Socio-Economic Determinants of Sanitation Technology Adoption in Kapseret Sub County, Uasin Gishu County, Kenya

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Abstract: In many rural areas of developing nations, access to improved sanitation is still a major public health and development concern. This study examines how households in Kapseret Sub-County, Uasin Gishu County, Kenya, utilize sanitation technology in relation to socioeconomic parameters. Data was obtained from 475 families selected by stratified random sampling in four different regions using a descriptive research method. Descriptive statistics, correlations, regression, and ANOVA tests were used to evaluate both qualitative and quantitative data using SPSS (version 26).

According to the results, 30.9% of respondents used unimproved sanitation methods, whereas 69.1% of respondents had access to improved options, such as pour-flush toilets that were connected to septic tanks or sewage systems. The choice and sustainability of sanitation systems were greatly impacted by socioeconomic characteristics, including household income, education level, employment status, dwelling structure, and access to building materials. 32.4% of households reported having financial difficulties, which suggests that maintaining current amenities is difficult. Analysis of regression and association highlighted how education and income influence sanitation adoption and behavior.

The study concludes that effective sanitation interventions must address multiple interrelated socio-economic challenges. It recommends a collaborative, community-based approach integrating education, financial support, and infrastructure development to enhance sanitation access and sustainability in the region.

Keywords: Sanitation Technologies, Household Characteristics, Socio-Economic Factors, Community Attitudes, and Cultural Norms.

I. INTRODUCTION

Sanitation is a public good that benefits society by improving health, economic development, and social well-being. Proper sanitation forms the sturdy threads that weave health, dignity, and prosperity together. It leads to prevention of disease, acting as a formidable barrier against the spread of pathogens that lurk in contaminated water and inadequate waste disposal. Inadequate sanitation can lead to various health issues, particularly affecting children, including diarrhoea, worm infections, and stunting. According to the UNICEF/WHO (2015) report, Insufficient sanitation affects more than one billion people globally and thus harms entire communities due to environmental pollution. Socioeconomic factors form the warp and weft that shape the fabric of our lives. From the cradle to the grave, they exert a profound influence on our well-being, determining our access to resources, opportunities, and essential services. The socioeconomic status encompasses a myriad of interconnected elements, including income, education, occupation, and social class. These factors serve as the compass that navigates our journey through life, shaping the landscape of our experiences and shaping the contours of our aspirations. The household's income status, for example, dictates the purchasing power and economic security. It determines the ability to afford basic necessities such as food, shelter, and healthcare, laying the foundation for a life of stability.

Rural residents in many developing countries face challenges in addressing sanitation issues, especially in comparison to their urban counterparts who have access to modern sanitation and sewerage systems (Acheampong et al., 2024). A majority of those lacking proper sanitation resort to unsafe and unhygienic facilities at home, and some still practice open defecation (Belay et al., 2022). The consequences of inadequate sanitation in rural areas are far-reaching. Beyond the immediate health risks, poor sanitation can hinder economic productivity, perpetuate cycles of poverty, and exacerbate social inequalities. Women and girls, in particular, may face additional burdens due to the lack of privacy and hygiene facilities, which can affect their education, safety, and overall well-being. Reports from the United Nations Children's Fund and the World Health Organization (2015) highlight the dire consequences of open defecation, which increases the risk of sanitation-related diseases. Promoting simple hygiene practices like handwashing can significantly reduce diarrheal infections, potentially by up to 45%.

According to a World Health Organization report (2021), a significant portion of Africa's population still lacks access to improved sanitation facilities, with many practicing open defecation. Globally, 45% of the population has access to safely managed sanitation services, while 14% rely on basic sanitation facilities. Approximately 2 billion people lack basic sanitation technologies, and 673 million individuals defecate openly.

In Kenya, sanitation coverage is estimated at only 50%, with approximately 6 million people practicing open defecation due to lack of access to sanitation facilities (UNICEF 2015 & WHO, 2021). Poverty is closely linked to poor sanitation in many Kenyan households (Njuguna, 2019). The sanitation technologies currently in use are costly, time-consuming to construct, and often insufficiently protect groundwater. Community acceptance plays a crucial role in the widespread adoption of sanitation technologies (Tamene & Afework, 2021). The economic impact of poor sanitation and hygiene in Kenya is estimated to be around 27 billion Kenya Shillings annually (Bundi, 2023).

Poor sanitation costs Uasin Gishu County a significant amount, totaling 533 million Kenyan Shillings annually (Mutai et al., 2023). These costs encompass factors such as time spent accessing sanitation facilities, premature deaths, healthcare expenses, and reduced productivity. This estimate does not include certain potentially substantial costs, like water pollution and the impact on tourism, and thus likely underestimates the true expense of inadequate sanitation.

Research in various contexts suggests that households' characteristics play a significant role in determining their sanitation status. For instance, a comprehensive study by Donacho et al. (2022) found that several key factors, including household size, education level of household members, and income levels, are crucial determinants of sanitation practices. These factors influence not only the availability and use of sanitation facilities but also the overall hygiene behaviors within households. Similarly, a study by

Dongzagla (2022) highlighted the importance of demographic factors such as household size, composition, and socio-economic status in shaping sanitation behavior. This study demonstrated that larger households often face greater challenges in maintaining adequate sanitation due to increased demand and resource constraints.

There is a huge gap in sanitation between developed and developing countries. Developed nations like the US, Germany and China boast near-universal access to safe sanitation with little to no open defecation. On the other hand, developing countries like Afghanistan, Haiti, Ethiopia and Solomon Islands face a different reality. Here, a large portion of the population, especially in rural areas, lack proper sanitation facilities and many resort to using basic or unimproved options, or even open defecation. Poverty plays a major role - households with less income simply can't afford proper sanitation. The study also critiques a previous analysis (Bankole et al., 2023) for painting developing countries with too broad a brush, arguing that each nation has its own unique set of circumstances that influence sanitation access.

Access to proper sanitation, good hygiene and clean water is critical in preventing children mortality and enhances safe living environment. Kenya has sufficient sanitation policy and regulation frameworks. The Article 43(1) (c) of the Kenyan Constitution gives every person in Kenya the right to access reasonable sanitation standards (GoK, 2010). The Kenya Environmental Sanitation and Hygiene Policy (KESHP) 2016–2030 outlines strategies required to achieve the Vision 2030 regarding access to good hygiene and proper sanitation.

Poverty, as Andrés (2021) notes, is a major determinant of ill health, and people with limited resources are often forced to live in unsanitary environments lacking clean water and proper sanitation facilities. Njuguna (2019) associates this lack of sanitation with a higher prevalence of infectious diseases. In Kenya, this vicious cycle is especially evident in rural areas, where over 40% of the population lacks proper sanitation, with nearly 9% resorting to open defecation. Even those who escape poverty can easily fall back due to factors like weather impacting their harvests. This economic uncertainty makes it difficult for them to invest in sanitation improvements. The situation is slightly better in urban Kenya, with more people having access to improved sanitation facilities, but a significant portion (over 44%) still faces limitations in sanitation access.

Even though the Government of Kenya has put tremendous investment in improving sanitation and hygiene, there's limited progress. Not all citizens put collective effort in adhering to the sanitation rules and regulations. It is essential to investigate the challenges the citizens face in abiding by the regulations. Moreover, there is a shortage of past research addressing the influence of socio-economic factors on sanitation within the local Kenyan, specifically in Uasin Gishu context. Many of the past studies focused on the regional context, therefore, only providing a generic view of the topic. Therefore, it is crucial to further investigate the factors contributing to the choice of sanitation technologies.

Consequently, this study aims to address the question: "Is there a connection between socio-economic factors and the selection of sanitation technologies in Kapseret Sub County and Uasin Gishu County?"

Table 1 Sanitation Status in Kenya

Type of Residence	Sanitation Service Level	% Coverage	Population
Urban	Limited	44.9	7,034,782
	Safely (improved)	27.9	4,376,956
	Unimproved	14.4	2,256,774
	Basic	11.9	1,864,984
	Open defecation	0.9	135,554
Rural	Safely managed	33.0	12,641,109
	Basic service	2.2	852,499
	Limited	15.9	6,110,289
	Unimproved	40.2	15,405,225
	Open defecation	8.7	3,349,314

Source: WHO/UNICEF JMP (2022)

II. METHODOLOGY

This study employed descriptive research design, targeting a population of 198,499 with a total of 59,746 households in Kapsaret Sub-County, Uasin Gishu, Kenya (Kenya National Bureau of Statistics [KNBS], 2019). The study focused on the households with permanent or semi-permanent residents who use various sanitation technologies and come from diverse socio-economic backgrounds.

The researchers used stratified random sampling to select participants for their study on sanitation practices in Kapseret Sub County. The study divided the sub-county into four locations (strata) - Kapseret, Pioneer, Ngeria, and Simat - and then randomly selected households from each area. This ensures a good mix of participants from different locations within the county.

A sample size 475 households we selected using Mugenda and Mugenda (2003) formula that considers the desired confidence level of 95.5% and a margin of error of 4.5%.

Table 2 Sample Distribution Per Location

Location	Population	No. of Households	Sample	% Sample
Pioneer	127,167	42,798	340	71.6
Kapseret	28,575	6,805	54	11.4
Ngeria	25,213	6,035	48	10.1
Simat	17,544	4,108	33	6.9
Total	198,499	59,746	475	100.0
Source: KNBS (2019)				

The study used a study questionnaire and interview guide to collect both qualitative and quantitative data. Quantitative data was analysed using SPSS (version 26) in order to determine the extent of the variables that are being studied, as well as through content analysis, correlations, regression and ANOVA test. The resulting data was displayed through frequency percentage tables, means, and standard deviations. The researcher sought approval from the relevant parties including the respondents consent before engaging them in data collection, local authority, and the Meru University Institutional Research Ethics Review Committee (MIRERC).

III. RESULTS

➤ *Size of Households*

Household sizes in the study area range from 3 to 10 members. The most common household sizes are 3-4 members (34.1%) and 5-6 members (32.4%). Additionally, 1-2 member households represent 22.5% of the total. There are also households with 7-8 members (10.7%) and a small proportion with 9-10 members (0.2%).

Table 3 Size of Households

Household size	Frequency (n)	%
1-2.	107	22.5%
3-4.	162	34.1%
5-6.	154	32.4%
7-8.	51	10.7%
9-10.	1	0.2%

Total	475	100.0%

Source: Research Data

Gender dynamics within households significantly affect sanitation practices. In this study, the distribution of gender among respondents was as follows:

Table 4 Gender Distribution

Gender	Frequency (n)	%
Male	275	57.89
Female	200	42.11
Total	475	100.0

Source: Research Data

The questionnaires asked for the respondent's age and the results are indicated in the table below. The study categorized them into different age groups from 18 to 64 years. To better understand the demographic distribution of the participants in the study, the following table presents the age brackets, corresponding frequencies, and their percentages:

Table 5 Age of Respondents

Age bracket (yrs)	Frequency (n)	%
18-24	52	10.9
25-34	109	22.9
34-45	131	27.6
45-54	154	32.4
55-64	29	6.1
Total	475	100.0

Source: Research Data

Table 6 Type of Housing

Type of Housing	Frequency (n)	%
Owned	146	30.7%
Rent	329	69.3%
Total	475	100.0%

Source: Research Data

Table 7 Housing Structure

Type	Frequency (n)	%
Permanent	259	54.5%
Semi-permanent	164	34.5%
Temporary	52	10.9%
Total	475	100.0%

Source: Research Data

Table 8 Type of Sanitation Technology

Type of Sanitation Technology	Frequency (n)	%
Improved	328	69.1%
Unimproved	147	30.9%
Total	475	100.0%

Source: Research Data

Table 9 Specific Technology

Specific Sanitation Technology	Frequency (n)	%
Bucket latrine	2	0.4%
Temporary pit latrine	31	6.5%
Ventilated improved pit	88	18.5%
Pour-flash toilet linked to a septic tank	163	34.3%
Connected sewer system toilet	183	38.5%
Pour-flash toilet linked to a sewer system	8	1.7%
Total	475	100.0%

Table 10 Satisfaction with the Facility

Level of satisfaction	Frequency (n)	%
Dissatisfied	6	1.3%
Less Satisfied	63	13.3%
Satisfied	324	68.2%
Very satisfied	67	14.1%
Somehow satisfied	15	3.2%
Total	475	100.0%

Source: Research Data

Table 11 Source of Water

Source	Frequency (n)	%
Surface water e.g. river, dam, etc.	36	7.6%
Borehole/well	75	15.8%
Piped	347	73.1%
Rainwater	17	3.6%
Total	475	100.0%

Source: Research data

Economic Factors Influencing Households' Adoption of Sanitation Technologies

Economic factors play a pivotal role in households' decisions to adopt sanitation technologies. Affordability, availability of financial resources, and economic incentives significantly impact whether households can invest in and maintain sanitation facilities. This section examines how income levels, cost considerations, access to financing, and economic benefits influence the adoption and sustained use of sanitation technologies.

➤ *Source of Income*

The study also established the profusions of the respondents where they get their income from ranging from Business, Farming, Salary and Donation. The source of income among respondents varies considerably, reflecting diverse economic activities. The majority, comprising 43.2%, rely on salaried employment as their primary source of income. Business ventures constitute another significant source, with 40.8% of respondents engaged in entrepreneurial activities. A smaller yet notable portion, accounting for 14.1%, derives income from farming. Additionally, 1.9% of respondents depend on donations and support from well-wishers.

Table 12 Source of Income

Source	Frequency (n)	%
Salaried employment	205	43.2%
Business	194	40.8%
Farming	67	14.1%
Donations and well-wishers	9	1.9%
Total	475	100.0%

Source: Research Data

➤ *Income Level*

When considering the influence of 85 on the choice of sanitation technology, 33.3% of respondents acknowledged its significance, indicating that income plays a role in shaping their preferences. The majority of respondents (85.7%) specified that financial constraints significantly influence their choice of sanitation technology. Factors cited include affordability, the high cost of better technology, expensive maintenance, and limited options due to low income. Other reasons mentioned were the determination of neighbourhood quality, type of technology used, and the quality of materials, among others.

Table 13 Influence of Technology Choice

Influence of technology choice	Frequency (n)	%
N/A	12	2.5%
No	305	64.2%
Yes	158	33.3%
Total	475	100.0%

Source: Research Data

➢ *Cost*

The majority of respondents perceived the cost of installation and maintenance favourably, with 51.6% assigning it a rating of '4' and 21.5% rating it as '5', indicating a relatively high satisfaction level. A moderate proportion rated it as '3' (24.2%), suggesting a balanced perception. However, only a small fraction rated it lower, with 1.9% rating it as '2', reflecting a minority dissatisfaction. The missing responses were minimal, accounting for 0.8%, indicating a generally clear stance on this aspect of sanitation technology.

➢ *Literacy Levels*

Literacy levels significantly impact sanitation practices and the choice of sanitation technology within the community. Higher education levels are often associated with greater awareness of sanitation and hygiene practices, as well as a higher likelihood of investing in improved sanitation facilities. The distribution of literacy levels among the respondents in this study is as follows:

Table 14 Satisfaction with the Facility

Education Level	Frequency (n)	%
College or Vocational Technical Training	161	33.89%
University	146	30.74%
Secondary	114	24.00%
Primary	36	7.58%
No Formal Education	7	3.2%
Total	475	1.47.0%

Source: Research Data

➢ *Level of Education*

The education level distribution among the respondents indicates a diverse range of educational backgrounds. Approximately 1.5% of participants have had no formal education, while 7.8% have completed primary education. A significant portion, comprising 24.4%, has attained a secondary education level. Additionally, 35.2% of respondents have received college or vocational technical training, and 31.2% have obtained a university degree.

Table 15 Respondents' Education Level

Level of education	Frequency (n)	%
No formal education	7	1.5
Primary	37	7.8
Secondary	116	24.4
College/Vocational Technical training	167	35.2
University	148	31.2
Total	475	100.0

Source: Research Data

➢ *Prestige in the Society*

The distribution of ratings for prestige varied, with the highest proportion of respondents (40.2%) assigning a rating of '3', indicating an average perception of their status in society. Additionally, 36.4% rated their prestige as '4', suggesting a relatively high status. A smaller fraction rated it as '5' (17.9%), indicating a strong perception of prestige. However, only a minority of respondents rated their prestige lower, with 0.4% assigning a rating of '1'. The missing responses were minimal, accounting for 0.8%.

Table 16 Level of Prestige

Level of prestige	Description	Frequency (n)	%
1	Very low	2	0.4%
2	Low	20	4.2%
3	Moderate	191	40.2%
4	High	173	36.4%
5	Very High	85	17.9%
Not indicated		4	0.8%
Total		475	100.0%

Source: Research Data

➢ *Reliability and Durability of the Technology*

The data reflects a favorable perception of the reliability and durability of sanitation technology, with the majority of respondents (51.8%) assigning a rating of '4'. Another substantial portion (21.9%) rated it as '5', indicating high reliability and durability. However, a notable proportion (21.7%) rated it as '3', suggesting a moderate perception. A smaller fraction rated it lower, with 0.8% assigning a rating of '1'. The missing responses were minimal, accounting for 0.6%, indicating a generally clear stance on this aspect of sanitation technology.

Table 17 Level of Reliability and Durability of Sanitation Technology

Level of reliability and durability of sanitation technology	Description	Frequency (n)	%
1	Very low	4	0.8%
2	Low	15	3.2%
3	Moderate	103	21.7%
4	High	246	51.8%
5	Very High	104	21.9%
Not indicated		3	0.6%
Total		475	100.0%

Source: Research Data

➤ *Availability of Materials for Installation/Construction*

Respondents generally perceived the availability of materials for installation/construction positively. The highest proportion (45.3%) rated it as '4', indicating adequate availability. Additionally, 32.2% rated it as '3', suggesting moderate availability. However, a small fraction (0.8%) rated it as '1', indicating limited availability. The missing responses were minimal, accounting for 0.6%, suggesting a relatively clear perception regarding the availability of materials.

Table 18 Availability of Material

Level of availability of construction/installation material	Description	Frequency (n)	%
1	Limited	4	0.8%
2	Somewhat	17	3.6%
3	Moderate	153	32.2%
4	Adequate	215	45.3%
5	Excessive	83	17.5%
Not indicated		3	0.6%
Total		475	100.0%

Source: Research Data

➤ *Level of Income*

The distribution of ratings for the level of income varied, with a substantial proportion (47.6%) assigning a rating of '4'. This suggests a moderate to high level of income among respondents. Another significant portion (23.4%) rated their income as '5', indicating a relatively high income level. However, a small proportion rated it lower, with 0.6% rating it as '1'. The missing responses were notable, accounting for 5.7%, indicating a range of income levels among respondents.

Table 19 Level of Income

Income level	Description	Frequency (n)	%
1	Very low	3	0.6%
2	Low	11	2.3%
3	Moderate	100	21.1%
4	High	226	47.6%
5	Very High	111	23.4%
Not indicated		27	5.7%
Total		475	100.0%

Source: Research Data

➤ *Financial Constraints in Maintaining*

A notable proportion of respondents (67.6%) indicated no financial constraints in maintaining sanitation facilities, while 32.4% reported facing financial constraints. This suggests that financial considerations play a significant role in the maintenance of sanitation facilities, with a substantial portion of respondents facing challenges in this regard. In agreement with the study conducted by Wrisdale et al., (2017) that finances is the biggest factor in determining the type of sanitation technology and their maintenances.

Table 20 Financial Constraints in Maintaining Sanitation Facilities

Maintenance financial constraints	Frequency (n)	%
No	321	67.6%
Yes	154	32.4%
Total	475	100.0%

Source: Research Data

> *Correlation Analysis*

Table 21 Correlational Analysis

Rate of influence on the choice of adoption a sanitation facility	Mean	Std. deviation	N
Cost of installation and maintenance	3.93	0.731	471
Prestige in the society	3.68	0.831	471
Reliability and durability of sanitation technology	3.91	0.797	472
Availability of construction/installation material	3.75	0.813	472
Level of income	3.97	0.777	448
Level of education	3.12	1.093	468

Source: Research data

Table 22 Correlation Matrix

Factor7	Household Size	Gender Distribution	Age Composition	Education Level	Employment Status
Household Size	1.000	0.134	-0.052	0.217	0.095
Gender Distribution	0.134	1.000	0.076	0.082	0.103
Age Composition	-0.052	0.076	1.000	0.195	0.064
Education Level	0.217	0.082	0.195	1.000	0.291
Employment Status	0.095	0.103	0.064	0.291	1.000

The correlation analysis reveals significant relationships among factors influencing the adoption of sanitation technologies. Higher education levels exhibit positive correlations with both household size ($r = 0.217$) and employment status ($r = 0.291$), suggesting that individuals with more education tend to reside in larger households and are more likely to be employed. Additionally, employment status shows a positive correlation with education level ($r = 0.291$), indicating that individuals with higher education are more often employed. However, household size demonstrates weak correlations with gender distribution ($r = 0.134$) and education level ($r = 0.217$), implying only a slight association between household size and these factors. These insights illuminate the intricate interplay between socio-economic factors and sanitation technology adoption, enhancing comprehension of the study's objectives.

> *Regression Analysis*

Regression analysis is employed to determine the relationship between dependent and independent variables and to identify the factors that significantly influence the dependent variable. In this context, the regression model assesses the impact of various factors on sanitation practices within the community. The regression equation is as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \cdots + \beta_n X_n + \epsilon$$

Where:

- Y represents the dependent variable (sanitation practices).

- β_0 is the intercept.

- $\beta_1, \beta_2, \beta_3, \cdots, \beta_n$ are the coefficients of the independent variables.

- $X_1, X_2, X_3, \cdots, X_n$ are the independent variables (income, education level, household size, gender, employment status,

- access to information, and religious affiliation).

- ϵ is the error term.

Table 22 ANOVA Test

ANOVA [a,b]					
Source	Sum of square	Df	Mean square	F	Sig.
Regression	1.136E+10	1	1.136E+10	10.666	0.001
Residual	5.036E+11	473	1064738438		
Total	5.150E+11	474			
a. Dependable variable: Income (KES)					
b. Model (Intercept): Type of sanitation technology					

Based on the significant F-value (10.666) and the small p-value (.001) for the regression model, it appears that the type of house is a significant predictor of sanitation technology.

IV. DISCUSSION

The survey in Kapseret Sub County paints a picture of a community with a mix of young working families and a significant number of renters. Most people live in permanent structures, with a third in semi-permanent housing and a smaller portion in temporary ones. The most common household sizes are 3-4 and 5-6 people. There's good news on sanitation. Almost 70% of those surveyed have access to improved sanitation facilities like flush toilets or ventilated pit latrines. This is likely due to the presence of a central sewer system in urban areas, allowing toilets to be connected for waste disposal. In places without this system, another common technology is the pour-flush toilet linked to a septic tank. Despite this progress, there's still work to be done. Over 30% of the population lacks improved sanitation, and addressing their needs is crucial to ensure the health and well-being of everyone in the community.

Money plays a big role in how good your toilet is in Kapseret Sub County. People with more money can afford fancier toilets, like ones hooked up to septic tanks or a central sewer system. These are more expensive to install but keep things cleaner. Even if a family manages to get a decent toilet, keeping it working well can be tough due to cost. Regular maintenance is needed to keep things sanitary, but some families just can't afford it. Education levels are all over the map in the survey, with some folks having no formal education and others holding college degrees. The good news is that a well-educated community is more likely to embrace new sanitation ideas and technologies. The way people make money in Kapseret Sub County is also varied. Most folks have salaried jobs (almost half) or run their own businesses (nearly as many). Farming brings in income for some as well. This mix of incomes highlights the complex link between money and sanitation. Even if people are open to better toilets because of education, if they can't afford them or keep them up, it's all for naught.

The bottom line of the study in Kapseret Sub County is that improving sanitation requires tackling a bunch of different things at once. Education, money, culture, and even habits all play a part in what toilets people use.

V. CONCLUSION

Improving sanitation in Kapseret Sub County requires a multifaceted approach. Education campaigns led by trusted community figures can debunk myths and emphasize the health and economic benefits of good toilets. Financial aid like microloans can help overcome the cost barrier, while infrastructure development focuses on building affordable and accessible sanitation facilities alongside clean water sources. Collaboration between the community, government, and NGOs is crucial, and regular monitoring ensures these solutions continue to meet the evolving needs of the community. By addressing sanitation holistically, Kapseret Sub County can create a healthier, more prosperous future for all its residents.

➢ Conflict of Interest
There was no conflict of interest.

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