sanitation in urban contexts must also account for population mobility, land tenure issues, and affordability, all of which influence the sustainability of sanitation initiatives.

Within both urban and rural contexts, vulnerable groups such as the elderly, disabled persons, and marginalized communities face distinct challenges in accessing sanitation services. Simiyu et al. (2017), in a study conducted in Kenya, documented the barriers faced by vulnerable populations, revealing that they often had limited or no access to sanitation facilities. For example, physically disabled individuals may be unable to use conventional latrines without modifications, while marginalized groups may lack legal or social recognition to demand basic services. These inequalities exacerbate health risks

and deepen social exclusion. Addressing the sanitation needs of vulnerable groups is therefore central to achieving equitable and sustainable sanitation outcomes. Tailored interventions, such as inclusive toilet designs, subsidies for marginalized households, and community support mechanisms, are essential to ensure no one is left behind in the quest for universal sanitation coverage.

A number of studies have employed statistical analysis methods including regression analysis, chi-square tests, and logistic regression to explore correlations between demographic characteristics and sanitation outcomes. These analyses have provided critical insights into the factors that most strongly determine sanitation access and sustainability. The literature consistently highlights demographic features such as age, gender, education, and income as key drivers of sanitation practices and infrastructure quality. Socioeconomic disparities emerge as particularly influential, shaping who can access improved sanitation facilities and who continues to rely on unsafe practices.

Age is one important factor, as younger individuals tend to be more receptive to adopting improved sanitation practices compared to older generations. This finding suggests that sanitation awareness campaigns targeted at youth could have lasting impacts, promoting sustainable behaviors that extend into future generations. Gender disparities also persist in sanitation access. Women, for example, often face greater challenges due to cultural restrictions, safety concerns, or inadequate facilities that do not accommodate menstrual hygiene needs. Addressing these gender disparities is not only an issue of fairness but also essential for ensuring equal benefits from sanitation programs.

Education emerges as another critical determinant of sanitation behavior. Higher levels of education are consistently linked to better sanitation knowledge, improved hygiene practices, and greater willingness to invest in sanitation infrastructure. As such, integrating educational components into sanitation initiatives can significantly improve

their effectiveness and sustainability. Household income, as already highlighted, plays a decisive role in shaping sanitation outcomes. Wealthier households are better able to build, maintain, and upgrade sanitation facilities, while poorer households often face barriers due to cost. Addressing income disparities, therefore, is central to ensuring universal access to sanitation services. Subsidies, microfinance, and community-driven financing models can help bridge these gaps (Simiyu et al., 2017).

At the community level, collective demographics such as average income and education strongly influence sanitation outcomes. Communities with higher socioeconomic status often enjoy better sanitation infrastructure and services, underscoring the importance of addressing inequalities not only at the household level but also across communities. Urbanization, on the other hand, presents both opportunities and challenges. While cities offer the potential for economies of scale in sanitation provision, they also magnify problems like income inequality and overcrowding. Urban sanitation programs must therefore prioritize innovative and affordable solutions that address both infrastructure needs and demographic realities.

The importance of ensuring access to clean and safe drinking water, sanitation, and hygiene (WASH) services cannot be overstated. Improvements in WASH lead to significant benefits, including better health outcomes, environmental protection, educational achievements, time savings, dignity, and gender equality. However, poor and vulnerable populations consistently face lower levels of access to WASH services, which negatively affects their health and overall quality of life. Improving WASH access is thus a critical strategy for reducing poverty, promoting equality, and fostering socioeconomic development. Global development frameworks have recognized this importance. The Millennium Development Goals (MDGs) set targets for improving access to drinking water and sanitation by 2015, while the Sustainable Development

Goals (SDGs) now aim for universal access to WASH by 2030. Additionally, the United Nations' 2010 resolution affirmed access to safe drinking water and sanitation as a fundamental human right, underscoring the moral and legal imperative of addressing WASH deficits.

The public health consequences of inadequate sanitation are severe. A recent study reported that approximately 842,000 deaths occurred globally in 2012 as a result of diarrheal diseases, with children under five accounting for nearly 43% of the burden (Pruss, 2019).

Inadequate drinking water alone contributed to around 502,000 of these deaths, while poor sanitation and limited hand hygiene contributed to 280,000 and 297,000 deaths, respectively. South-East Asia and Sub-Saharan Africa bear the heaviest burden of these preventable deaths. Data limitations and methodological differences, however, have led to varying estimates of disease burden. For instance, the Global Burden of Disease (GBD) study estimated that poor water and sanitation contributed to 0.9% of global Disability-Adjusted Life Years (DALYs), equating to approximately 300,000 deaths annually (Lim et al., 2022). These differences highlight the challenges in quantifying health impacts but do not diminish the clear association between inadequate sanitation and high mortality rates.

Improved sanitation and clean water access are consistently associated with significant reductions in waterborne diseases. Research by Freeman et al. (2017) in Sub-Saharan Africa demonstrated a significant decrease in diarrhea prevalence among children under five in households with improved sanitation. Similarly, Heijnen et al. (2014) conducted a review of multiple studies and found a 25% reduction in diarrhea risk associated with better sanitation facilities. Access to clean potable water further amplifies these health benefits. Bartram and Cairncross (2010) showed that improved water quality

substantially reduced the incidence of waterborne diseases, while Futrell et al. (2017) demonstrated that household water treatment and safe storage reduced diarrhea risk by 39%. These findings collectively confirm that improved sanitation and water services are critical for reducing disease prevalence and improving overall community health.

Despite these proven benefits, numerous challenges hinder the implementation of effective sanitation measures. Inadequate infrastructure, resource limitations, weak governance, and lack of education remain major obstacles. Garn et al. (2017) revealed that access to sanitation in low-income cities is often highly unequal, necessitating targeted interventions and policy reforms. Institutional settings such as schools, healthcare facilities, and refugee camps are particularly vulnerable, as inadequate WASH services in these environments amplify health risks. Jasper et al. (2022) found that schools without adequate drinking water and sanitation facilities experienced higher rates of diarrheal diseases and gastrointestinal infections.

Beyond infrastructure, social and cultural factors play an essential role in sanitation adoption. Jenkins and Scott (2017) emphasized the importance of community engagement and behavior change for sustainable sanitation improvements. They argued that statistical analysis, while valuable, must be complemented with culturally sensitive strategies that address underlying beliefs, taboos, and social norms surrounding sanitation. Techniques such as regression analysis, meta-analysis, and propensity score matching are useful for quantifying impacts, but without community ownership and participation, sanitation initiatives often fail to achieve long-term sustainability.

Several empirical studies demonstrate the health benefits of sanitation interventions. For instance, Clasen et al. (2019) conducted a rigorous evaluation of a sanitation program in rural India and found a substantial reduction in diarrhea cases after implementation. Similarly, Wolf et al. (2018), through a meta-analysis, synthesized data from multiple

studies and reinforced the strong relationship between improved water access and reduced diarrheal diseases. These results have direct policy implications, particularly for achieving SDG 6, which calls for universal access to clean water and sanitation by 2030.

Addressing challenges in sanitation requires context-specific interventions. Policymakers should consider infrastructure needs, socioeconomic disparities, and cultural contexts when designing programs. Community engagement and behavior change communication are critical for ensuring that interventions are not only adopted but also sustained over the long term. Moreover, continuous research is essential to evaluate innovative sanitation technologies, monitor the effects of climate change on water resources, and integrate sanitation with broader health interventions. Longitudinal studies, in particular, provide valuable insights into the long-term health, economic, and social benefits of sanitation improvements.

In conclusion, access to clean water and sanitation remains pivotal for public health, social equity, and sustainable development. While progress has been made in expanding WASH services, persistent disparities based on income, education, gender, and community demographics continue to pose challenges. Urbanization, vulnerability of marginalized groups, and limited resources further complicate sanitation efforts. Nonetheless, research consistently demonstrates the profound positive impact of improved sanitation on reducing disease prevalence, enhancing dignity, and promoting socioeconomic development. Achieving universal sanitation access requires a comprehensive approach that integrates infrastructure investment, demographic considerations, behavior change, and policy reforms. Continued global action and collaboration are essential to ensure that sanitation is prioritized as a cornerstone of community well-being and sustainable development.

2.2 Socioeconomic Factors and Improved Sanitation Practices

Sanitation is a critical determinant of public health, social development, and economic progress. Access to improved sanitation facilities not only reduces the burden of communicable diseases but also improves dignity, safety, and overall quality of life. Despite these benefits, the global adoption and sustained use of enhanced sanitation practices remain uneven, particularly in low- and middle-income countries. A large body of literature attributes this disparity to various socioeconomic factors, which directly or indirectly shape the ability and willingness of individuals and communities to invest in, adopt, and maintain improved sanitation facilities. Income levels, educational attainment, occupational status, and housing conditions emerge as some of the most significant determinants, while cultural perceptions, community participation, and gender dynamics also play pivotal roles. This essay explores these influences in depth, drawing from global case studies, statistical evidence, and scholarly debates to demonstrate how socioeconomic realities continue to shape the sanitation landscape.

One of the most commonly cited barriers to the adoption of improved sanitation is cost. In rural Bangladesh, for instance, Robert and John (2017) noted that the expense of constructing durable latrines often surpasses household incomes. This situation forces many households to resort to alternative practices such as open defecation, which, although hazardous, are perceived as more cost-effective. An interesting dynamic noted in this context is that human fecal matter is sometimes considered a valuable resource for fertilization. For farmers struggling to afford chemical fertilizers, open defecation is rationalized as a way of enriching soils, thereby creating an incentive structure that discourages latrine construction. Such beliefs highlight the complex intersection between poverty, agricultural livelihoods, and sanitation behavior. They also illustrate how

decisions about sanitation are not solely about health but are tied to broader economic survival strategies.

In Indonesia, similar financial constraints intersect with perceptions of community development. Mukherjee (2019) found that while collective involvement is crucial for the construction of sanitation facilities, many villagers regarded the required contributions as overly expensive. Instead of channeling scarce resources into sanitation, they preferred to invest in materials such as cement and reinforcing steel for housing projects. This preference underscores the reality that in resource-limited settings, sanitation often competes with other pressing household needs. Phillips (2010) observed a related challenge in Liberia, where geographical and environmental conditions complicated latrine construction. Hard or unstable soils demanded advanced construction techniques, which were beyond the financial and technical means of most households. These examples collectively show that both affordability and contextual factors like geography affect the feasibility of latrine construction and long-term sustainability.

The economic costs of poor sanitation extend beyond households to entire national economies. A study conducted in Nigeria revealed that inadequate sanitation practices lead to billions of dollars in annual losses due to healthcare expenses, productivity declines, and environmental degradation (Otieno, 2011). Similarly, Rotowa et al. (2015) emphasized that while multiple socioeconomic factors shape sanitation choices in Akure, Nigeria, gender of the household head was not a statistically significant determinant. Instead, other factors such as income, education, and housing played a more decisive role. This finding reflects the broader consensus in the literature that although gender may influence decision-making indirectly, structural socioeconomic conditions exert a more immediate impact on sanitation adoption.

From the perspective of sanitation planners, engineers, and policymakers, these findings highlight the necessity of integrating socioeconomic realities into program design. For instance, the World Health Organization (WHO) and UNICEF (2014) emphasized that household income is crucial in determining whether families can afford toilet facilities and sustain their maintenance. Burton (2017), in his investigation of WaterAid's Community-Led Total Sanitation (CLTS) program in Nigeria, further highlighted how differences in waste management strategies across socioeconomic groups were statistically insignificant, suggesting that once minimum thresholds of affordability and awareness are met, communities can adopt improved practices. Nevertheless, the ability to cross this initial affordability threshold remains highly uneven, necessitating targeted support.

Access to enhanced sanitation is not merely a technical matter but a social imperative with profound implications for public health. Improved sanitation reduces the prevalence of diarrheal diseases, cholera, typhoid, and other waterborne illnesses. It also strengthens community resilience by decreasing healthcare burdens and improving productivity. Despite these benefits, disparities in adoption persist across the globe, largely due to socioeconomic inequities. Income, education, occupation, and housing conditions consistently emerge as influential factors shaping sanitation behavior, and these determinants have been documented across numerous contexts over the last decade (Burton, 2017).

Income, in particular, is one of the most powerful determinants of sanitation adoption. Low-income households often struggle to allocate funds for constructing or upgrading latrines, prioritizing immediate survival needs such as food and shelter over long-term investments in sanitation infrastructure. Ejemot-Nwadiaro et al. (2015), in a Nigerian context, found that wealthier households had significantly better access to improved

sanitation facilities compared to their poorer counterparts. Hossain et al. (2016) made similar observations in Bangladesh, noting that poverty severely slowed down the adoption of improved sanitation, with wealthier households opting for modern, durable, and safer facilities. These findings emphasize that income not only determines affordability but also influences household perceptions of what constitutes acceptable sanitation standards. The correlation between income and sanitation behavior underscores the importance of subsidies, microfinance options, and social protection schemes to bridge affordability gaps.

Education also plays a transformative role in shaping sanitation practices. Educational attainment equips individuals with knowledge of hygiene, disease transmission, and the benefits of improved sanitation. Pattanayak et al. (2018) demonstrated in India that maternal education significantly influenced the use of improved sanitation facilities. Heijnen et al. (2014) also stressed the importance of education in promoting hygiene practices, especially in low-income countries. These studies collectively highlight that education empowers individuals to make informed decisions about sanitation and strengthens community awareness campaigns. When individuals understand the health risks associated with open defecation, they are more likely to support and sustain improved sanitation practices.

Occupation is another determinant with indirect but powerful effects on sanitation adoption. As Sultana et al. (2017) documented in rural Bangladesh, agricultural laborers often face income fluctuations, which limit their ability to invest in permanent sanitation solutions. Seasonal migration and remote working conditions further complicate access to latrines. Conversely, individuals with stable urban employment are more likely to have both the financial resources and logistical access to invest in better sanitation

facilities. Thus, occupation influences sanitation behavior both directly, through income, and indirectly, through the stability and predictability of livelihoods.

Housing conditions are equally significant. Adequate space, secure tenure, and physical infrastructure play crucial roles in determining whether households can construct and maintain improved latrines. Kwiringira et al. (2015) highlighted the difficulties faced by households in informal Ugandan settlements, where overcrowding and lack of secure land tenure hindered the construction of durable sanitation facilities. In such contexts, open defecation or reliance on shared, poorly maintained facilities becomes the norm. Conversely, households with better housing infrastructure are not only more capable of installing latrines but are also more inclined to invest in maintenance and upgrades. Housing thus acts as both a facilitator and a barrier depending on quality, security, and space availability.

Statistical analyses reinforce these findings. Anteneh et al. (2019) in Ethiopia, using logistic regression, identified income and education as the most significant predictors of sanitation adoption. Tumwebaze et al. (2018) in Uganda similarly underscored the combined influence of income, education, and housing conditions. These quantitative insights provide empirical grounding for policy prioritization. They also demonstrate that interventions must be evidence-based, tailored to the most influential socioeconomic factors within specific contexts.

The policy implications of these findings are far-reaching. Governments and NGOs must design targeted interventions that address socioeconomic barriers directly. Subsidies for latrine construction, microfinance schemes, and conditional cash transfers are viable strategies to help low-income families overcome affordability constraints. Equally important is the promotion of sanitation education through schools, community health workers, and mass campaigns, which can enhance awareness and reshape behavioral

norms. Housing improvements, particularly in informal urban settlements, can indirectly bolster sanitation adoption by providing adequate space and secure tenure for latrine construction. Crucially, interventions must be context-specific: rural areas may require approaches linked to agricultural livelihoods, while urban areas may need strategies focusing on employment stability and housing upgrades.

Gender dynamics also warrant careful attention. Magala and Roberts (2019), in their study of Ghana, revealed that despite improvements in health, education, and economic opportunities, gender inequalities persist, particularly in decision-making roles. Women and girls often bear the burden of poor sanitation, including risks to safety, dignity, and health. In fragile and conflict-affected states, these vulnerabilities are magnified, necessitating gender-sensitive approaches that prioritize women's involvement in sanitation planning and implementation. Without addressing gender inequities, sanitation interventions risk reinforcing existing disparities rather than mitigating them.

Kenya provides a case study of how socioeconomic variables shape access to essential services. Mbeki (2019) found that revenue, household size, education, age, employment status, and proximity to facilities all influenced sanitation utilization. Elderly household heads, often accustomed to traditional practices, were less likely to adopt new sanitation approaches, while educated heads of households demonstrated greater awareness of health implications. Income again emerged as a decisive factor, determining whether households could afford improved water and sanitation sources. Shah (2017) similarly emphasized that income and education are central to sanitation adoption in Kenya, echoing global trends.

Ultimately, the literature consistently shows that socioeconomic factors such as income, education, occupation, and housing are not isolated determinants but interact in complex ways to shape sanitation behavior. Income directly affects affordability, education shapes

awareness, occupation influences income stability, and housing conditions determine feasibility. Together, these factors explain why sanitation adoption remains uneven globally. Addressing them requires integrated approaches that combine financial assistance, educational outreach, livelihood support, and housing improvements.

The challenge of sanitation adoption also intersects with global development goals, particularly the Sustainable Development Goals (SDGs). SDG 6 emphasizes universal access to clean water and sanitation, but progress toward this target has been slow in many regions due to entrenched socioeconomic inequalities. Understanding these dynamics is crucial for designing effective strategies that move beyond one-size-fits-all solutions. Evidence-based policies must recognize the structural constraints households face and seek to dismantle them through coordinated action.

In conclusion, socioeconomic factors exert profound influence on the long-term acceptance of enhanced sanitation. Income determines affordability, education enhances awareness, occupation shapes income stability, and housing conditions determine feasibility. Case studies from Bangladesh, Indonesia, Liberia, Nigeria, Uganda, Ethiopia, Ghana, and Kenya collectively illustrate the global relevance of these determinants. The evidence underscores the need for policies and programs that directly address socioeconomic barriers through subsidies, educational campaigns, housing improvements, and gender-sensitive approaches. Only by tailoring interventions to the socioeconomic realities of communities can universally access to improved sanitation be achieved. Addressing these factors not only improves public health but also promotes dignity, equity, and sustainable development, thereby advancing the broader vision of global well-being.

2.3 The Impact of Infrastructure Variables on the Effectiveness of CLTS Initiatives

In the past decade, Community-Led Total Sanitation (CLTS) initiatives have gained considerable global recognition as a promising approach to improving sanitation and hygiene practices. Rooted in participatory methodologies, CLTS emphasizes mobilizing communities to collectively eliminate open defecation and adopt improved sanitation practices without heavy reliance on external subsidies. The unique strength of CLTS lies in its ability to shift attitudes, stimulate local ownership, and promote sustainable sanitation practices. However, despite its potential, the success of CLTS does not occur in isolation. Infrastructure-related variables such as the availability of sanitation facilities, access to water sources, and functional waste disposal systems remain fundamental in shaping program outcomes. Infrastructure determines not only the feasibility of behavioral adoption but also the sustainability of practices over time. This literature review explores the role of infrastructure in influencing CLTS outcomes, focusing on research published within the past decade to offer a contemporary perspective.

Sanitation facilities occupy a central place within CLTS interventions and are strongly linked to improvements in hygiene and health outcomes. Adequate infrastructure, such as latrines that are safe, accessible, and affordable, provides communities with practical alternatives to open defecation. According to Shah (2017), the mere availability of sanitation facilities serves as a catalyst for sustained behavioral change by offering convenience and privacy. For example, a study by Shah et al. (2019) in rural Indian communities revealed that households with improved sanitation infrastructure were significantly more likely to adopt safe hygiene practices following CLTS interventions. These findings highlight the indispensable role of infrastructure in translating knowledge and awareness into consistent behavioral action. Without accessible facilities, community members may revert to open defecation even after initial CLTS successes,

underscoring the importance of integrating infrastructure development into program design.

The role of water infrastructure is equally crucial. Access to safe and reliable water sources is not only essential for drinking but also for maintaining hygiene practices such as handwashing and cleaning sanitation facilities. Drew (2015) emphasized that water scarcity undermines sanitation adoption by making hygiene maintenance impractical.

In a more recent study, Drew and Exley (2020) examined sub-Saharan African communities and found that those lacking clean water access faced persistent difficulties in sustaining hygiene practices despite the roll-out of CLTS programs. This finding underscores the interdependence between water and sanitation infrastructure: one cannot be sustained without the other. In communities where water sources are located far from households or are contaminated, even well-built latrines may not translate into improved health outcomes, since hygiene practices like hand washing become inconsistent. Thus, water provision must be seen as a complementary infrastructure component of CLTS interventions.

Another critical infrastructure element is waste disposal systems. Waste management directly affects environmental cleanliness and public health, reducing exposure to pathogens and preventing disease spread. Han et al. (2018) demonstrated that communities with effective waste management structures were more likely to sustain sanitation gains after CLTS implementation. In such settings, proper disposal of household and community waste reinforced hygiene norms and reduced risks of contamination. O'Reilly (2017) added that waste management systems also foster collective responsibility, reinforcing community-level behavior change. However, establishing effective waste disposal systems remains challenging in low-income contexts. Barriers such as inadequate financial resources, lack of technical knowledge,

and insufficient construction materials often result in weak or incomplete infrastructure. These limitations not only reduce the impact of CLTS programs but also contribute to inequities, as marginalized groups including women, the elderly, and people with disabilities are disproportionately affected by inadequate infrastructure (Mukherjee, 2018; Balasubramanian, 2021).

The issue of infrastructure sustainability has become an increasing concern for practitioners and scholars. Makoni (2019) warned that investments in sanitation infrastructure often falter due to inadequate maintenance, weak community engagement, and climate-related challenges such as flooding or drought. For example, latrines built with locally available materials may deteriorate quickly without proper reinforcement, while seasonal flooding can destroy water sources or waste management systems. This suggests that CLTS success requires not only the initial construction of infrastructure but also long-term strategies for upkeep and resilience. Community involvement in infrastructure maintenance, coupled with government or NGO support, is essential to ensure that gains made through CLTS programs are not short-lived.

Quantitative analyses have provided important insights into how infrastructure influences sanitation outcomes. Using regression models, Smith et al. (2017) established a positive correlation between the presence of sanitation facilities and the uptake of improved hygiene practices in rural Kenyan communities. Their findings suggested that while behavior change messaging is vital, the presence of infrastructure acts as an enabling environment that transforms intent into action. Similarly, Yang et al. (2020) evaluated communities in Cambodia and found that comprehensive infrastructure improvements including latrine construction, clean water access, and waste management systems produced stronger and more sustainable outcomes than partial infrastructure upgrades. These results reinforce the idea that sanitation, water, and waste management

infrastructure must be considered holistically, as improvements in one area alone may not suffice to drive long-term behavioral change.

Nevertheless, infrastructure impacts are not uniform across contexts.

Jenkins et al. (2019) argued that cultural norms, socioeconomic conditions, and geographic realities mediate the relationship between infrastructure and CLTS success. For example, in some societies, cultural taboos around shared latrines hinder usage, while in geographically remote areas, transportation barriers make it difficult to procure construction materials for sanitation facilities. Statistical analyses that incorporate such contextual variables often yield more nuanced insights, suggesting that infrastructure must be tailored to local realities rather than applied through one-size-fits-all approaches.

Contextualization is especially important when designing CLTS methodologies. Alemu et al. (2018) demonstrated that in Ethiopia, culturally sensitive approaches were necessary to encourage adoption of sanitation infrastructure. Traditional beliefs and practices had to be respected and integrated into program strategies to ensure community acceptance. Such findings emphasize the need to couple infrastructure development with cultural adaptation, making interventions relevant and acceptable to local populations. Infrastructure that is technically sound but socially inappropriate may fail to achieve intended outcomes.

Community participation emerges as another cornerstone of successful CLTS infrastructure development. Numerous scholars have argued that involving community members in the planning, construction, and maintenance of infrastructure fosters ownership and accountability. Arunachalam (2019) and Tumwebaze (2021) stressed that participatory approaches strengthen the sustainability of sanitation infrastructure by empowering local actors to take responsibility for upkeep. Khan et al. (2020), for example, reported that in Pakistan, community involvement in latrine design led to

higher satisfaction rates, greater usage, and stronger adherence to hygiene practices. Participation not only improves infrastructure quality but also ensures that facilities are adapted to meet the diverse needs of different social groups within the community.

Importantly, infrastructure interacts with behavioral factors such as knowledge, attitudes, and social norms. Molbak (2018) argued that well-maintained facilities reinforce positive hygiene practices by providing convenient, dignified, and safe options. Infrastructure therefore plays a symbolic as well as functional role, signaling community commitment to sanitation.

In rural China, Wang et al. (2021) demonstrated that communal sanitation facilities acted as focal points for hygiene education campaigns and collective action, accelerating community-wide behavior change. This interaction between infrastructure and behavior illustrates the dynamic nature of CLTS success: infrastructure enables behavior, while behavior, in turn, ensures the proper use and maintenance of infrastructure.

Despite these benefits, researchers face methodological challenges in measuring the infrastructure–sanitation relationship. Data collection in resource-limited settings is often difficult, with reliance on self-reported surveys introducing biases such as social desirability (Kolady, 2017). Furthermore, tracking the long-term sustainability of infrastructure requires extended monitoring, which is costly and logistically demanding. These challenges can create gaps in the evidence base, making it difficult to conclusively assess the long-term effectiveness of infrastructure investments.

To address these challenges, scholars have begun employing innovative data collection methods. Osumanu (2020) noted that mobile data collection tools and remote sensing technologies are improving data accuracy and timeliness, enabling real-time tracking of sanitation infrastructure and behavioral outcomes. Such advancements have the potential

to transform monitoring and evaluation frameworks, allowing policymakers to make evidence-based decisions more effectively.

The policy implications of these findings are profound. Governments and development partners must recognize that infrastructure development is not ancillary but central to CLTS success. Effective programs require adequate funding, technical expertise, and material support for sanitation facilities, water systems, and waste management infrastructure. Policies should prioritize equitable distribution of resources to ensure that marginalized populations are not left behind. Moreover, governments should integrate CLTS infrastructure development into broader national sanitation and health policies, aligning community-level interventions with national goals such as Sustainable Development Goal (SDG) 6, which emphasizes universal access to water and sanitation.

Finally, this literature review situates its analysis within the Andersen Behavioral Model of Health Services utilization, which provides a useful conceptual framework for understanding infrastructure's role in sanitation adoption. Originating in the late 1960s, the model highlights the importance of predisposing factors such as social structure, education, occupation, ethnicity, and health beliefs. These interact with enabling resources like health facilities, income, and health insurance to influence service utilization.

Applied to CLTS, infrastructure variables sanitation facilities, water access, and waste management serve as enabling resources that determine whether predisposing factors translate into improved behaviors. Biological imperatives such as age and sex, as well as socio-cultural variables, mediate the extent to which infrastructure is utilized. Intervening variables, such as community engagement, implementation quality, and socioeconomic status, further clarify the relationship between infrastructure provision and sanitation

outcomes. In this way, the Andersen model underscores the multifactorial nature of sanitation adoption, highlighting infrastructure as a necessary but not sufficient condition for success.

In summary, the evidence reviewed over the past decade illustrates that CLTS initiatives cannot thrive without robust infrastructure. Sanitation facilities, water sources, and waste disposal systems are critical in enabling communities to translate awareness into action and sustain behavioral changes. While infrastructure development faces significant challenges particularly in resource-constrained and marginalized contexts innovative solutions, community engagement, and policy prioritization can help overcome these barriers. Moreover, infrastructure interacts with cultural norms, behavioral factors, and contextual realities, underscoring the importance of context-specific, participatory, and integrated approaches. As CLTS continues to evolve as a global sanitation strategy, its success will depend heavily on the ability of governments, development partners, and communities to invest in and sustain the infrastructure that underpins sanitation behavior change.

2.4 Conceptual Framework

The study employed the Andersen Behavioral Model of Health Services utilization, which originated in the late 1960s. This model encompasses predisposing factors, including social structure, demographic variables, and health beliefs related to service utilization. Additionally, the model incorporates biological imperatives such as sex, and age, which are considered part of the demographic factors that help elucidate the necessity for seeking particular healthcare services.

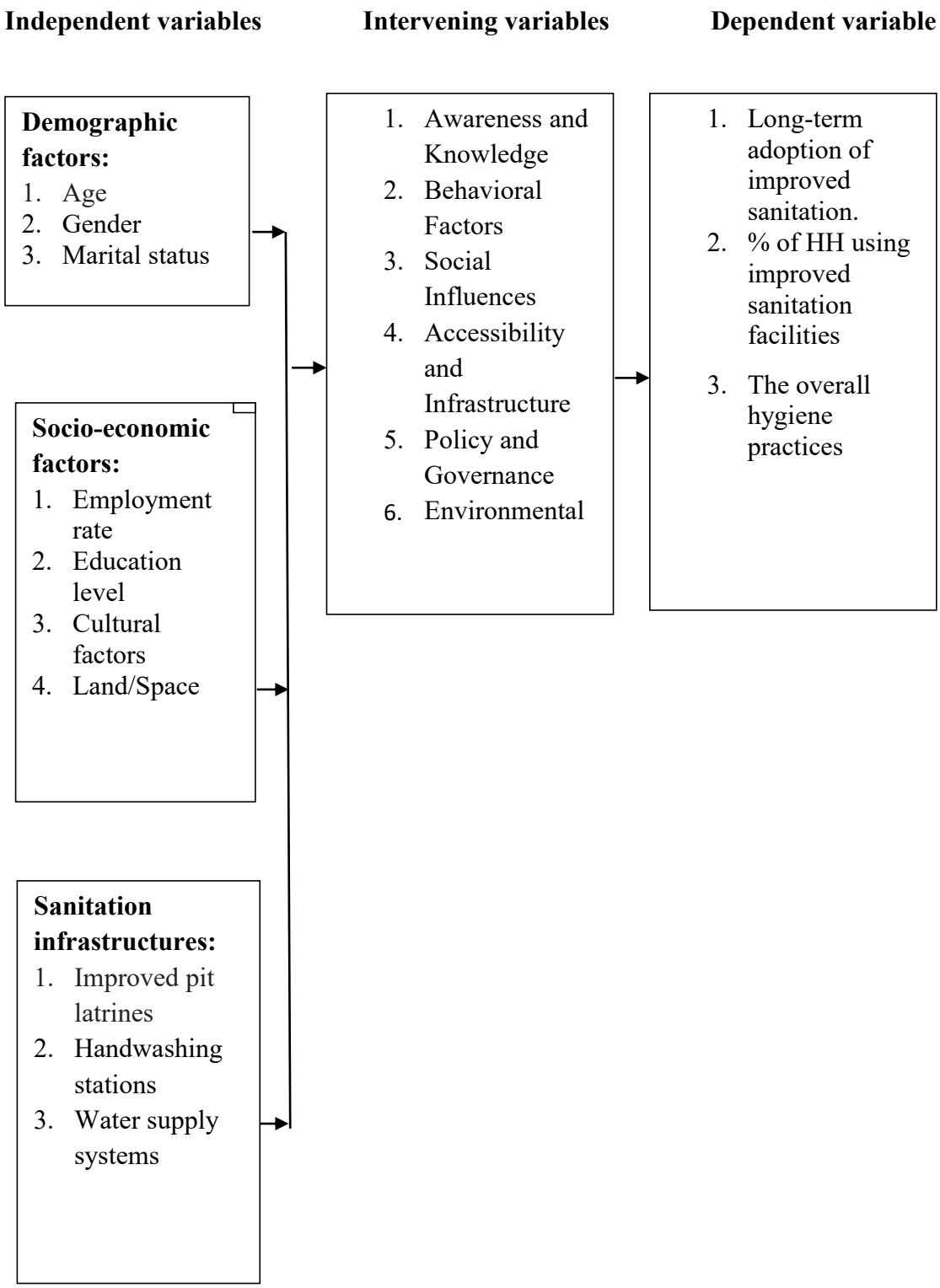
The social structure factors were assessed through variables such as occupation, education, ethnicity, social interactions, and societal culture. These aspects were complemented by the availability of healthcare facilities and personnel within the

residential and occupational areas of individuals. It is crucial for members of society to have the capability to access and utilize these services effectively. Other vital determinants encompass health insurance coverage, income, having a consistent source of care, as well as factors related to travel and waiting times.

Intervening variables are crucial for clarifying the relationship among independent and dependent variables. In this regard, intervening variables may include factors that mediate the impact of demographic, implementation, and socio-economic factors on the long-term adoption of improved sanitation, household percentage using improved sanitation facilities, and overall hygiene practices.

Figure 2. 1

Conceptual frame for factors contributing to long-term adoption of improved sanitation



CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The chapter discusses the research design, study site, research variables, target population, sampling technique and sample size, research instruments, pilot study, validity, reliability, data collection processes, data analysis, logistics, and ethical considerations.

3.2 Study Area

Magarini Sub-County is located in Kilifi County and comprises Adu, Sabaki, Garashi, Gongoni, Magarini and Marafa wards. It lies between 2° 58' 32" S and 3° 16' 8" S/SN and between 40° 1' 29" E and 40° 30' 0" E/W. It has a population of 191,610 (KDHS, 2022) and with 12,795 households. It spans an area of approximately 232.00 km². Magarini Sub-County is located about 420 km south-east of Nairobi, 60 km north of Mombasa, and 25 km from Malindi Sub County.

The sub-County is characterized by sand dunes that border the Indian Ocean lagoon towards the east. These sand dunes are believed to have originated from the organic matter transported into the area from inland areas into the coastline by the River Sabaki (Opiyo *et al*., 2022). As noted earlier, the area is endowed with sandy and limestone zones that assist in the water supply due to their high permeability and hydraulic properties conductible. These sandy and limestone areas comprise the focal recharge areas to the 18 unconfined aquifers, but their characteristics render them highly susceptible to contamination.

3.3 Research design

This involved cross-sectional study, which is a type of observational research design used to gather data about a population at a single point in time and provided a snapshot of a population's characteristics and behaviors at a specific moment. Households were

surveyed to identify the factors that contribute to the long-term adoption of improved sanitation through CLTS. Quantitative data was gathered through questionnaires, primarily directed at the heads of households.

3.4 Target Population

This is the group that a researcher aims to study and analyze. The study targeted 388 households distributed within Magarini sub county administrative units (Wards)

3.5 Sample Size Determination

The required sample size was determined based on the Yamane formula, which is as follows:

$$n = \frac{N}{1+Ne^2}$$

Where:

- n = desired sample size
- N = total population size
- e = margin of error (expressed as a decimal)

Given:

$N = 12797$

$n = 388$

$e = 0.05$

Let's plug these values into the formula to find the desired sample size:

$$n = \frac{12797}{1+12797\times(0.05)^2}$$

$$n = \frac{12797}{1+12797\times0.0025}$$

$$n = \frac{12797}{1+31.9925}$$

$$n = \frac{12797}{32.9925}$$

$$n \approx 388.072$$

Therefore; n = 388.

3.5.1 Sampling frame

The research took place in Magarini Sub County, where the researcher employed proportionate sampling of wards, aiming for an accurate representation of the population and minimizing sampling errors from under or overrepresentation of certain groups.

3.5.2 Sampling procedure

The proportional sample technique entailed picking an appropriate number of homes from each of the six administrative wards based on their sizes. The method began with determining the percentage of households in each ward relative to the total number of households across all six wards, which was accomplished by dividing the number of households in each ward by the total number of households in all six wards using a specific formula as shown below.

$$\frac{\text{No. of HH per ward}}{\text{Total No. of HH in S/C}} \times \text{Sample size}$$

When this is calculated for every ward, the sampled households should sum up to the sample size which is 388.

Table 3. 1

Distribution of samples (KDHS 2022)

Ward	Population	Households	Sample Size
Adu	16,298	2,588	79
Sabaki	4,221	816	25
Garashi	6,749	1,202	36
Gongoni	2,797	4,136	124
Magarini	3,795	2,241	68
Marafa	2,097	1,812	55
Total	85,957	12,795	388

Source: Researcher (2024)

To produce the illustrative sample of households, 388 families were selected using simple random sampling from household registrations in these villages, ensuring that each household had an equal chance of inclusion in the sample, decreasing bias and increasing the generalizability of the findings. The selection technique used sequential sampling to choose 388 houses from the registers as the study's target population. At the village level, the researcher used simple random sampling and a random number table to assign a unique number to each family. With the table, he began at a random position, preferably near the center, and systematically selected numbers, matching them to households on a list. Each number matched to a distinct home, preventing bias. This method allowed unbiased selection, where every household had an equal chance of being chosen, crucial for fair representation. This continued to generate random numbers until the desired number of households was obtained, ensuring a comprehensive and representative sample was attained. Within each sampled household, an interview was

conducted with the head of the household, whether male or female. In polygamous households, the husband was interviewed first in the initial household, followed by interviews with the second and third wives in their respective households.

3.6 Inclusion and Exclusion Criteria

3.6.1 Inclusion criteria

The inclusion criteria included household heads aged 18 years and above and willing to consent. Household heads with residence in the area of study for 6 months and above were also included.

3.6.2 Exclusion criteria

The household survey excluded household heads under 18 years old, those 18 years and older unwilling to consent, and household heads who had not lived in the study area for 6 months or more.

3.7 Research Instrument

The questionnaire served as a primary data collection tool. Participants, in using it, understood both the study's significance and the questionnaire's contents (Nganga, 2018). The study instrument incorporated variables from the conceptual framework relevant to the study's objectives.

3.8 Pre-testing

Pretesting research instruments enabled identification and potentially reducing measurement error thereby improving statistical estimates for the study population. The pre-tests were conducted in Malindi Sub County, adjacent to Magarini Sub County within the same County, sharing similar characteristics. Concurrently, Community-Led Total Sanitation (CLTS) activities were implemented. Selected individuals, comprising 20% of the intended sample size of 388 for the main study (equating to 77 households), responded to instrument items.

Respondents from the pre-test were excluded from the final study sample. Subsequent feedback and review sessions with research assistants and supervisors addressed identified concerns. Data collection tools underwent pre-testing for reliability and validity, ensuring rigorous quality control throughout the study. The researcher supervised data collection for completeness and consistency, holding daily meetings to address any issues and review raw data for completeness and accuracy.

3.8.1 Bias minimization

The structured questionnaire served as the main instrument for gathering data from participants. To mitigate bias, measures were taken on multiple fronts. Efforts focused on addressing response bias, ensuring participants' responses accurately reflected their perspectives.

Additionally, steps were taken to mitigate researcher bias, safeguarding against any predispositions that might have influenced the study's outcomes. To minimize sampling bias, a table of random numbers was employed during the sampling process.

This approach aimed to ensure fair and unbiased selection of participants. Moreover, interviewer bias was reduced by creating carefully standardized data collection instruments, guaranteeing consistency and impartiality throughout all interviews.

3.9 Data Collection Procedure

The research employed simple random sampling to gather household-level data from two specific wards identified based on Sub County MOH data showing high rates of open defecation and sanitation-related diseases. At the household level, data was collected using both qualitative and quantitative methodologies, with each approach exploiting its strengths to achieve a thorough grasp of the research issue. After selecting random samples, researchers contacted selected families, described the research objectives, and

asked for their permission to collect data, ensuring that each household provided informed consent.

3.9.1 Recruitment and training of research assistant

The research involved fifteen research assistants, all of whom were from the study area. Their local expertise was important because they were familiar with the area and had at least a Form four certificate in their educational background. Proficiency in English (spoken and written) and Kiswahili was necessary. They underwent a two-day training session covering study objectives, procedures, and instrument usage, which included pre-testing.

3.10 Data analysis and Presentation

The quantitative data underwent cleaning, coding, and analysis using statistical packages: SPSS version 29.0, R, and Microsoft Excel for graphical representation. Results were presented equally through tables and figures.

Cross tabulation analyzed variable associations, while inferential statistics, specifically a p-value at a 95% confidence interval, determined variable relationships. A p-value ≤ 0.05 indicated significance, while a p-value > 0.05 indicated non-significance, with the Chi-square test forming the basis of the p-value in the study.

3.11 Ethical Considerations

Scientific approval was obtained from the departmental Graduate Studies, and ethical approval was obtained from the Meru University Research Ethics Committee. Permission was sought from county health managers and individual respondents. Respondents were assured of the confidentiality of their personal information, which was excluded from the research. Participants provided informed consent, and codes were used instead of real names. Participation in the study was voluntary. Confidentiality of information in all questionnaires was assured to research assistants, researchers, and

respondents. Guides were securely stored in a locked cupboard with limited access. Data access was restricted to the principal investigator, university supervisors, and MIRERC members for future reference. Participants who did not understand English were asked to bring a trusted interpreter, briefed on the study's purpose, to explain it in their language before participation. Data was stored in coded form with a secure password in the database.

CHAPTER FOUR: RESULTS

4.0 Introduction

The chapter gives the results of the three research objectives through frequency distribution, showing a significant difference between intended categorical demographic variables and relationship between demographic variables.

4.1 Demographic Characteristics of the Study Respondents in Magarini Sub County

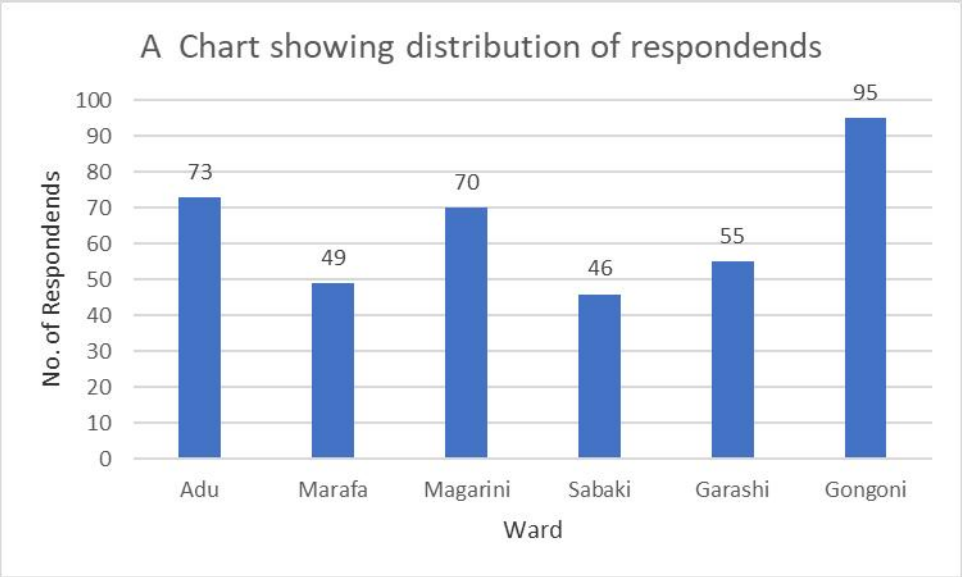
4.1.1 Frequency distribution of respondents in Magarini

Figure 4.1 shows the distribution of respondent in all the locations. The results in the figure have been presented based on the number of respondents at each station and their percentage.

388 respondents participated in the survey as shown in figure 4.1.

Figure 4. 1

Distribution of respondents in Magarini



Source: Researcher (2024)

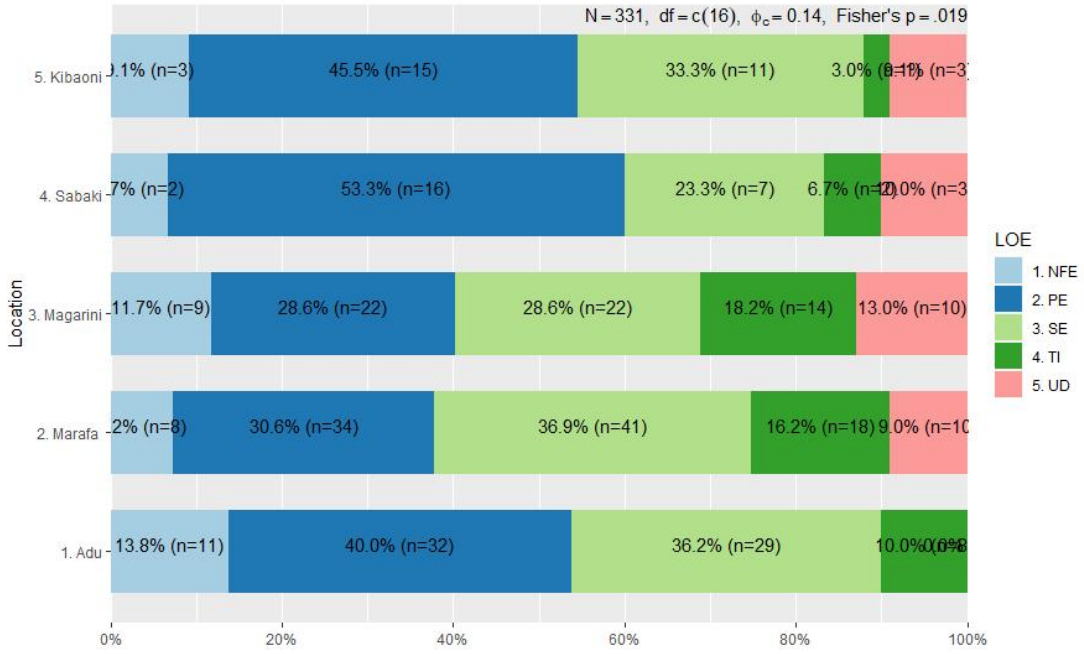
4.1.2 Association between Magarini respondents and their level of education (LOE)

The results in figure 4.2 shows that there is no statistically significant association (p=0.19) between level of education and population in Magarini at the conventional

significance level of P = 0.05. In Magarini, 9 respondents representing 11.7% had no formal education (NFE) 22 respondents which is 28.6% of the total sample size attended Primary education (PE), 22 respondents which is 28.6% of the total sample size attended Secondary education (SE), 14 respondents representing 18.2% attended Tertiary Institutions (TI) and 10 respondents representing 13.0% have university degrees (UD).

Figure 4. 2

Association between Magarini people and Education



Source: Researcher (2024)

4.1.3 Cross-Exploring Relationships between Location and Religion

The cross-tabulation analysis examined the relationship between the location of respondents and their religious affiliations in Magarini Sub-County (Table 4.1). The cross-tabulation test of independence shows a statistically significant link between location and religion in Magarini Sub-County ($\chi 2$ = 34.558, df = 20, p = 0.027). The strength of association is moderate, as indicated by Cramer's V coefficient (0.162).

Table 4. 1

Religious affiliations in Magarini Sub-County

	Atheist		Protestant		Catholic		Pentecostal		Muslim		Traditional		Total	
Location	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Adu	15	31.9	28	35.9	14	20.6	10	13.3	11	20.0	2	25.0	80	24.2
Marafa	17	36.2	19	24.4	17	25.0	35	46.7	20	36.4	3	37.5	111	33.5
Magarini	9	19.1	12	15.4	17	25.0	20	26.7	16	29.1	3	37.5	77	23.3
Sabaki	3	6.4	6	7.7	11	16.2	5	6.7	5	9.1	0	0.0	30	9.1
Kibaoni	3	6.4	13	16.7	9	13.2	5	6.7	3	5.5	0	0.0	33	10.0
Total	47	100.0	78	100.0	68	100.0	75	100.0	55	100.0	8	100.0	331	100.0

χ^2=34.558 · df=20 · Cramer's V=0.162 · Fisher's p=0.027

Source: Researcher (2024)

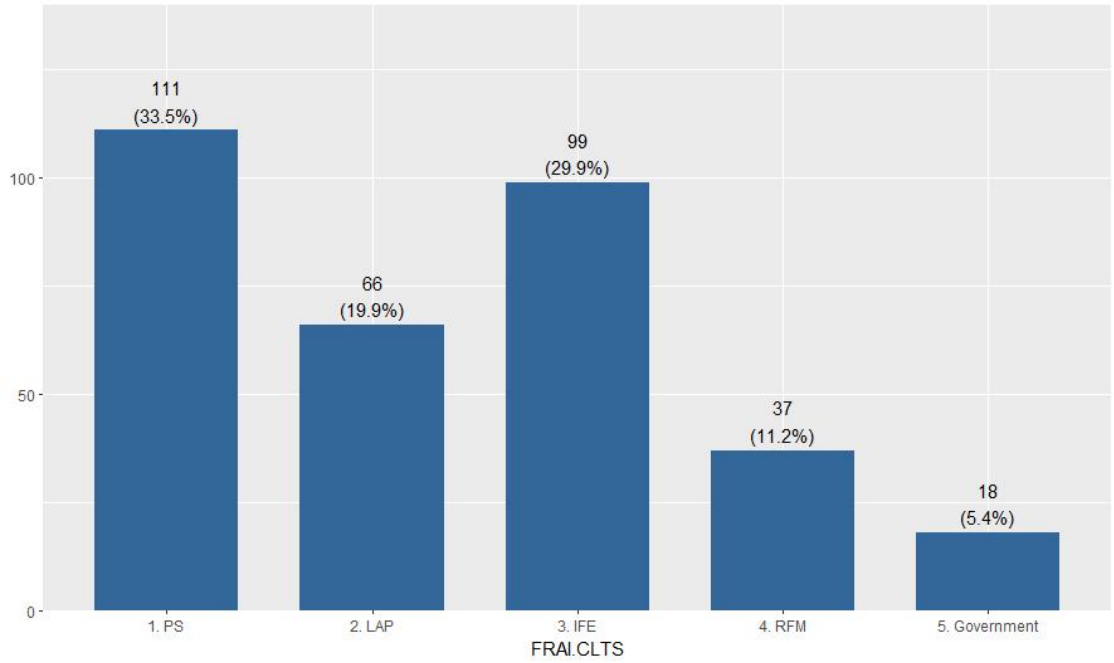
4.2 Social-economic Factors Contributing to Long Term Adoption of Improved Sanitation

4.2.1 Frequency distribution of Socio-economic resources available for implementing CLTS practices

The results in Figure 4.3 shows the distribution of. Social economic resources available for implementation of CLTS practices (FRAI-CLTS). The available resources include 33.5% from personal savings (PS), 19.9% from livestock or Agricultural products (LAP), 29.9% from employment income (IFE), 11.2% from Family members Remittances (RFM) and 5.4% comes Government salaries.

Figure 4. 3

Distribution of Social economic Resources



Source: Researcher (2024)

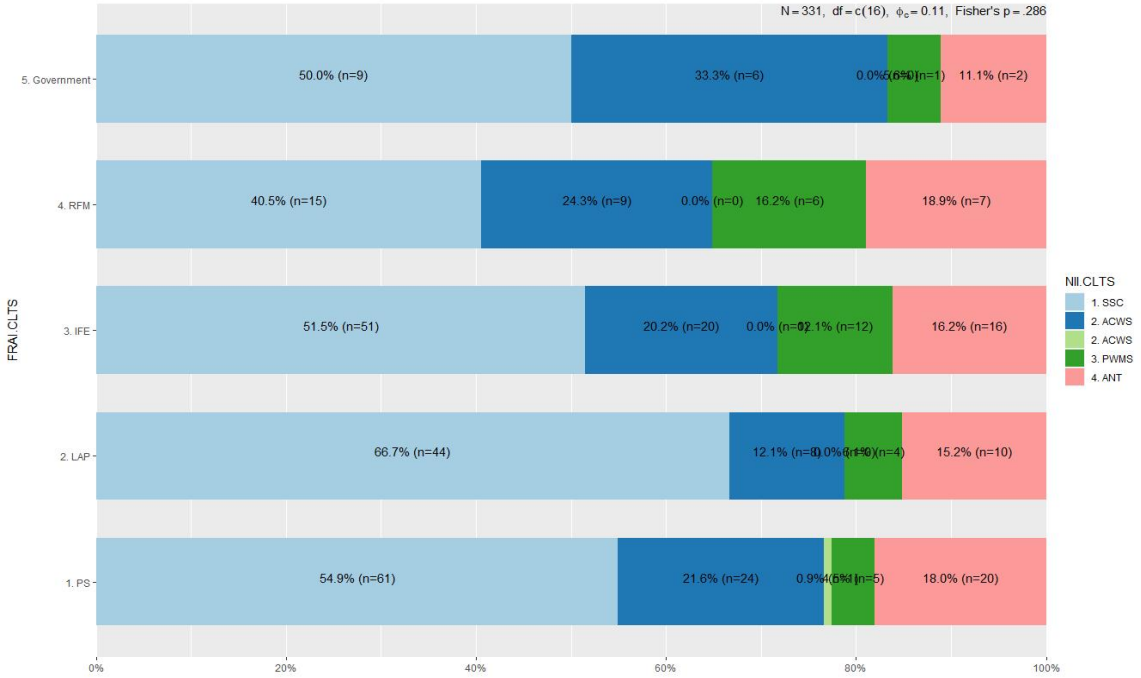
4.2.2 Relationship between FRAI.CLTS (Financial resources available for implementing CLTS practices) and NII.CLTS (necessary infrastructure to implement CLTS practices)

The relationship between financial resources and necessary infrastructure is symbiotic in the context of implementing CLTS practices. Adequate financial resources ensure that the necessary infrastructure can be developed and maintained, while good infrastructure maximizes the impact of financial investments by supporting sustainable sanitation practices.

The p-value of 0.286 suggests that there is no statistically significant association between FRAI.CLTS and NII.CLTS at the conventional significance level of $\alpha = 0.05$ (Figure 4.4).

Figure 4. 4

Relationship between FRAI.CLTS and NII.CLTS



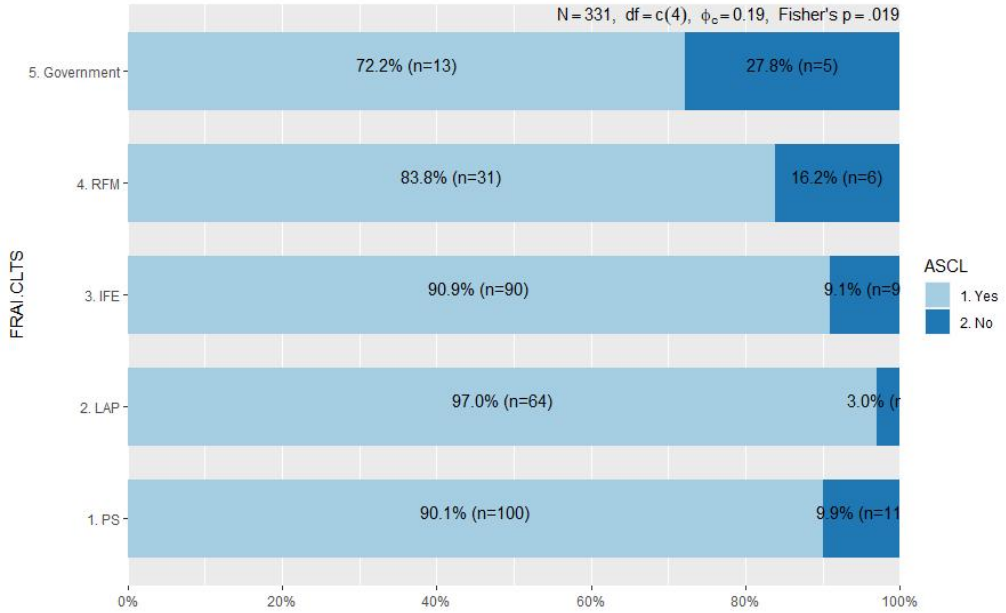
Source: Researcher (2024)

4.2.3 Relationship between FRAI.CLTS (Financial resources available for Implementing CLTS practices) and ASCL (adequate space to construct latrines)

The successful implementation of CLTS practices hinges on the interplay between financial resources and adequate space for latrine construction. Both factors are interdependent and critical. Financial resources enable the purchase of materials, labor, and the implementation of efficient designs, while adequate space ensures that latrines can be constructed and maintained effectively. The p-value of 0.19 suggests that there is no statistically significant association between FRAI.CLTS and ASCL at the conventional significance level of $\alpha = 0.05$ (Figure 4.5).

Figure 4. 5

Relationship between FRAI.CLTS and ASCL



Source: Researcher (2024)

4.2.4 Cross-exploring relationship between FRAI.CLTS and NII.CLTS

Table 4.2 presents the cross-tabulation of FRAI.CLTS and NII.CLTS, showing the count and percentage of respondents in each category. The test of independence suggests no statistically significant relationship between FRAI.CLTS and NII.CLTS ($\chi 2 = 16.977$, df = 16, p = 0.288).

A chi-square test of independence was performed to assess whether there is a significant relationship between FRAI.CLTS and NII.CLTS, examining whether the distribution of respondents across one variable's categories is independent of their distribution across the other variable's categories.

Table 4. 2

Cross-exploring relationship between FRAI.CLTS and NII.CLTS

	SSC		SCWS		PWMS		ANT		Total	
FRAI.CLTS	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
PS	61	33.9	24	35.8	5	17.2	20	36.4	110	33.2
LAP	44	24.4	8	11.9	4	13.8	10	18.2	66	19.9
IFE	51	28.3	20	29.9	12	41.4	16	29.1	99	29.9
RFM	15	8.3	9	13.4	6	20.7	7	12.7	37	11.2
Government	9	5.0	6	9.0	2	6.9	2	3.6	19	5.7
Total	180	100.0	67	100.0	29	100.0	55	100.0	331	100.0

χ^2=16.977 · df=16 · Cramer's V=0.113 · Fisher's p=0.288

Source: Researcher (2024)

4.3 Available Sanitation Infrastructure that can facilitate the Successful Implementation of CLTS in Magarini Sub-County

4.3.1 Exploring association between location and ASCL

The results in table 4.3 presents the association of adequate space to construct latrines (ASCL) and Location, showing the count and percentage of respondents in each category. The test of independence suggests no statistically significant relationship between ASCL and Location ($\chi2 = 33.21$, df = 4, p = 0.487). The lack of a significant association implies that the potential for implementing CLTS in terms of space availability is relatively consistent throughout the sub-county.

Table 4. 3

Association of adequate space to construct latrines (ASCL) and Location

	Adu		Marafa		Magarini		Sabaki		Kibaoni		Total	
ASCL	f	%	f	%	f	%	f	%	f	%	f	%
Yes	74	92.5	98	88.3	68	88.3	26	86.7	32.0	97.0	298	90.0
No	6	7.5	13	11.7	9	11.7	4	13.3	1.0	3.0	33	10.0
Total	80	100.0	111	100.0	77	100.0	30	100.0	33	100.0	331	100.0

χ^2=3.321 · df=4 · Cramer's V=0.100 · Fisher's p=0.48

Source: Researcher (2024)

The results in Table 4.3 indicate that the majority of respondents across all locations reported having adequate space to construct latrines. Overall, 90% of respondents affirmed having sufficient space, while only 10% reported otherwise. Location-wise distribution shows relatively high proportions of households with adequate space: Adu (92.5%), Marafa (88.3%), Magarini (88.3%), Sabaki (86.7%), and Kibaoni (97.0%). The chi-square test of independence ($\chi^2 = 3.321$, df = 4, p = 0.487) reveals no statistically significant association between location and ASCL. This suggests that availability of space for latrine construction does not vary substantially across the different wards in Magarini Sub-County.

The lack of significant variation implies that space availability is not a limiting factor for latrine adoption under Community-Led Total Sanitation (CLTS) within the sub-county. This is further supported by the consistently high percentages of households with adequate space across locations.

The low Cramer's V value (0.100) reinforces the weak relationship between the two variables. Therefore, other contextual factors such as economic capacity, cultural practices, awareness, and household priorities are likely to play a more influential role in latrine adoption than mere availability of land.

These findings align with previous studies which emphasize that while land or space may be a necessary condition for latrine construction, it is not a sufficient determinant of adoption. Instead, interventions should place greater emphasis on addressing behavioral, financial, and social barriers to sanitation improvement.

The results suggest that CLTS programming in Magarini Sub-County should not prioritize location-specific strategies for addressing space limitations, since this factor is relatively uniform across wards. Rather, program planners should focus on complementary drivers such as household motivation, affordability of latrine construction, and sustained community engagement to enhance sanitation uptake.

CHAPTER FIVE: DISCUSSIONS

5.1 Association between Magarini Respondents and Level of Education (LOE)

The results of the study conducted in Magarini reveal no statistically significant association between the level of education (LOE) of respondents and the overall population distribution in relation to Community-Led Total Sanitation (CLTS) outcomes. This conclusion is based on a chi-square test that generated a p-value of 0.19, which is greater than the conventional significance threshold of 0.05. A p-value above this threshold indicates that any observed differences in the distribution of educational attainment across the sampled population could have occurred by random chance rather than by a systematic relationship between education levels and sanitation outcomes.

The sample distribution of respondents further illustrates this point. Among the surveyed population, 9 respondents (11.7%) had no formal education (NFE), 22 respondents (28.6%) had attained primary education (PE), 22 respondents (28.6%) had completed secondary education (SE), 14 respondents (18.2%) had reached the tertiary institution (TI) level, and 10 respondents (13.0%) held university degrees (UD). This relatively balanced spread across the education spectrum underscores that while differences exist, they did not yield a statistically significant association with sanitation outcomes in this particular study area.

At first glance, these findings might seem counterintuitive when compared to existing literature. In other contexts, education has been highlighted as a critical factor in shaping sanitation practices and improving CLTS outcomes. For instance, Kar and Chambers (2018) documented that communities with higher educational attainment tended to record better CLTS results. Their findings emphasized that education plays a pivotal role in enabling individuals to understand, interpret, and adopt health-promoting behaviors, such as latrine construction, proper waste disposal, and adherence to hygiene guidelines.

Educated individuals often act as role models within their communities, demonstrating improved practices and encouraging others to follow suit.

Similarly, Biran et al. (2019) established a positive correlation between education levels and the effectiveness of CLTS interventions. They observed that communities with a larger proportion of individuals with higher education were more responsive to sanitation initiatives, leading to higher rates of latrine adoption and usage. Their study suggested that education equips individuals with the cognitive skills necessary to appreciate the health risks of poor sanitation and the long-term benefits of improved hygiene practices. By enhancing comprehension of sanitation messages, education fosters greater willingness to engage in CLTS activities and to sustain them over time.

However, the results from Magarini tell a different story. Unlike the aforementioned studies, the Magarini findings did not reveal a significant association between education levels and sanitation outcomes. This divergence aligns with other studies, such as Cavill, Chambers, and Vernon (2018), who argued that the success of CLTS does not always hinge on participants' educational attainment. Instead, their research highlighted that other factor, such as strong community cohesion, effective local leadership, and entrenched cultural practices, often play more critical roles in determining the success or failure of sanitation programs. In communities where social unity and local leadership are strong, collective action can thrive even in the absence of high levels of education.

The contrasting results across different studies emphasize the complexity and multifaceted nature of CLTS implementation. While education may be a driver of positive sanitation outcomes in some contexts, it may not be the decisive factor everywhere. The Magarini case demonstrates this complexity, illustrating that education alone does not determine community sanitation behavior or the success of interventions.

Delving deeper into the implications of these findings, it becomes clear that CLTS programs cannot adopt a one-size-fits-all approach. Instead, interventions must be tailored to reflect local realities, dynamics, and challenges. In Magarini, the absence of a significant association suggests that other variables likely play a more dominant role in shaping sanitation outcomes. For instance, local leadership can be a decisive factor. Charismatic, respected, and proactive leaders often mobilize communities to embrace sanitation initiatives, leveraging their social capital to overcome resistance. In such contexts, leadership can drive behavioral change irrespective of the community's educational composition.

Cultural practices and beliefs also exert considerable influence on sanitation behaviors. Communities may have traditional practices regarding waste management and hygiene that either align with or contradict CLTS principles. Where cultural norms reinforce safe sanitation, communities can achieve success even with low levels of formal education. Conversely, deeply rooted taboos, stigmas, or misconceptions about sanitation can undermine CLTS efforts even in relatively educated populations. This underscores the need to integrate cultural sensitivity into program design and implementation.

In addition, the availability and accessibility of resources play a pivotal role. Education may increase awareness of sanitation needs, but without adequate resources such as affordable latrine materials, access to water, or financial support communities cannot translate knowledge into action. In Magarini, as in many rural settings, infrastructural and economic barriers may overshadow the role of education. Communities may understand the benefits of improved sanitation yet remain unable to act due to poverty or logistical constraints.

The role of marginalized groups, particularly women and youth, also warrants consideration. In many communities, women are the primary caregivers and are directly

responsible for household water and sanitation management. Their empowerment and participation in CLTS activities can significantly improve outcomes, regardless of their formal education levels. When women are actively involved in decision-making, sanitation interventions tend to be more inclusive and sustainable. Similarly, engaging youth, who often act as change agents, can foster intergenerational adoption of positive sanitation practices.

Viewed collectively, these factors highlight that the effectiveness of CLTS is shaped by a complex interplay of social, cultural, economic, and leadership elements rather than education alone. The Magarini case therefore contributes to a broader understanding of CLTS dynamics by underscoring the need for comprehensive, context-sensitive strategies. Programs that rely solely on education as the lever for behavior change may fall short, particularly in settings where other determinants such as culture, leadership, and resources play stronger roles.

Policymakers and practitioners must therefore approach CLTS design with flexibility and adaptability. Instead of emphasizing education as the primary determinant of sanitation outcomes, they should adopt a holistic framework that integrates multiple dimensions. Interventions should combine awareness campaigns with efforts to strengthen local leadership, promote cultural alignment with sanitation goals, improve access to resources, and foster inclusive participation of all community members.

In conclusion, the Magarini findings offer valuable insights into the complexities of CLTS implementation. The lack of a statistically significant association between education levels and sanitation outcomes highlights the limitations of relying solely on educational attainment as a predictor of program success. While education is undoubtedly an important factor that can enhance awareness and comprehension, it is not the sole driver of behavior change. The divergent findings across different studies

reaffirm that CLTS outcomes are shaped by a confluence of factors that vary across contexts. By embracing this nuanced perspective, policymakers and program designers can craft more effective and sustainable sanitation strategies that are responsive to local realities, ultimately leading to stronger and more resilient sanitation improvements in diverse communities.

5.2 Cross-Exploring Relationships between Location and Religion

The cross-tabulation analysis conducted in Magarini Sub-County reveals a significant association between the location of respondents and their religious affiliations, as evidenced by the chi-square test ($\chi^2 = 34.558$, df = 20, p = 0.027). These statistical results highlight that the relationship between location and religion is not merely coincidental but is indeed statistically significant, showing that where people live plays a key role in shaping their religious practices and affiliations.

The strength of this association, as measured by Cramer's V coefficient of 0.162, suggests a moderate connection between the two variables. While the association is not overwhelmingly strong, it is meaningful enough to warrant careful attention when exploring religious demographics and cultural landscapes. Such findings are consistent with existing literature that has investigated the intersection of geography and religion across different contexts, demonstrating the broader relevance of location in influencing religious distribution.

For instance, Stark and Finke (2021) demonstrate that religious diversity and affiliation are deeply influenced by geographic factors. Different regions often display unique religious compositions that stem from complex layers of historical events, cultural evolution, and local traditions. In many cases, these factors serve as the foundation upon which communities establish their spiritual identities.

Similarly, research conducted by the Pew Research Center (2017) on global religious demographics concluded that geographic distribution profoundly shapes religious affiliation. Historical settlement patterns, migration flows, and the diffusion of religious groups across territories often determine the dominant faiths in a particular area. These studies reveal that religion does not exist in isolation but evolves within socio-historical environments that are rooted in place and location.

Migration, in particular, emerges as a powerful explanatory factor. Migration flows, often driven by socio-economic conditions or historical conflicts, bring with them religious traditions and practices that integrate into or coexist with local ones. Over time, this leads to the emergence of religious diversity and, in some cases, religious syncretism. In coastal regions of Kenya such as Kilifi County, centuries of trade, settlement, and missionary activity have created a patchwork of religious affiliations that still persist today. The Magarini Sub-County analysis fits within this broader global narrative, where location, history, and mobility converge to shape religious life.

The Magarini data reveals a diverse religious landscape, marked by variations across different locations within the sub-county. Protestant and Pentecostal groups dominate in areas such as Adu and Marafa, reflecting the widespread influence of modern evangelical movements. This pattern is also likely tied to historical missionary activities that penetrated inland communities and left lasting religious legacies. In contrast, Catholicism has established a stronger presence in Sabaki.

This dominance can be traced back to earlier missionary efforts by Catholic organizations, particularly during the colonial era when Catholic missions invested heavily in education, healthcare, and religious instruction. Such institutional footholds provided long-term sustainability for Catholicism in those areas.

Islam, on the other hand, maintains a stronghold in coastal locations such as Marafa and Magarini. This is consistent with the historical spread of Islam through trade networks along the Indian Ocean coast, where Arab and Swahili traders played central roles in introducing Islamic faith and practices. The enduring presence of mosques and Islamic schools in these regions reflects not only historical roots but also the continuation of cultural and religious traditions tied to coastal heritage. Interestingly, traditional religious practices are now minimal across all locations within the sub-county. This decline may be attributed to the combined effects of globalization, modernization, and the expansion of more organized religions, which often delegitimize or replace indigenous spiritual systems.

These localized patterns echo broader findings from studies conducted in Sub-Saharan Africa, where colonial history, missionary activities, and trade networks played defining roles in shaping the religious landscape (Johnson & Grim, 2018). The evidence from Magarini therefore illustrates how broader historical and cultural dynamics become localized and visible in the religious affiliations of specific communities.

Although location is a strong determinant of religious affiliation in Magarini, it is not the only factor at play. The moderate strength of the association (Cramer's V = 0.162) suggests that other variables intersect to shape religious identity. Socio-economic conditions, educational opportunities, and patterns of migration all influence the religious affiliations of individuals and communities. For instance, areas with more developed educational institutions may demonstrate greater religious diversity, as education often exposes people to a variety of worldviews and fosters tolerance for different beliefs. Similarly, socio-economic challenges may push individuals toward religious communities that provide not only spiritual guidance but also social and material support. Religious organizations in Kenya often play a central role in

community development, offering services ranging from healthcare and education to food aid, which can in turn strengthen affiliation and loyalty.

Norris and Inglehart (2011) provide a theoretical framework for understanding these dynamics, arguing that socio-economic development and educational progress tend to promote secularization and alter religious commitments. As communities experience growth and modernization, traditional religious practices often decline, while organized religions adapt to provide new forms of relevance. In Magarini, where modernization and migration are ongoing, such dynamics are particularly evident in the decline of indigenous traditions and the rise of global religious movements like Pentecostalism.

The findings from Magarini therefore contribute to a deeper understanding of the broader global relationship between geography and religion. The religious diversity observed in different areas of the sub-county illustrates the interplay of historical, cultural, and socio-economic influences. These patterns echo similar observations globally, where geography provides the framework upon which other factors such as migration, education, and socio-economic conditions operate to shape religious affiliation.

Moreover, the moderate association found in Magarini underscores the need to consider religion as a multidimensional phenomenon. It is not merely determined by geography but shaped by an intersection of variables that continually interact and evolve. Migration, for example, introduces new beliefs that can either complement or challenge existing religious traditions. Education broadens exposure to different perspectives, sometimes leading to shifts in religious affiliation or to more pluralistic communities. Economic challenges and inequalities also strengthen the social role of religion, as faith-based groups often become vital providers of welfare and community support.

The relationship between location and religion is thus a complex and layered one. In Magarini Sub-County, the findings reflect the combined weight of historical missionary

activity, the legacy of Islamic trade routes, and the ongoing impact of socio-economic and cultural dynamics. These results align with global evidence showing that religion is not static but shaped by a continuous interplay between place, history, and social conditions.

Recognizing this complexity allows researchers and policymakers to develop more nuanced understandings of religious diversity. It also emphasizes the need for context-sensitive approaches in community development, governance, and social cohesion efforts. Religion in Magarini, as elsewhere, cannot be explained by geography alone; it must be understood within the broader framework of historical settlement patterns, educational and economic opportunities, migration, and cultural change.

In conclusion, the relationship between location and religion in Magarini Sub-County demonstrates the significance of geographic factors while highlighting the equally important role of socio-economic, cultural, and historical influences. The moderate but statistically significant association found in the study reflects a multifaceted reality where religion is shaped not by a single determinant but by an intricate web of forces. These insights not only contribute to the academic understanding of religion and geography but also have practical implications for policymakers, religious leaders, and community organizations seeking to foster coexistence and inclusivity in diverse contexts.

5.3 Distribution of Socio-economic resources available for implementing CLTS practices

The cross-tabulation analysis of FRAI.CLTS and NII.CLTS variables indicates that there is no statistically significant relationship between the two measures ($\chi 2 = 16.977$, $df = 16$, $p = 0.288$). This statistical outcome suggests that the socio-economic resources allocated to Community-Led Total Sanitation (CLTS) practices are distributed consistently across

the various categories assessed in the study. In other words, the way resources are mobilized and applied within CLTS interventions is not significantly influenced by the variables under investigation.

This consistency is important because it demonstrates a degree of uniformity in how communities approach the financing of sanitation initiatives, regardless of their socio-economic differences. The implication is that, whether a community is relatively wealthy or poor, the manner in which resources are pooled and utilized for sanitation purposes tends to follow a similar pattern. Such uniformity speaks to the shared recognition of sanitation as a collective need that transcends household-level disparities. It also reflects the social cohesion that underpins many community-driven projects, where public health goals are treated as common responsibilities.

A closer look at the sources of resources reveals notable trends that help explain the patterns of financing observed in the study. Among the various socio-economic inputs, personal savings stand out as the most common origin, accounting for 33.5% of the total contributions. This high level of dependence on personal financial reserves highlights the strong personal commitment of community members to improving sanitation conditions within their localities. It reflects an internalized sense of ownership and responsibility, where individuals willingly channel their limited financial resources toward collective sanitation goals.

This willingness to contribute from one's own savings is not only a demonstration of commitment but also an expression of trust in the CLTS process as a viable means of improving community well-being. However, while this demonstrates commendable dedication, it also raises sustainability concerns. For lower-income individuals, the constant use of savings for community projects could lead to the rapid depletion of financial reserves. Over time, this might compromise the ability of households to meet

other essential needs such as food, education, or healthcare, thereby threatening the long-term sustainability of CLTS practices. Communities that depend excessively on personal savings risk reaching a point of financial fatigue, where contributions decline because households simply cannot sustain the financial pressure.

This reliance on personal savings is not unique to the communities studied in this particular context. Research conducted by Harter et al. (2018) confirms similar trends across various rural settings, where personal savings remain a key driver of sanitation projects. Their findings suggest that individuals often prioritize immediate health and hygiene benefits over the potential financial burden that comes with repeatedly spending from their savings. This reflects a widespread phenomenon in which urgent health-related needs tend to overshadow considerations of long-term financial stability. In practice, households make a deliberate trade-off, valuing improved sanitation and reduced disease burden over the risks of financial exhaustion. Such behavior illustrates the urgency with which communities view sanitation improvements, even if it comes at personal financial strain. The significance of this trade-off cannot be understated, as it underscores the perception that improved sanitation is a matter of survival rather than convenience. However, while this underscores community resilience, it also highlights the need for external support systems to prevent households from being overburdened.

In addition to personal savings, livestock and agricultural products form another significant source of resources, contributing 19.9% of the total. This finding reflects the predominantly rural and agrarian nature of many communities engaged in CLTS initiatives. Agricultural resources serve as an alternative form of capital that can be mobilized either through direct contribution of products such as grains, livestock, or farm produce, or through income earned from selling these commodities. Chambers and

Myers (2020) emphasize the importance of agricultural income in sustaining community development projects, noting that rural livelihoods often hinge on this sector.

The ability to convert farm outputs into financial resources gives communities a unique mechanism for supporting CLTS initiatives without necessarily drawing down cash savings. However, this type of contribution introduces a unique set of vulnerabilities. Agricultural resources are highly sensitive to external shocks such as unpredictable weather patterns, droughts, floods, pest invasions, and volatile market prices. These externalities make agricultural income an inherently unstable and unreliable source of funding. Rogers and Lydon (2017) similarly highlight how agricultural incomes are prone to disruption, stressing that such instability can pose significant challenges for sustaining sanitation programs over the long term. Therefore, while agriculture plays a critical role, the risks associated with its volatility underscore the importance of finding complementary and stable sources of funding.

Income from employment makes up 29.9% of the contributions, indicating that a significant portion of the population involved in CLTS activities has access to stable wage-based employment. This is an encouraging finding as employment income tends to be more predictable and less subject to seasonal or environmental fluctuations compared to agricultural income.

Employment-based earnings provide households with a consistent financial base, making it easier to support sanitation initiatives without compromising other essential expenditures. Research by Kar and Chambers (2020) affirms the importance of stable employment in enhancing the financial capacity of communities to engage in collective initiatives. They argue that households with wage income are better positioned to sustain contributions to community-led projects because of the reliable nature of their earnings. This highlights the role of employment not only as a source of individual security but

also as a collective driver of sustainable sanitation funding. In the long run, employment-based contributions can be particularly effective in creating predictable cash flows that support routine maintenance and expansion of sanitation infrastructure.

Remittances represent another notable component, contributing 11.2% of the resources mobilized for CLTS activities. This emphasizes the critical role of external monetary support, often from family members working in urban centers or abroad. Remittances are a well-documented driver of rural development projects, including sanitation initiatives. Satterthwaite et al. (2015) highlight their importance, showing that funds sent by migrants often serve as lifelines for communities with limited local economic opportunities. In the context of sanitation, remittances provide an infusion of external resources that can help bridge local funding gaps, thereby sustaining project implementation even when local income sources are constrained.

This highlights the interconnectedness between rural communities and their diaspora or urban-based family members, where external economic activities indirectly fuel rural sanitation progress. Remittances thus play a dual role: they supplement household income while simultaneously enhancing the collective capacity of communities to support public health initiatives. However, reliance on remittances also introduces an element of unpredictability, as they depend on broader economic conditions in urban centers or foreign labor markets.

Interestingly, government salaries and direct government-related contributions make up the smallest share of resources, at only 5.4%. This low percentage suggests limited direct governmental involvement in financing CLTS projects, at least within the communities under study. This observation aligns with the findings of Chambers (2019), who noted that government contributions to rural sanitation initiatives are often minimal compared to community and external inputs.

The relatively low proportion of government funding raises concerns about the adequacy of institutional support for rural sanitation. It implies that much of the financial burden is borne by individuals, households, and communities rather than being complemented by robust government investments. A stronger governmental presence in funding could enhance stability and sustainability, reducing the over-reliance on personal and community resources. Moreover, government funding could also enable more structured interventions, such as capacity building, supply chain strengthening, and long-term infrastructure investments that communities alone might not manage effectively.

The socio-economic resource distribution for CLTS practices, as depicted in Table 4.2, reflects both strengths and challenges. The findings are consistent with broader research, demonstrating the heavy reliance on personal savings, the significant but unstable contribution of agricultural income, the stabilizing role of employment, the importance of remittances, and the limited involvement of government.

Taken together, these observations underscore the need for a diversified and sustainable funding model for CLTS initiatives. Relying too heavily on any one source of funding, whether personal savings or agriculture, can expose communities to risks that threaten the continuity of sanitation improvements. A balanced mix of resources offers the best foundation for long-term success. Such balance would ensure that the weaknesses inherent in one type of contribution are compensated by the strengths of another, creating a more resilient financial system for CLTS.

The heavy reliance on personal savings reflects a deep sense of ownership and personal commitment but raises serious sustainability concerns for poorer households. Agricultural contributions, though important, are inherently unstable due to external shocks beyond community control. Employment income provides a relatively stable foundation and should be encouraged as a key pillar of community financing.

Remittances remain vital, as they allow communities with limited local economic opportunities to sustain sanitation efforts. However, the minimal government involvement signals a critical gap that must be addressed through stronger public sector commitment to rural sanitation. Public investment could help institutionalize sanitation programs, making them less vulnerable to the ebbs and flows of household finances and external remittance flows.

Overall, the distribution of socio-economic resources for CLTS practices highlights the importance of a diversified funding strategy. A combination of personal contributions, agricultural income, wage employment, remittances, and more substantial government support can create a more sustainable financial base for sanitation improvements.

Such diversification is critical not only for mitigating the risks associated with reliance on any single source but also for ensuring the resilience and longevity of CLTS initiatives. By adopting a multi-faceted approach to resource mobilization, rural communities can safeguard their sanitation achievements, reduce vulnerabilities, and move toward more sustainable public health outcomes. In essence, the study reveals that while communities are already demonstrating strong ownership and commitment to sanitation through varied resource mobilization strategies, the inclusion of stronger institutional support from government and external agencies will be essential to consolidate and sustain the progress achieved so far.

5.4 Distribution of Existing Sanitation Infrastructure (ESI) in the Community for the Successful Implementation of CLTS in Magarini Sub County

The frequency distribution of existing sanitation infrastructure (ESI) in Magarini Sub-County reveals a wide spectrum of perceptions among community members, an aspect that is fundamental for the successful implementation of Community-Led Total Sanitation (CLTS). According to the data, 9.5% of the respondents agreed that they have

sanitation infrastructure, while 34.1% disagreed. Additionally, 11.2% remained neutral, 13.6% strongly agreed, 10.6% strongly disagreed, 10.3% somewhat agreed, 9.1% somewhat disagreed, and 1.5% were unaware of the existence of such infrastructure.

These variations in perception highlight that while some segments of the community recognize the existence of sanitation facilities, a significant portion either doubts their adequacy or is entirely uninformed. Understanding this distribution of perceptions is critical because community attitudes strongly influence participation in sanitation initiatives.

These findings underscore the urgent need for enhanced communication, consistent engagement, and awareness-raising campaigns to ensure that the community is not only aware of the available facilities but also appreciates their benefits. Inadequate knowledge or misconceptions about sanitation infrastructure can undermine adoption and long-term sustainability. Previous research has consistently highlighted this gap. For instance, Mosler (2019) observed that behavior change in sanitation is not solely dependent on infrastructure provision but requires sustained community education, engagement, and reinforcement to alter entrenched perceptions and habits.

Likewise, Cameron et al. (2020) established that community-led initiatives yielded stronger results in areas where there was high awareness and appreciation of the benefits of sanitation infrastructure. These insights support the idea that infrastructure alone cannot drive sanitation transformation unless it is accompanied by active and inclusive community participation.

The 1.5% of respondents who indicated they were unaware of the existence of sanitation infrastructure reflect a critical communication gap. Even though this may appear to be a small fraction, it symbolizes households that are left behind in sanitation messaging. Such lack of awareness can result in non-participation or resistance to CLTS, further

limiting the success of interventions. Tailored awareness campaigns must, therefore, be designed to inform this segment about the current state of sanitation and the available infrastructure. This requires the use of locally accessible communication channels such as village meetings, local radio stations, community health volunteers, and school-based programs.

On the other hand, respondents who were neutral (11.2%) or somewhat agreed (10.3%) represent a group that is undecided and possibly skeptical. Their indecisiveness indicates either insufficient information or mixed experiences with the infrastructure. Providing targeted and relatable information that addresses their specific concerns could help shift their perceptions positively. For example, messages highlighting improvements in health outcomes, reductions in diarrheal diseases, or increased dignity and safety for women and children could resonate with this group. Sijbesma et al. (2010) emphasized that directly addressing community-specific concerns and offering clear, practical information significantly improves the acceptance and usage of sanitation facilities.

The group comprising 34.1% who disagreed and 10.6% who strongly disagreed is particularly important. Together, they form nearly half of the population, signaling widespread dissatisfaction or lack of recognition of existing sanitation facilities. Their perspectives cannot be ignored, as they likely reflect genuine concerns about the adequacy, quality, or accessibility of the infrastructure. Engaging them in open community dialogues, focus group discussions, and participatory mapping of sanitation challenges can help uncover these issues. Whaley and Webster (2019) argued that involving communities in co-identifying problems and solutions fosters trust and enhances ownership of sanitation programs. By understanding whether these groups are dissatisfied due to physical shortages of facilities, poor maintenance, cultural factors, or lack of awareness, planners can design targeted solutions.

Similarly, the 9.1% who somewhat disagreed and the 10.3% who somewhat agreed represent individuals whose perceptions can be swayed gradually. These groups may already recognize some infrastructure but feel it is either insufficient or not meeting their expectations.

Demonstrating incremental improvements, such as constructing new latrines, upgrading existing ones, or ensuring regular maintenance, can boost their confidence. Jenkins and Curtis (2018) observed that visible and progressive improvements in sanitation services help build community trust, sustain engagement, and eventually increase adoption rates. Furthermore, consistent updates on the progress of CLTS interventions through community scorecards or participatory monitoring could help these groups witness and acknowledge tangible change.

The 13.6% who strongly agreed and the 9.5% who agreed with the presence of sanitation infrastructure represent an invaluable resource to the CLTS initiative. This group already recognizes the importance of sanitation facilities and views them positively. They can be mobilized as community champions or role models to advocate for wider adoption. Kar and Chambers (2021) demonstrated the power of local champions in CLTS programs, noting that peers often inspire stronger behavior change than external actors. By showcasing their positive experiences, these supporters can influence undecided or skeptical households. For instance, through testimonials in community meetings, participation in sanitation demonstration activities, or hosting exchange visits, champions can effectively spread enthusiasm and encourage wider participation.

A closer analysis of these findings indicates that community perceptions of sanitation infrastructure in Magarini are far from uniform, reflecting a complex interplay of awareness, access, cultural beliefs, and experiences. The fact that more than one-third of respondents (34.1%) disagreed about the existence of infrastructure raises concerns about

gaps in either physical provision or visibility of facilities. Such a large portion of the community expressing doubt suggests the need for interventions that go beyond infrastructure development to include participatory planning, improved visibility of services, and accountability mechanisms. Addressing such concerns requires integrating both technical solutions such as construction and maintenance of latrines and social strategies such as awareness creation, behavior change campaigns, and engagement of marginalized groups.

The relatively high percentages of respondents who were neutral (11.2%) or somewhat agreed (10.3%) further highlight the opportunity for targeted communication. These groups represent the "swing population" whose perceptions can be influenced through consistent, persuasive messaging. By tailoring interventions to their specific concerns, program implementers can secure gradual yet meaningful shifts in community attitudes. This may include showcasing local success stories, sharing evidence of improved health outcomes, or even engaging respected local leaders to reinforce positive messages.

Meanwhile, leveraging the strong positive perceptions of the 13.6% who strongly agreed and the 9.5% who agreed is crucial. Their support should not only be acknowledged but also strategically harnessed. These individuals can act as the frontline advocates of CLTS, spreading knowledge and influencing the more skeptical segments. Peer-to-peer influence, as highlighted by Kar and Chambers (2021), is one of the most powerful tools for behavior change in sanitation.

In conclusion, the frequency distribution of perceptions of existing sanitation infrastructure in Magarini Sub-County paints a detailed picture of the challenges and opportunities for implementing CLTS. The data demonstrates that while a portion of the community acknowledges and supports existing infrastructure, significant segments are skeptical, neutral, or entirely unaware. Addressing this variation requires a multifaceted

approach enhanced communication and awareness campaigns, participatory community engagement, targeted interventions for neutral or skeptical groups, and strategic use of community champions. By combining these strategies, CLTS initiatives in Magarini can move beyond simply providing infrastructure to building community trust, fostering ownership, and ensuring long-term adoption and sustainability of improved sanitation practices.

5.5 Relationships between Location and Adequate Space to Construct Latrines

Investigating the relationship between location and sufficient space for latrine construction offers fascinating insights into sanitation infrastructure. The study revealed no statistically significant relationship between location and adequate space to construct latrines (ASCL). This outcome, derived from rigorous statistical analysis, contributes to the broader discussion on sanitation access, particularly the structural and environmental barriers communities face in ensuring proper hygiene facilities.

The cross-tabulation of ASCL and location produced a chi-square value of 3.321 with 4 degrees of freedom and a p-value of 0.487, suggesting that the distribution of adequate space across different locations is fairly uniform. In essence, the availability of space for constructing latrines does not vary considerably by location within the study context. This lack of significant association was reinforced by Cramer's V value of 0.100, which indicated a very weak relationship between the variables. Additionally, Fisher's Exact Test, often used to strengthen chi-square test results in cases of small sample sizes or uneven data distributions, corroborated these findings with a p-value of 0.487. Collectively, these statistical outputs underscore the robustness of the conclusion that location is not a key determinant of space availability for latrine construction in this study.

Placing these findings in comparative perspective is essential to appreciate their contribution to the existing body of knowledge. Previous studies have often reported varied results depending on geographical context, population density, and socio-economic conditions. For example, research conducted by Huda et al. (2021) demonstrated significant relationships between location and sanitation infrastructure, particularly emphasizing challenges in urban versus rural settings. Their study highlighted those urban areas, characterized by high population density, often struggle with limited physical space, making sanitation infrastructure development more difficult. In contrast, rural areas, while less constrained by space, encounter other challenges such as accessibility, financial resources, and cultural practices. This contrast suggests that the study context whether urban or rural plays a crucial role in determining the feasibility of sanitation projects. Unlike the current study, which shows uniform distribution of ASCL, Huda et al.'s research underscores the importance of considering settlement patterns when evaluating sanitation infrastructure.

Another perspective is provided by Jenkins and Curtis (2019), who highlighted the predominance of socio-economic factors over geographical location in shaping sanitation access. Their findings indicated that variables such as household income, education levels, and land ownership patterns exert more influence on sanitation infrastructure than physical location alone. Households with higher income levels are more likely to allocate resources toward constructing and maintaining adequate sanitation facilities, while education equips communities with the knowledge to appreciate the health benefits of sanitation. Land ownership further determines the willingness of residents to invest in permanent sanitation solutions. These insights resonate with the suggestion from the current study that beyond location, socio-economic factors must be explored more

deeply to fully understand barriers to ASCL. This line of thought shifts the discussion from a purely geographical focus to a broader socio-economic and structural framework.

Policy dimensions further enrich this discourse. Günther et al. (2021) investigated the role of policy interventions in improving sanitation infrastructure and found that while uniform policies may provide a baseline, tailored approaches that consider local demographic and socio-economic realities often yield better results. In contexts where space availability is uniform across locations as demonstrated in the current study policy interventions could be applied uniformly at the structural level. However, Günther et al. argue that flexibility should be embedded within such policies to address specific challenges faced by vulnerable groups, such as low-income households or communities with insecure land tenure. This nuanced perspective implies that while uniformity offers efficiency, adaptability ensures inclusivity and sustainability in sanitation initiatives.

Synthesizing these findings highlights several important dimensions. First, the lack of significant relationship between location and ASCL in this study provides a baseline indication that space constraints may not be a primary barrier in the specific study context. This contrasts with other studies in urban settings where spatial constraints are pronounced, reinforcing the idea that contextual differences must always be considered when interpreting sanitation research. Second, socio-economic variables emerge as critical factors requiring further exploration. The evidence from Jenkins and Curtis suggests that improving household income, enhancing education, and securing land tenure may be more impactful strategies for advancing sanitation than focusing solely on location. Third, policy approaches should balance uniformity with flexibility. While a uniform policy framework may ensure a consistent baseline of sanitation access, incorporating context-sensitive adaptations ensures that the needs of diverse populations are effectively addressed.

From a practical standpoint, these findings have significant implications for sanitation programming. In urban areas where population density is high, innovative solutions are required. For instance, vertical sanitation models, shared facilities, or integration of sanitation within broader urban planning strategies can mitigate space constraints. In rural areas, where space may be less of a limiting factor, interventions could focus on mobilizing communities, providing subsidies or microfinance for latrine construction, and addressing cultural barriers that discourage latrine use. Importantly, both urban and rural initiatives should incorporate education campaigns to promote awareness of sanitation benefits, thereby reinforcing behavior change.

Socio-economic considerations should also guide implementation strategies. Financial support mechanisms such as subsidies, low-interest loans, or material provision can empower low-income households to construct latrines. Educational programs aimed at increasing awareness about hygiene and sanitation can encourage households to prioritize these facilities. Addressing land ownership challenges is equally critical. In contexts where residents lack secure land tenure, investing in permanent structures such as latrines may be perceived as risky. Policies that improve land security can therefore serve as an enabling factor for better sanitation outcomes.

Moreover, this analysis underscores the interdependence of sanitation with broader development agendas. Improved sanitation not only enhances health outcomes by reducing waterborne diseases but also contributes to dignity, gender equality, and educational attainment, particularly for women and girls. Recognizing these interlinkages can help policymakers integrate sanitation interventions within broader frameworks such as poverty reduction, education, and public health strategies. The Sustainable Development Goals (SDGs), particularly Goal 6 on clean water and sanitation, provide a global framework that aligns well with such integrated approaches.

In conclusion, while the current study's findings reveal no significant relationship between location and adequate space for latrine construction, the broader context provided by comparative studies enriches the interpretation. The uniformity in space availability across locations suggests that, at least within the study setting, location may not be the most pressing constraint. However, socio-economic variables, cultural practices, and policy frameworks remain central to understanding and addressing sanitation challenges. Uniform policies can offer a foundation for sanitation interventions, but adaptability and context-specific strategies are essential for ensuring inclusivity and sustainability. By considering multiple dimensions spatial, socio-economic, and policy-related stakeholders can design more effective and equitable sanitation solutions. Ultimately, ensuring access to adequate sanitation for all communities requires a holistic approach that transcends location alone, embracing the complex interplay of social, economic, and structural factors.

5.6 Relationships between Location and Existing Sanitation Infrastructure (ESI) in Magarini Sub County

The statistical analysis of the relationship between location and perceptions of existing sanitation infrastructure (ESI) in Magarini Sub County reveals critical insights into the interplay between geography and public opinion on sanitation services. Sanitation remains a cornerstone of public health and community well-being, yet disparities in infrastructure availability and quality across regions often create unequal experiences. In this study, geographic factors emerged as a strong influence shaping residents' perception, highlighting that where people live directly affects how they experience sanitation services and how they evaluate their adequacy.

The chi-square test ($\chi^2 = 66.636$, df = 28, p = 0.000) confirms that there is a statistically significant relationship between ESI and location. This means that the differences in perceptions across various locations within Magarini Sub County are not random but are instead linked to local realities. Moreover, the analysis indicates a moderate association (Cramer's V = 0.224), which reinforces the idea that geographical factors contribute meaningfully to differences in satisfaction levels. Patterns identified across the sub-county reveal a prevailing sense of dissatisfaction with sanitation infrastructure, though the intensity of this sentiment varies from one locality to another.

In Adu**,** the findings show a mixed but leaning-negative perception. The largest group of respondents (28.7%) disagreed with the statement regarding the adequacy of existing sanitation infrastructure. A moderate number of respondents either agreed or remained neutral, suggesting that although some residents perceive the services as functional, dissatisfaction is the dominant view. This highlights variability in the quality of services provided within Adu, suggesting that while some areas may benefit from relatively better infrastructure, other areas are underserved. The coexistence of neutral and agreeing responses points to the possibility that certain facilities are functioning reasonably well, but systemic weaknesses in infrastructure provision and maintenance undermine overall community satisfaction. For policymakers, this implies that Adu would benefit from targeted assessments to identify why perceptions diverge and how specific areas of weakness can be addressed.

The situation in Marafa**,** which had the highest number of respondents (111), reveals even more pronounced dissatisfaction. Here, 29.7% disagreed and 20.7% strongly disagreed with the adequacy of sanitation infrastructure. This shows that almost half of the population sampled in Marafa holds a negative view of sanitation services. Agreement levels were notably lower compared to Adu, underscoring that dissatisfaction

is more intense and possibly more widespread in this location. Such findings may reflect underlying issues such as poor maintenance, insufficient coverage, or facilities that fail to meet the needs of a growing population. Interestingly, the high level of engagement by Marafa's residents in expressing their views also suggests that the community is both aware of sanitation challenges and potentially ready to participate in interventions aimed at improvement. For stakeholders, this represents an opportunity: investing in sanitation solutions in Marafa could yield visible improvements and possibly foster stronger community participation in sustaining infrastructure over the long term.

Moving to Magarini, the results depict even stronger negative perceptions. Here, 36.4% of respondents disagreed with the adequacy of sanitation infrastructure, while only 10.4% agreed. This indicates a striking gap between negative and positive evaluations. Such a pattern reveals deep dissatisfaction, pointing to critical deficiencies in the provision of sanitation services. The implications of these findings are substantial. When more than one-third of a community expresses dissatisfaction and less than one-tenth affirms adequacy, it suggests not only widespread service delivery challenges but also a growing risk of public health issues and reduced quality of life. These findings make it evident that Magarini requires urgent and prioritized interventions. Improvements must not only involve the physical upgrading of sanitation facilities but also community engagement to rebuild trust and ensure that services meet local needs sustainably.

In Sabaki**,** although the sample size was relatively small (30 respondents), the findings still provide valuable insights. About 30% of respondents disagreed with the adequacy of sanitation services, while others expressed neutral or agreeing views in roughly balanced proportions. Although the smaller sample limits the extent to which general conclusions can be drawn, the dissatisfaction of nearly one-third of respondents cannot be ignored. The balanced distribution of neutral and positive views suggests that certain parts of

Sabaki may have access to functioning sanitation facilities, while others remain underserved. This points to the need for targeted rather than blanket interventions. Addressing issues in Sabaki would require localized assessments to identify problem areas, ensuring that interventions are resource-efficient and effective in improving the quality of services where dissatisfaction is highest.

The case of Gongoni stands out as the most alarming. Findings revealed that 60.6% of respondents disagreed with the adequacy of sanitation infrastructure, and notably, no respondents agreed. This means that in Gongoni, dissatisfaction is nearly unanimous, with the remaining percentage consisting of neutral responses. Such an outcome indicates a critical situation where existing sanitation infrastructure is perceived as entirely inadequate, leaving residents without reliable or acceptable services. The complete lack of agreement underscores a systemic failure in sanitation provision, pointing to severe deficiencies that may pose significant public health risks. Gongoni, therefore, must be considered a priority for immediate and substantial intervention. The level of dissatisfaction suggests that incremental improvements may not be sufficient; instead, large-scale investments and a comprehensive overhaul of sanitation systems may be necessary to restore basic standards and rebuild public trust in service delivery.

The findings from Magarini Sub County align with broader literature on the relationship between geography and sanitation. Previous studies, such as those by Tumwine et al. (2020) and Kativhu et al. (2018), also report that rural and peri-urban areas frequently experience lower satisfaction with sanitation facilities. These deficits often arise from challenges such as inadequate investment, poor maintenance, limited access to water supply, and growing population pressures. By situating the Magarini findings within this wider context, it becomes evident that geographical disparities are a consistent factor shaping public perceptions of sanitation adequacy. Importantly, these studies reinforce

the notion that solutions must be context-specific, recognizing that what works in one area may not automatically succeed in another.

The statistically significant relationship between location and perceptions of ESI in Magarini emphasizes the importance of localized conditions such as resource availability, institutional capacity, and maintenance systems. For instance, areas like Gongoni and Magarini, where dissatisfaction is most pronounced, may suffer from more severe infrastructure deficits or weaker systems of upkeep compared to Adu or Sabaki. The variations underscore the necessity for interventions that are responsive to local contexts rather than adopting a uniform approach across the sub-county. Policymakers and stakeholders should therefore consider tailoring strategies to the unique needs and challenges of each location. This could include measures such as increasing investments in sanitation infrastructure, strengthening routine maintenance systems, and involving communities in planning and oversight processes. Community participation is particularly crucial, as it fosters ownership, ensures that interventions address real needs, and enhances the sustainability of improvements.

The implications of this analysis extend beyond immediate sanitation concerns. Improved sanitation infrastructure not only reduces disease prevalence but also enhances overall quality of life, supports educational outcomes by keeping children in school, and contributes to economic development by improving productivity and reducing health-related costs. For Magarini Sub County, addressing the widespread dissatisfaction with sanitation infrastructure could therefore generate broad social and economic benefits, reinforcing the urgency of the issue.

In conclusion, the relationship between location and perceptions of existing sanitation infrastructure in Magarini Sub County is both statistically significant and practically important. Variations in satisfaction levels across Adu, Marafa, Magarini, Sabaki, and

Gongoni highlight the uneven distribution of service adequacy, with Gongoni and Magarini facing the most critical challenges. These findings point to the necessity of localized, context-sensitive interventions that recognize the unique conditions of each area. By prioritizing investment, maintenance, and community involvement, policymakers and stakeholders can address the deficiencies identified in the study. Doing so will not only improve sanitation outcomes but also contribute to broader public health, social well-being, and economic progress in Magarini Sub County.

CHAPTER SIX: CONCLUSION, RECOMMENDATIONS AND PUBLICATION

6.0 Introduction

This section highlights the conclusion drawn, recommendations given and how the research publication.

6.1 Conclusion

The study aimed to assess the factors influencing the long-term adoption of improved sanitation through Community-Led Total Sanitation (CLTS) in Magarini Sub-County, Kilifi County. Specifically, it sought to examine the socio-economic factors that shape adoption and evaluate the extent of existing sanitation infrastructure that either facilitates or constrains implementation. From the findings, several important conclusions can be drawn that highlight the complexity of sanitation adoption and sustainability in the study area, revealing that sanitation is not simply a matter of knowledge dissemination but rather a multifaceted process shaped by cultural, economic, infrastructural, and governance-related considerations.

With respect to socio-economic factors, the results revealed that while education is often emphasized in sanitation research, its role in Magarini is less definitive. The study found that the lack of a statistically significant association between education levels and CLTS outcomes underscores that education alone does not determine adoption. This challenges the conventional assumption that raising educational attainment automatically translates to improved sanitation behavior. Instead, other factors, such as community leadership, cultural practices, women's involvement, and the availability of resources, appeared to be more decisive in influencing outcomes. This conclusion resonates with a body of literature that emphasizes the multi-dimensionality of sanitation adoption, where education enhances awareness but does not necessarily guarantee behavioral change. In Magarini, the adoption of improved sanitation was influenced more strongly by social

cohesion, leadership mobilization, and deeply rooted cultural norms than by formal educational attainment. This suggests that interventions focusing solely on education campaigns may not yield the desired outcomes unless complemented by context-specific strategies that engage cultural and community dynamics in meaningful ways. For example, the role of elders and traditional leaders in mobilizing households, or the involvement of women in championing sanitation practices, could be stronger drivers of sustained behavioral transformation.

The distribution of socio-economic resources highlighted both strengths and vulnerabilities in sustaining CLTS efforts. Personal savings emerged as the primary source of financing, reflecting a strong personal commitment among households to sanitation improvement. This demonstrates that households in Magarini value sanitation and are willing to dedicate financial resources to it, even in the absence of formal institutional support. However, this reliance on individual financial reserves raises significant sustainability concerns, particularly for low-income households who may quickly exhaust savings and find it difficult to rebuild them. While employment income and remittances from family members working elsewhere provided supplementary stability, agricultural income although a significant contributor to household earnings was shown to be highly vulnerable to external shocks such as drought, erratic rainfall, and fluctuating market prices. Such vulnerabilities compromise the ability of households to maintain or upgrade sanitation facilities over the long term. Moreover, the minimal government involvement in financing further compounded these challenges, suggesting that sanitation adoption is largely a community-driven effort with very limited institutional backing. This lack of consistent public sector engagement leaves households exposed to financial instability and makes long-term sustainability tenuous. Therefore, unless more stable and diversified financial mechanisms are introduced to support CLTS

initiatives such as microcredit schemes, subsidies, or government-backed programs the prospects for sustaining gains remain uncertain.

The extent and quality of sanitation infrastructure in Magarini also presented mixed outcomes. The findings revealed varied perceptions among residents, with a substantial proportion disagreeing that adequate infrastructure exists, while others acknowledged its presence or expressed neutral views. This divergence in perceptions points to both gaps in infrastructure provision and weaknesses in communication about the availability or functionality of existing facilities. For example, communities such as Gongoni and Magarini expressed overwhelming dissatisfaction, reflecting severe deficits in access to sanitation infrastructure. In contrast, areas like Adu and Sabaki showed more mixed perceptions, suggesting that infrastructure was present but perhaps unevenly distributed or inconsistently maintained. These variations underscore the importance of geographic context in sanitation planning. Where infrastructure is inadequate or poorly maintained, dissatisfaction tends to undermine adoption and sustainability, as households perceive efforts as futile or burdensome. Conversely, in areas where facilities exist and are visible, community champions can reinforce positive perceptions and encourage uptake of sanitation practices. The overall conclusion is that sanitation infrastructure is unevenly distributed and inconsistently perceived across the sub-county, necessitating targeted and localized interventions that address specific community needs and contexts.

Additionally, the study found no significant relationship between location and adequate space to construct latrines, suggesting that land availability is relatively uniform across Magarini. This finding indicates that the primary barriers to sanitation are not spatial in nature but rather socio-economic and infrastructural. Households generally had access to land on which to construct latrines, but the challenge lay in acquiring the financial resources, technical expertise, or appropriate materials to build durable and hygienic

facilities. By contrast, the significant association between location and perceptions of sanitation infrastructure confirmed that geography does matter in shaping experiences of sanitation services. Locations such as Gongoni, where dissatisfaction with sanitation infrastructure was near universal, demonstrated how localized conditions create distinct challenges requiring urgent policy attention. These insights stress the importance of moving beyond blanket policies toward more nuanced, area-specific interventions that account for geographical variations in both perceptions and realities of sanitation infrastructure.

From a broader perspective, the findings contribute to the understanding that sanitation adoption is not determined by any single factor but rather a complex interplay of social, cultural, economic, and infrastructural dynamics. In Magarini, adoption is constrained by limited government involvement, reliance on unstable financial sources, uneven infrastructure distribution, and persistent cultural attitudes that sometimes hinder behavioral change. At the same time, the study highlighted important opportunities. For instance, community leadership and women's involvement emerged as powerful levers for change. Similarly, remittances and the presence of local champions offered potential pathways for building momentum toward long-term adoption. These opportunities suggest that while progress has been uneven, there is a foundation upon which more comprehensive and integrated strategies can be built.

Thus, the overall conclusion is that CLTS in Magarini requires a more holistic and multi-sectoral approach. Interventions need to integrate socio-economic empowerment, infrastructural development, cultural sensitivity, and stronger government support. Addressing financial instability through accessible credit facilities, engaging traditional leaders to shift cultural norms, and ensuring equitable infrastructure development could collectively create an enabling environment for sustainable sanitation adoption.

Moreover, greater collaboration between government institutions, non-governmental organizations, and community groups would enhance the resilience of CLTS initiatives and reduce the risk of reversal of gains.

Ultimately, the study underscores that for improved sanitation through CLTS to be sustained in Magarini, strategies must go beyond awareness creation and behavior change. They must address the structural and systemic barriers that limit access, equity, and sustainability. Only through such a comprehensive and inclusive approach can CLTS realize its full potential to transform sanitation outcomes and improve public health in the long term. The key message from the findings is clear: successful sanitation interventions in contexts like Magarini depend not only on mobilizing communities but also on building robust systems that protect and empower households against economic shocks, infrastructural deficits, and cultural constraints. This balanced, holistic approach offers the best chance of ensuring that sanitation gains are not only achieved but also sustained for future generations.

6.2 Recommendations

Building on the findings and conclusions of this study, several recommendations can be made to enhance the long-term adoption of improved sanitation through CLTS in Magarini Sub-County. These recommendations are directed at policymakers, program implementers, community leaders, and other stakeholders committed to improving sanitation outcomes in rural Kenya.

There is a need for strengthened government involvement and financial support in sanitation programming. The study revealed minimal contribution from government resources, leaving households to rely on personal savings, agricultural income, and remittances. To ensure sustainability, county and national governments should increase budgetary allocations for rural sanitation, including subsidies for latrine construction,

micro-financing schemes for low-income households, and maintenance funds. Establishing partnerships with NGOs and private sector actors can further diversify funding streams, reducing reliance on unstable household finances. Policy frameworks should also integrate sanitation financing into broader rural development agendas, ensuring consistent and long-term support.

Community leadership and cultural engagement must be harnessed more strategically. The absence of a significant link between education and sanitation adoption suggests that local leaders and cultural influencers play a more critical role in shaping behaviors. CLTS implementers should therefore prioritize identifying, training, and empowering community champions, including women and youth leaders, who can drive peer influence and collective action. Integrating local traditions and cultural practices into sanitation messaging can enhance acceptance and minimize resistance. Religious leaders should also be engaged, given their influence in shaping community values and mobilizing collective efforts.

Infrastructure development and maintenance require targeted and location-specific interventions. The study showed stark differences across locations, with some communities expressing near-total dissatisfaction with sanitation infrastructure. Policymakers should prioritize high-need areas such as Gongoni and Magarini for urgent interventions, while sustaining momentum in relatively better-performing areas like Adu and Sabaki. Strategies should include the construction of affordable, context-appropriate latrines, rehabilitation of existing facilities, and establishment of maintenance committees to ensure longevity. Awareness campaigns must complement infrastructure provision, addressing misconceptions and ensuring households recognize the value of available facilities.

A critical need also exists to diversify and stabilize financing sources for sanitation. Beyond government support, innovative financing mechanisms should be explored, including community savings groups, sanitation cooperatives, and microcredit schemes tailored for latrine construction and maintenance. Encouraging partnerships with microfinance institutions can provide low-interest loans for households, while donor-funded revolving funds could offer initial capital for community projects. Additionally, leveraging remittances by creating community sanitation funds where diaspora contributions are pooled could further support collective initiatives.

Gender inclusion and empowerment of marginalized groups must be central to CLTS implementation. Women, who are often responsible for household water and sanitation management, should be given leadership roles in CLTS committees. Their participation has been shown to improve the sustainability of sanitation practices, ensuring facilities are well maintained and hygienic practices consistently applied. Similarly, marginalized groups, including the poor and landless, should be supported through subsidies and targeted interventions to ensure equity in sanitation adoption.

Policy flexibility and local adaptation should guide implementation. Although location was not significantly associated with space availability for latrines, the study found that perceptions of infrastructure varied widely across communities.

This highlights the importance of tailoring interventions to local needs rather than applying uniform strategies. Policies should be adaptive, allowing for context-specific solutions that reflect socio-economic realities, cultural dynamics, and geographic disparities.

Monitoring, evaluation, and learning systems should also be strengthened. Regular assessments of sanitation adoption, infrastructure quality, and community perceptions can help identify gaps and successes early. Establishing participatory monitoring systems

that involve community members will not only enhance accountability but also foster ownership of CLTS outcomes. Sharing best practices across locations within Magarini and beyond can further accelerate progress by replicating successful models.

In conclusion, sustaining improved sanitation through CLTS in Magarini Sub-County requires a multi-pronged approach that integrates financial, cultural, infrastructural, and policy dimensions. By enhancing government support, leveraging community leadership, diversifying funding, empowering women, and adopting context-sensitive strategies, CLTS can move from short-term adoption to long-term sustainability. These recommendations, if effectively implemented, hold the potential to transform sanitation practices, improve public health outcomes, and contribute to broader socio-economic development in Magarini and similar rural contexts.

6.3 Publication

Simiyu, K., Mutembei,J., Mberia, J. & Eliud, G. (2025). Assessing Socio-Economic Barriers to the Long- Term Success of Community-Led Total Sanitation in Magarini, Kilifi County Kenya. *International Journal of Innovative Science and Research Technology (IJISRT),10*(8), 187-194. https://doi.org/10.38124/ijisrt/25aug127**REFFRENCES**

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APPENDICES

Appendix A. Informed consent

Part One: Information Sheet

I am a research assistant conducting research on behalf of Meru University of Science and Technology on factors that contribute to long-term adoption of improved sanitation through Community Lead Total Sanitation in Magarini, Sub-County in Kilifi County.

I will provide you with details about the study and invite you to participate in it. You do not need to decide whether or not to participate in the study today. Before you make a decision, you can discuss the findings with whomever you feel comfortable with. This permission form may include words you do not understand. Please ask me to stop as we go over the facts, and I will explain. This study will require your participation in an interview that will last 15-30 minutes.

Your participation in this research is entirely voluntary. You can choose whether or not to participate. You are kindly encouraged to participate in this study, which is critical for increasing the effectiveness of community-based tuberculosis care in Meru County. The information gathered from this research proposal will be kept private. Any information about you will include a number instead of your name. Only the researcher will know your phone number and the information will be kept strictly confidential. It will not be shared or supplied to anybody other than the people involved in this project or the university.

If you have any questions, you can ask now or later. If you wish to ask questions later you may contact the following 0704425790.

Part Two: Certificate of Consent

I read or had the information read to me. I had the opportunity to ask questions concerning the study. My questions have been answered satisfactorily. I provide my voluntary consent to participate in this study.

Number of the participant…….

Signature of the participant…….……

Date…….

If a participant is illiterate but provides oral agreement, a witness must sign. A researcher or the person reviewing the informed consent must sign each consent since the certificate is an inherent element of the informed consent and not a separate document.

Name of participant Signature of subject/thumbprint Date

(Witness to print if subject is unable to write)

Name of representative /Witness Relationship to subject

Name of person obtaining consent Signature Date

Printed name of Investigator Signature Date

Appendix B. Questionnaire

Section 1: Demographic information

1	Record the date of theinterview	day [ ][ ] month [ ][ ] year [ ][ ][ ][ ]
2	Location	Community/village.....
3	What is your gender?	1.....Female 2.....Male ☐

4	Have you lived in this community/village for atleast 1 year?	1.....Yes 2.....No ☐
5	What's your age group?	1. 18-25 years 2. 26-35 years 3. 36-45 years 4. 46-55 years 5. 56-65 years 6. 66 years and above ☐
6	What is your marital status?	1.....single 2..... married 3..... widowed 4..... cohabiting 5..... ☐ ..... divorced
7	What is your level of education?	1.....No formal education 2.....Completed primary education 3.....Completed secondary education 4.....University degree 5.....Tertiary institution ☐
8	What is your religious affiliation?	1.....No religious affiliation 2.....Catholic 3.....Protestant 4.....Pentecostal 5.....Muslim 6.....Buddhist 7.....Traditional/animist 8.....other ☐

Section 2: Socio-economic factors contributing to long-term adoption of improved sanitation through CLTS

9	How far is the defecation site from your house?	1..... Less than 50 Meters 2..... Between 50-100 Meters 3..... Between 100-200 Meters 4..... Above)metres
10	Do you believe the current sanitation infrastructure is sustainable in the long term?	1..... Strongly Disagree 2..... Disagree 3..... Neutral 4..... Agree 5..... Strongly Agree
11	Are there members of your family who have had diarrhea in the last two (2) weeks?	1.....YES 2.....NO
12	On the response above, how much was spent on treatment on each member?	1.....Less than Ksh100 2.....Between Ksh101 and Ksh500 3.....Between Ksh 501 and Ksh1000. 4.....More than Ksh 1000
13	How responsible do you think the community is for maintaining sanitation facilities?	1..... Not responsible at all 2..... Slightly responsible 3..... Moderately responsible 4..... Highly responsible

		5..... Completely responsible
14	Are there any cultural barriers hindering one from owning and/ or using a latrine?	1.....YES 2.....NO ☐
15	People in your community do not own a latrine because they lack funds to construct one.	1..... Strongly Disagree 2..... Disagree 3..... Neither Agree nor Disagree 4..... Agree 5..... Strongly Agree ☐
16	Are there cultural beliefs and practices that have hindered you from constructing a latrine?	1. Yes 2. No 3. Don't know ☐
17	Improved sanitation can have positive impact on your health and well-being.	1. strongly Agree 2. Agree 3. Neutral 4. Disagree 5. Strongly Disagree ☐

Section 3: Availability of sanitation infrastructure

18	What types of sanitation facilities are available in your community?	1. Pit latrines 2. Flush toilets 3. Composting toilets 4. No sanitation facilities 5. Other (please ☐ify)
19	On a scale of 1 to 5, how would you rate the overall hygiene practices in your community?	1 - Poor 2 - Fair 3 - Average 4 - Good 5 – Excellent ☐

20	How often do sanitation facilities require repairs or maintenance in your community?	A. Very frequently B. Frequently C. Occasionally D. Rarely E. Never
21	Existing sanitation infrastructure in your community are adequate for the successful implementation of CLTS.	1. Strongly Agree 2. Agree 3. Somehow Agree 4. Neutral 5. Somehow Disagree 6. Disagree 7. Strongly Disagree 8. Don't Know
22	How often do you utilize the available sanitation facilities?	1. Rarely 2. Occasionally 3. Frequently 4. Very frequently
23	How frequently do you engage in handwashing practices?	1. Much less frequently 2. Less frequently 3. About the same 4. More frequently 5. Much more frequently
24	Do you have access to a private toilet or latrine at your household?	1. Yes 2. No
25	Do you share sanitation facilities with other households?	A. Yes B. No
26	Are there any traditional cultural practices that affect the adoption of modern sanitation methods in your community?	1. Yes, significantly 2. Yes, to some extent 3. No, not at all
26	To what extent do you think community beliefs influence sanitation practices?	1. Not at all 2. Slightly 3. Moderately 4. Significantly

		5. Completely
28	Have you changed your waste disposal practices in the previous year to ensure safety in your household?	1. Yes, significantly 2. Yes, to some extent 3. No change 4. No
29	Are there specific hygiene practices that you have adopted recently due to improved sanitation initiatives?	1. Yes 2. No
30	Do you think financial constraints has hindered the adoption of improved sanitation practices in your community?	1. Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly Agree

Thank you for your time.

Appendix C. NACOSTI License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 713888

Date of Issue: 01/February/2024

RESEARCH LICENSE

This is to Certify that Mr.. KELLY SIMIYU WANJALA of Meru University of Science and Technology, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kilifi on the topic: Factors Affecting Long-Term Adoption of Improved Sanitation Through Community Led Total Sanitation in Magarini Sub-County, Kilifi County. for the period ending : 01/February/2025.

License No: NACOSTI/P/24/32625

713888

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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See overleaf for conditions

Appendix D. Introductory School Letter

MERU UNIVERSITY
OF SCIENCE & TECHNOLOGY

P.O Box, 972-60200 Meru-Kenya
Phone: +254 (0) 712 524 293, +254 (0)799 529 958, +254 (0)799 529 959
Email: engineering@must.ac.ke *Website:* www.must.ac.ke

SCHOOL OF ENGINEERING AND ARCHITECTURE

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

TO: Whom It may concern **DATE:** 17th January, 2024

Dear Sir/Madam,

RE: INTRODUCTORY LETTER FOR SIMIYU KELLY WANJALA, REG NO. EG407/201527/21

The above-named, is a student in the Department of Civil and Environmental Engineering at Meru University of Science and Technology, pursuing a Master's degree in Sanitation. He has been approved to conduct research on **"Factors Affecting Long-Term Adoption of Improved Sanitation Through Community Led Total Sanitation in Magarini Sub-County, Kilifi County"** aimed at completing his studies. This is therefore, to request that you grant him any assistance needed to enable him meet the program requirements for his graduation.

Kindly contact us for any further enquiries.

Thank you

Mirara simon w.
Chair of Department Civil and Environmental Engineering
Meru University of Science and Technology
Email: CODcivilengineeing@must.ac.ke
Smirara@must.ac.ke

MUST IS ISO 9001:2015 CERTIFIED

Appendix E. Authorization letter

OFFICE OF THE PRESIDENT
MINISTRY OF INTERIOR AND NATIONAL ADMINISTRATION
STATE DEPARTMENT OF INTERNAL SECURITY AND NATIONAL ADMINISTRATION

Telephone:
Fax:
Email:cckilificoordination@gmail.com
When replying please quote
Ref: **EDUC.12/7/VOL.11/81**

County Commissioner's Office
Kilifi County
P. O. Box 29 - 80108
KILIFI

And Date 26th July, 2024

SIMIYU WANJALA KELLY
P.O.BOX 1369 - 80200
MALINDI - KENYA

RE: RESEARCH AUTHORIZATION
SIMIYU WANJALA KELLY LICENSE NO: NACOSTI/P/24/32625

Your unreferenced letter date 24th July, 2024 and Referenced letter on the above subject matter refers.
This office has no objection with your carrying research on ***"Factors Affecting Long -Term Adoption of Improved Sanitation Through Community Led Total Sanitation in, Kilifi County"*** which is scheduled between 1st February 2024 to 1st February, 2025 in Magarini, Sub County, Kilifi County so long as it is conducted within Ministry of Education and Health Guidelines.

You are therefore required to liaise with the County Director of Education and Health department for guidance.

Thank you.

COUNTY COMMISSIONER
KILIFI COUNTY
P. O. Box 29 - 80108
KILIFI

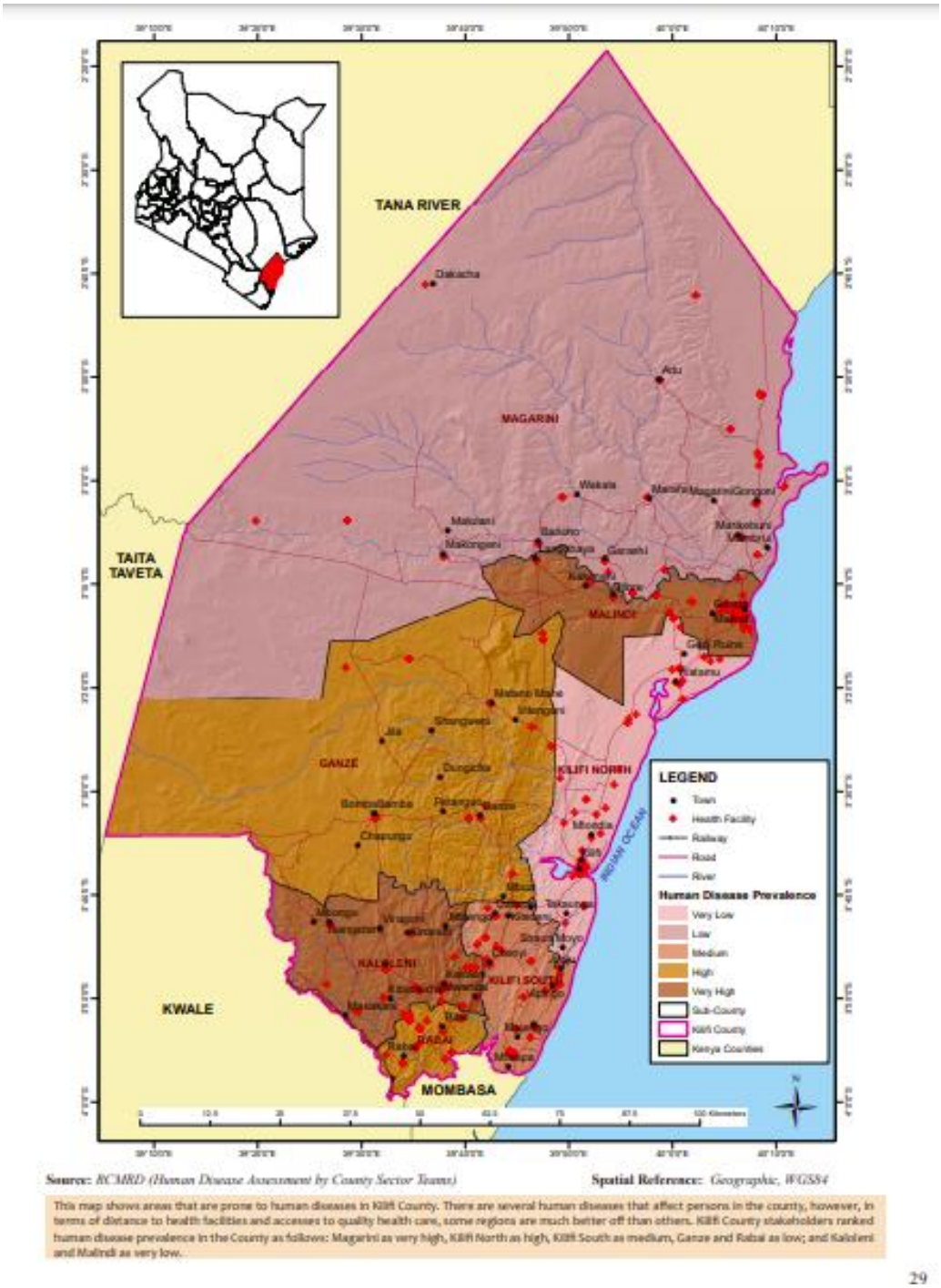
MISKEY AHMED
FOR: COUNTY COMMISSIONER
KILIFI COUNTY

c.c.
Deputy County Commissioners
Magarini Sub County
KILIFI COUNTY

County Director of Education
KILIFI COUNTY

Chair of Department Civil and
Environmental Engineering
Meru University of Science and Technology
Meru University of Science & Technology
P.O.BOX 972-60200
MERU- KENYA

Appendix F. Map of Study Area (Magarini Sub County)

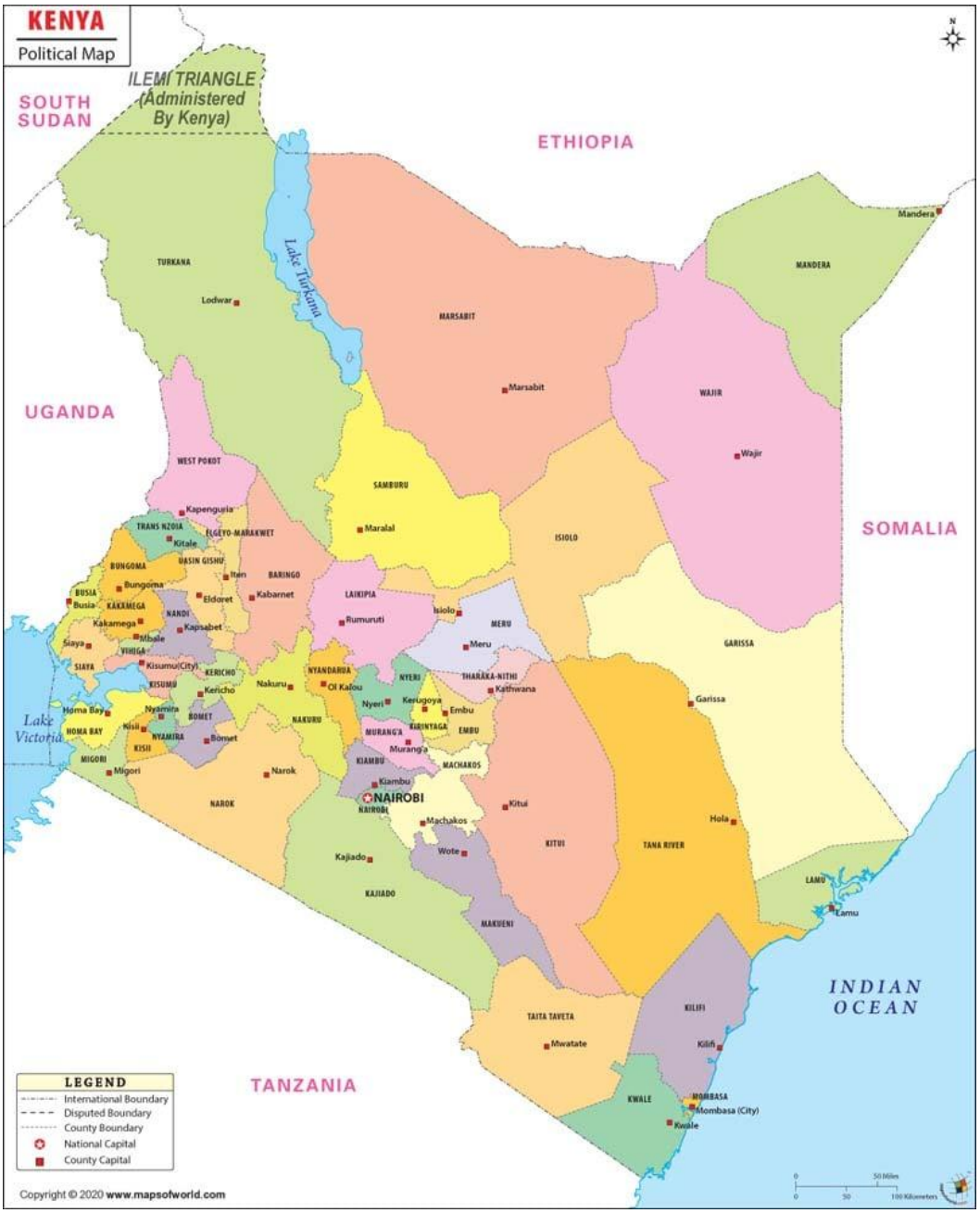


Source: *BCMRD (Human Disease Assessment by County Sector Teams)* **Spatial Reference:** *Geographic, WGS84*

This map shows areas that are prone to human diseases in Kilifi County. There are several human diseases that affect persons in the county, however, in terms of distance to health facilities and accesses to quality health care, some regions are much better off than others. Kilifi County stakeholders ranked human disease prevalence in the County as follows: Magarini as very high, Kilifi North as high, Kilifi South as medium, Ganze and Rabai as low; and Kaloleni and Malindi as very low.

29

Appendix G. Map of Kenya



Appendix H. Plagiarism Report

DrillBit

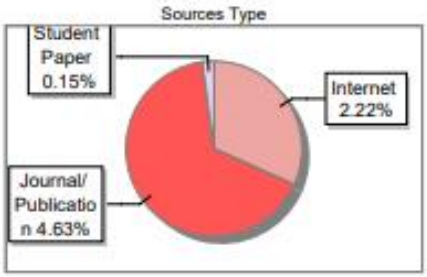
The Report is Generated by DrillBit Plagiarism Detection Software

Submission Information

Author Name	Kelly Simiyu
Title	FACTORS AFFECTING LONG-TERM ADOPTION OF IMPROVED SANITATION THROUGH COMMUNITY LED TOTAL SANITATION IN MAGARINI SUB-COUNTY, KILIFI COUNTY
Paper/Submission ID	4374839
Submitted by	library@must.ac.ke
Submission Date	2025-09-17 18:25:00
Total Pages, Total Words	123, 25724
Document type	Thesis

Result Information

Similarity 7 %



Exclude Information

Quotes	Excluded
References/Bibliography	Excluded
Source: Excluded < 14 Words	Not Excluded
Excluded Source	0 %
Excluded Phrases	Not Excluded

Database Selection

Language	English
Student Papers	Yes
Journals & publishers	Yes
Internet or Web	Yes
Institution Repository	Yes

A Unique QR Code use to View/Download/Share Pdf File

Appendix I. Publication

Volume 10, Issue 8, August – 2025 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25aug127

Assessing Socio-Economic Barriers to the Long-Term Success of Community-Led Total Sanitation in Magarini, Kilifi County Kenya

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Jane Kawira Mberia[2]; Grace Kasiva Eliud[1]

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* Corresponding Author: Simiyu Kelly

Publication Date: 2025/08/12

Abstract: Fecal-oral infections in Magarini Sub County remain a critical public health challenge, largely due to the insufficient execution of the Community Led Total Sanitation (CLTS) approach initiated by the Ministry of Health. Around 5.6 million Kenyans still engage in open defecation, underscoring the urgent need for improved sanitation measures. This research examined the socio-economic determinants affecting the sustained adoption of CLTS-induced sanitation enhancements in the area. A convergent research methodology was used, gathering quantitative data via structured questionnaires from 388 household heads, chosen through stratified and proportionate random sampling. Data analysis was conducted using SPSS version 25, generating descriptive and inferential statistics to assess variable relationships.

The results revealed a notable link between location and religion in Magarini Sub-County, with a chi-square value (χ^2) of 34.558, 20 degrees of freedom, and a p-value of 0.027. This suggests that geographic factors moderately influence religious affiliation, as indicated by a Cramer's V coefficient of 0.162. However, no significant correlation was found between education levels and population distribution. These outcomes emphasize the importance of culturally and socially tailored policies that account for regional and religious variations.

The study also identified personal savings and agricultural assets as key drivers in maintaining sanitation efforts. Sustainable financing approaches, community involvement, employment earnings, and government backing were deemed essential for long-term CLTS success. Dependence on these economic resources highlights the need for strategies that strengthen financial security and promote sanitation advancements. Policymakers and education leaders can leverage these findings to refine educational strategies and address sanitation disparities among different community segments.

Further research was recommended to explore household income and education as determinants of infrastructure requirements for lasting sanitation improvements in Magarini Sub County. Tackling these socio-economic barriers and cultivating an enabling environment could enhance sanitation and hygiene, thereby lowering the prevalence of fecal-oral infections in the region.

Keywords: *Socio-Economic Factors, Sanitation Interventions, Sanitation Practices, Improved Sanitation.*

How to Cite: Simiyu Kelly; Josephine Mutembei; Jane Kawira Mberia; Grace Kasiva Eliud (2025) Assessing Socio-Economic Barriers to the Long-Term Success of Community-Led Total Sanitation in Magarini, Kilifi County Kenya. *International Journal of Innovative Science and Research Technology*, 10(8), 187-194. https://doi.org/10.38124/ijisrt/25aug127