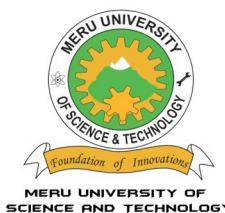




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Influence of social factors on the promotion of safe fecal management in flood-prone areas: a case of Nyando sub-county, Kenya

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ABSTRACT

Sustainable Development Goal No. 6 target 2 aims to provide universal access to sanitation by the year 2030. However, floodable areas which cover about 10% of the Earth's surface pose major constraints in the achievement of this goal. Nyando Sub-County in particular, which is prone to flooding registered a sanitation access reversal rate of 3.1% in the subsequent year after Open Defecation Free verification in 2013. The study aimed to investigate the influence of social factors on the promotion of safe fecal management in Nyando Sub-County. The area was selected due to prevalent flooding which led to the collapse of pit latrines stemming open defecation and reversal in sanitation access. The study employed a convergent parallel design approach that incorporated both quantitative and qualitative techniques. A sample size of 177 households was chosen as a representative of the 38,460 total households in the study area. Structured questionnaires and focus group discussions were used for data collection. (SPSS) version 26 was used to analyze quantitative data and the relationship between the variables was examined using Pearson's Product Moment correlation at a 5% significance level. Similarly, MAXQDA software was used to group coded data from qualitative methods into themes. From the results, household wealth and gender roles had the strongest influence on the regressor variable with correlation coefficients of ($r = .722$; $P \leq .022$) and ($r = .687$; $P \leq .049$) respectively. Additionally, the study revealed that 18.4%, ($n=30$) of the respondents did not have toilets and 55.2%, ($n=90$) of the toilets were unimproved. In conclusion, the choice of affordable sanitation solutions incorporating the aspects of gender may increase sanitation access during floods events. Therefore, bridging the socio-economic disparities and empowering communities to take ownership of sanitation facilities and fostering a sense of collective responsibility for fecal sludge management can lead to increased access to improved sanitation. Additionally, more studies should be carried out to explore the suitable sanitation alternatives for Nyando Sub-County which are acceptable to the community to reduce the impact of flooding on sanitation facilities and public health.

Introduction

Target 2 of Sustainable Development Goal No. 6 aims to provide universal access to sanitation by the year 2030, including ending all forms of open defecation (United Nations, 2015). To date, con-

siderable efforts have been made to achieve sanitation for all, however, by the year 2017 about 672 million people still practiced open defecation which accounted for 9% of the world population (UNICEF & WHO, 2019). The scenario is aggravated by the constraints in access to sanitation in

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floodable environments which cover about 10% of the Earth's surface and are challenging contexts for sanitation facilities (Pedro et al., 2020). In Kenya flooding has been linked to poor fecal management and high waterborne disease incidences (Onyuro, 2020). Nyando Sub-County particularly, which is prone to periodic flooding, registered a reversal rate of 3.1% in sanitation access between 2013 and 2018 after the declaration of Open Defecation Free status. In Kenya pit latrines without slab are the most common technological solution with the prevalence ranging between 35.9-37.9% (Njuguna, 2019). Solutions such as septic tanks and pit latrines require to be emptied safely to prolong their service life and efficiency in pathogen control when they fill up (Chipeta et al., 2017). Globally sanitation coverage among communities exhibits colossal disparities as household wealth index, gender of the household head, and environmental conditions are positively associated with access to improved sanitation (Mulenga et al., 2017).

The household head's educational level has a significant impact on social elements that support the promotion of safe fecal management in flood-prone locations. Education of the family head enhances the knowledge about the associated health risks of poor sanitation and the benefit of improved hygiene practices (WHO, 2021). Bartam & Caircross (2017) demonstrated that households with educated heads were more likely to construct and maintain sanitary latrines as opposed to those with lower education levels leaving them exposed to the practice of open defecation or inappropriate fecal waste disposal, worsening health risks during flood disasters (Xiaoquin & Zhou et al, 2018). Recent studies continue to focus on access to sanitation infrastructure, such as toilets and latrines, without fully exploring the role of education in ensuring consistent and proper use of these facilities. For instance, Odagiri et al. (2020) and Venkataramanan et al. (2018) emphasize the importance of latrine coverage but provide limited insights into how education, particularly that of household heads, influences be-

haviors like toilet maintenance, safe fecal disposal, or adoption of new sanitation technologies. The lack of attention to education-driven behavior change creates a gap in understanding how access translates into effective fecal management.

Amadi & Joshi (2016) linked Household wealth and education attainments as better education enables family members to access better economic opportunities. Wealthier households are likely better positioned to maintain and upgrade their sanitation facilities, which could have a direct impact on the sustainability of safe fecal management (Coffey et al., 2017). However, there is limited research examining how wealth influences the long-term upkeep of sanitation systems, such as pit emptying, fecal sludge management, or transitioning to more advanced systems as household income increases. For example, Tidwell et al. (2019) mentions wealth in the context of sanitation infrastructure, but do not explore how it impacts the ongoing management of these systems. This gap leaves questions about the role of wealth in ensuring the continued use of safe fecal management practices.

In most communities, women and girls are typically responsible for managing household sanitation which include toilet cleaning, fetching water for domestic cleaning and ensuring proper waste disposal (Levy et al., 2016). Similarly, in many cultures, women are caregivers and homemakers which places them at the forefront in managing sanitation (O'Reilly, 2016). According to Caruso et al. (2017), women in low income countries frequently lack access to private and safe sanitation facilities, increasing their vulnerability to harassment and violence. Agarwal (2016) emphasized that women participation in sanitation committees and decision-making processes ensured that the facilities met the specific needs of women hence increased community acceptance. Existing research often focuses on women's hygiene behaviors, particularly in relation to menstrual hygiene management, without examining the broader gender norms that influence household fecal management. To illustrate, Roose et al. (2017)

emphasize the importance of menstrual hygiene but do not examine how gendered expectations around cleanliness and caregiving extend to fecal management responsibilities. This narrow focus neglects the broader societal and cultural gender norms that may influence who is responsible for fecal management and how these roles are negotiated within the household.

The size of a household too can have a significant influence how safe fecal management is promoted in flood-prone locations. With an increase in the size of households, the financial burden also rises proportionately, making it difficult to allocate sufficient funds for the construction and maintenance of improved sanitation facilities as compared to smaller households (Ahmed et al., 2017). According to Mara et al., (2016) larger households have lower per capita rates for hand-washing and latrine use, often due to overcrowding and limited access to the facilities increasing the risk of waterborne disease transmission. Although many studies recognize that household size may influence sanitation outcomes, few have specifically explored how it affects fecal management practices. For example, Garn et al. (2017), focuses on general sanitation access, but does not explicitly analyze how larger or smaller household sizes influence the management of feces. The link between household size and practices such as latrine use, latrine maintenance, or the handling of fecal waste remains inadequately studied.

Finally, beliefs of communities require considerable attention as they may influence how human waste is managed particularly in floodable environments. Coffey et al. (2017) revealed that in rural India, cultural beliefs around purity and pollution significantly influenced pit latrine use. Many households preferred open defecation over using latrines which were considered impure and contaminating when located near living spaces. Religious beliefs also can either promote or hinder safe fecal management practices, for instance some religious doctrines advocate for cleanliness as a virtue encouraging adherent to embrace hy-

giene practices (Gosh et al., 2016). Many sanitation programs adopt a one-size-fits-all approach, which fails to account for the cultural diversity of target populations. There is a need therefore, for more culturally tailored interventions that consider specific local beliefs and practices related to fecal management. Pickering et al. (2019) explore sanitation interventions but do not emphasize the need for culturally specific strategies to promote safe fecal management. This gap highlights the importance of designing culturally sensitive programs that respect local traditions while encouraging safe sanitation behaviors.

Problem Statement

Floodable areas and wetlands cover about 10% of the Earth's surface and are challenging contexts for implementation of sanitation interventions due to the great fluctuations in water levels that may submerge extensive areas (Pedro et al., 2020). In rural Kenya, Nyando sub-County which is prone to periodic flooding and characterised by bimodal rainfall patterns with peaks between April and June and another peak between October and November (Masese et al., 2016) experiences challenges in sanitation access and high waterborne disease incidence (Onyuro, 2020). Since 2016, rural sanitation in Kenya has been guided by the Rural Sanitation Protocol (RUSAP) replacing the CLTS protocol which had achieved zero open defecation in the Nyando sub-County (Riungu, 2018) but faced a great set back in the sustainability of the pit latrines constructed during the intervention as many households reverted to open defecation (Ouma & Koech, 2023) with an open defecation reversal rate of 3.1% reported in 2018 (Riungu, 2018). The frequent flooding in the area exacerbates problems associated with safe fecal management, posing significant public health risks. Despite the previous interventions, the effectiveness of social dynamics, in promoting safe fecal management remains unclear as only 23.8% of the households had adopted the Ventilated Improved Pit Latrines specified by the Kenya Environmental and Hygiene Policy as a suitable sanitation

solution for rural areas (Riungu, 2018). With the existence of a paucity in research on the influence of social factors on the promotion of safe fecal management , there was a need to explore the issues.

Objective of the study

The aim of the study was to investigate the influence of social factors in the promotion of safe fecal management in flood-prone areas. Case of Nyando Sub-County, Kenya.

Methodology

Study area and design

The research was conducted in Nyando Sub-County, Kenya. The study adopted a convergent parallel design approach which enabled the collection of both qualitative and quantitative data simultaneously.

Target population and sample size determination

The study's target population was household heads from a total of 38,460 households (KNBS, 2019) aged above 18 years from 133 villages that make up Nyando Sub-County. The study also targeted Community Leaders, masons, Community Health Volunteers and Public Health Officers to obtain more insights on the promotion of safe fecal management in the study area. A sample of one hundred and seventy-seven (177) households from the five administrative wards that make up Nyando Sub-County was selected for the study. The Yamane's (1967) formula was used to calculate the sample size, as indicated below, with a 95% confidence level and a 0.10 significance level. Additionally, 15 Key informants were purposively sampled.

Sampling Technique

Cluster sampling technique was used in categorizing Nyando Sub-County into clusters of five wards. Proportionate random sampling was then employed where the study participants were chosen from unequally distributed cluster (Mukadi, 2016). Subsequently, the number of participants

$$n_c = \frac{N_c}{N} \times n$$

Ward Name	Households (Census, 2019)	No. of Villages	Sample Size
East Kano/Wawidhi	4,726	33	22
Awasi/Onjiko	8,436	37	39
Ahero	8,576	14	39
Kabonyo	6,835	28	31
Kobura	9,887	21	46
Total	38,460	133	177

Table 1: Sample size determination

per cluster (nc) was derived from the ratio of household in a ward (Nc) to the total number of households in the study area (N) against the intended total sample size (n) as shown in Table 1.

Data collection and analysis

Data was obtained from the respondents using structured questionnaires, focus group discussion guide and an observation checklist. Respondents were requested to rate their degree of concurrence on a 5-point Likert scale, which runs from (1) strongly disagree to (5) strongly agree, in response to the questions. The data derived from the household survey questionnaires was analyzed by the use of inferential and descriptive statistics in SPSS version 26. The results were presented in standard deviations, means, frequencies and percentages in charts and tables. Pearson's Product Moment was used to conduct correlation analysis while Regression Analysis was used to show the relationship between the indicators of the social factors with the promotion of safe fecal management in Nyando Sub-County. The audio recordings from qualitative data were transcribed to generate texts which were checked against the handwritten notes to identify any generalizations and word similarities. MAXQDA software was then used to group the coded data into themes. According to Baum & Clarke (2014), thematic analysis is an appropriate method when there is a need to understand people's experiences, thoughts and behaviors.

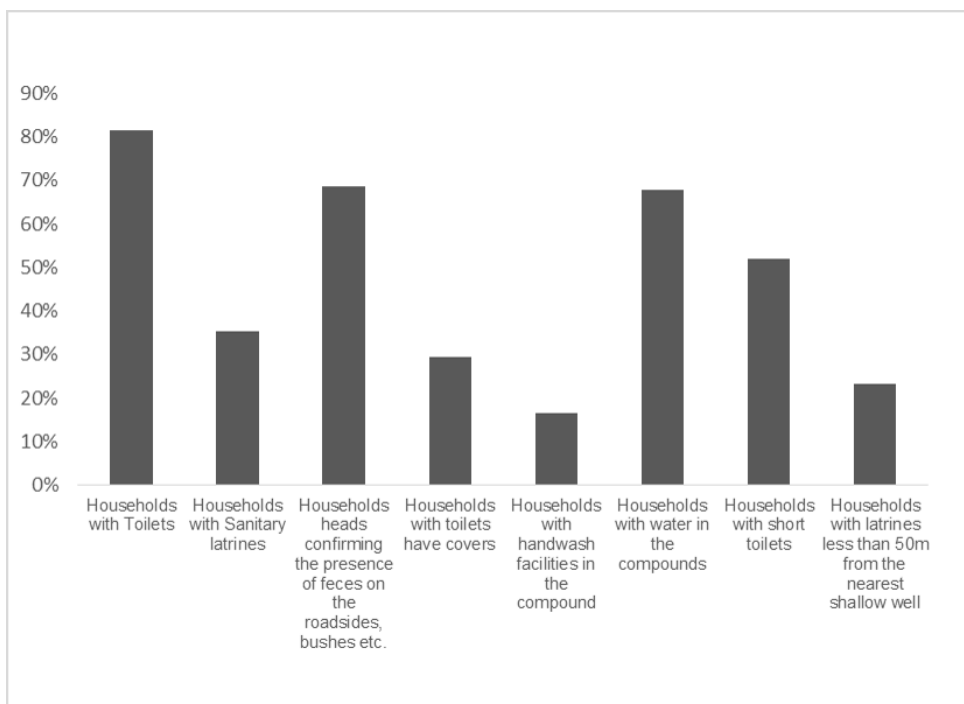


Figure 1: Sanitation and Hygiene General Information

Ethical considerations

The nature and goals of the study, the methods to be followed, and the expected benefits for both the respondents and the sanitation facilities were all fully disclosed to the respondents. The opportunity to ask questions and receive any clarification needed was granted to the respondents. The respondents’ voluntary permission to take part in the study was obtained. The data collected from the participants was treated with utmost confidentiality and used only for the study. Discretion and anonymity were also assured as the responders’ names were not recorded. An introduction letter from Meru University of Science and Technology and a research permit from NACOSTI were made available upon request.

Results and discussion

Demographic data

From the results, participants aged 18-28 years (n= 9) had a 5.5% representation; 29-39 years (n=43) had a 26.4% representation; 40-50 Years (n =48) had a 29.4% representation while Over 50 years (n =63) had a 38.7% representation. Also, most of the respondents were females (n=93) with a representation of 57.2% while males were the minority (n=70) with a representation of 42.8%. More-

over, the study also revealed that most of the study participants were Christians (n=157) a representation of 96.4% while Muslims (n=6) had the least representation of 3.6%.

Sanitation practices

The results for the sanitation practices are presented in the graph in Figure 1. Furthermore, majority of the households had a pit latrine without cover slab (n = 60) at 36.8%; metal sheets were used for toilet super structures (n= 68) at 50.9%; the material for toilet slabs was mud (n = 60) at 45.4% and depth of toilets was

Influence of household’s head level of education on safe fecal management

The investigation aimed to understand whether the education qualification of the household head as a social factor affected safe fecal management. Statement on whether household’s head education attainment influences their understanding and adoption of improved sanitation had a mean of 4.46; on whether education attainment of the family head influences the pit latrine cleaning and handwashing behaviors had a mean of 4.26. From the findings, it’s evident that participants strongly

Statement	Mean (x)	Std. Dev (σ)
Household head's education attainment influences the adoption of improved sanitation.	4.46	.843
The education attainment of the family head influences hygiene behaviors e.g. (pit latrine cleaning and handwashing)	4.26	.741
Higher household wealth/income level influences adoption of safe toilets in flood-prone areas.	4.28	.698
Household wealth/income influence pit emptying practices for filled up pits	4.23	.737
Household size influences the use of sanitation facilities during floods	3.78	.677
Gender roles within the household affect the allocation of responsibilities related to fecal management	3.69	.911
There exist local beliefs which influence accessibility and acceptance of sanitation solutions in this community.	4.24	.889
Average	4.13	

Table 2: Means and Standard deviations for the variable indicators.

agreed to the fact that the household head’s education attainment affects safe fecal management at household level. The Focus Group Discussion participants also shared similar findings by stating the following:

“Higher education enables people to get well-paying jobs enabling them to afford better toilets sometimes flushing ones. Educated people have more information on health and will try to avoid anything that brings diseases. Education teaches people to be clean and educated families will always try to observe higher levels of hygiene.” (Said a 61-year-old male community representative in Nyando Sub-County.)

Subsequently, from the observation checklist, 59.5% of the respondents (n=97) reported to have attained primary level education and below corresponding to the 64.7% of the participants (n=86) who reported that hygiene in their latrines not to be adequate pointing to a relationship between the perception of the benefits of safe fecal management and the education attainment of the household head. This argument is confirmed by Bartam & Caircross (2017) who demonstrated that families with more educated heads were likely to construct and maintain sanitary latrines as opposed to the those with lower education attainment. To address the sanitation inequality there-

fore, the local public health officers and policy makers should prioritize bridging the education gap to accelerate behavior change and adoption of improved sanitation.

Influence of household wealth on the promotion of safe fecal management

Statement on whether higher household wealth/income level influences adoption of safe toilets in flood-prone areas had a mean of 4.28 and statement on whether household wealth/income influence pit emptying practices for filled up pits had a mean of 4.23. From the findings, it’s clear the participants strongly agreed that household wealth affected safe fecal management in Nyando Sub-County. The results were confirmed by the participants in the Focus Group Discussion who said the following:

“Wealthy households have money and can afford better toilets. Households with higher income levels have access to good education hence have better knowledge on health matters and will use appropriate facilities.” (Said a 37-year-old male Public Health officer in Nyando Sub-County)

These findings are consistent with results by Joshi & Amadi (2016) who established that poorer households often must use inadequate and unsafe facilities which can compromise health and hygiene while wealthier households are more like-

ly to have durable and well-maintained latrines. In consideration of the above, addressing the socio-economic variance in Nyando Sub-County is cardinal to solving the apparent fecal management inequalities as 46% (n=75) respondents stated that they were unemployed signaling poor household majority. In addition, promotion of affordable and subsidized sanitation solutions might also be instrumental in increasing improved sanitation coverage which is now at 44.8% from the study findings.

Influence of gender roles on the promotion of safe fecal management

Statement on whether Gender roles within the household affect the allocation of responsibilities related to fecal management had a mean of 3.69. It's evident that participants moderately agreed that gender roles affected fecal management. These findings agree with the position held by the participants in the Focus Group Discussions who stated as follows:

“In our community it is women who wipe the children when they defecate and this puts them in closer contact with feces than men. Women also avoid the toilets when they are filled with flood waters for fear of spillages of contaminated water on their bodies and risk of collapse.” (Said a 46-year-old female Community Health Helper in Nyando Sub-County.)

In the study, 57.2% of the respondents (n=93) interviewed identified with the female gender, perhaps because some men had migrated to urban centers in search of better economic opportunities, a scenario which places the burden of fecal management decision making on women. It is imperative therefore to have women involved in community sanitation initiatives for assured sustainability. Orozco & Gass (2017) demonstrated that involvement of women in community sanitation initiatives led to improved outcomes highlighting the significance of addressing gender specific issues in sanitation facility design to ensure sustainability.

The fourth construct was to investigate wheth-

er household size as a social factor affected fecal management. Statement on whether household size influences the use of sanitation facilities during floods had a mean of 3.78. From the results it is evident that participants moderately agreed that household size affected fecal management. The findings agree with the Focus Group Discussion participants who stated the following:

“In this community most, households are comprised of between (3-5) members and own a single pit latrine. Households with more children normally have feces all over the compound as children don't use toilets.” (Said a 55-year-old male community representative in Nyando Sub-County.)

The findings were confirmed by Pena et al., (2017) who showed that larger households faced difficulties in maintaining clean and functional latrines exposing them to higher incidence of sanitation related illnesses. Similarly, Patil et al., (2016) revealed that in India larger households had more incidences of open defecation due to the overstretched toilet capacities resulting from overcrowding and poor hygiene.

Finally, the last construct was to assess whether beliefs as a social factor affected fecal management. Statement on whether there existed local beliefs which influenced accessibility and acceptance of sanitation solutions in the community had a mean of 4.24. The outcomes were confirmed by the participant in the Focus Group Discussion who stated the following:

“I cannot use pit latrine located next to my son's house in the homestead as our culture does not allow that. Also, we regard children's feces as non-hazardous and can be disposed by throwing anywhere in the compound.” (Said a 55-year-old community representative in Nyando Sub-County.)

The outcomes agree with Coffey et al., (2017) who found that in India cultural beliefs around purity and pollution had a strong influence on pit latrine use. Many households preferred open defecation to using latrines which were considered impure and contaminating when located near liv-

Component		Promotion	Education level	H/H wealth	H/H size	Gender roles	Beliefs
Promotion	R	1					
	Sig.	.033					
Education Level	R	.513**	1				
	Sig.	.001					
H/H wealth	R	.722**	.484**	1			
	Sig.	.022	.033				
H/H size	R	.486**	.574**	.522**	1		
	Sig.	.011	.043	.132			
Gender roles	R	.687**	.437**	.407**	.791**	1	
	Sig.	.049	.066	.087	.041		
Beliefs	R	.500**	.437**	.407**	.791**	.804	1
	Sig.	.022	.037	.040	.039	.0588	

Table 3: Correlational results.

ing spaces. It is therefore imperative to give due consideration to the beliefs of the community during the design and implementation of sanitation intervention for assured compliance and safer fecal management in Nyando Sub-County.

Correlational Analysis

Correlation analysis provided a numerical measure in understanding how changes in one variable correspond to changes in another. The findings are presented in the table below.

From the results, education level of the household head exhibited a significant positive correlation ($r = 0.513, p < 0.001$) with Household wealth showed a strong positive correlation ($r = 0.722, p < 0.022$). Household size demonstrated a moderate positive correlation ($r = 0.486, p < 0.011$); Gender roles had a strong positive correlation ($r = 0.687, p = 0.049$) and beliefs had a moderate positive correlation ($r = 0.500, p = 0.022$).

Overall, these findings underscored the significance of social factors in the influence promotion of safe fecal sludge management. Mwirigi et al., (2019) and Osumanu et al., (2019) both agreed with the results by demonstrating that while having a latrine in the home could end open defecation, structural injustices like a nasty smell and an awkward position could make it difficult for people to utilize the latrine.

Regression analysis

An analysis was undertaken to establish the strength and direction of the linear relationship between independent variables and the promotion of safe fecal management. Prior to the analysis a multi-collinearity test was conducted on the predictor variables and no significant multi-collinearity was observed between the variables.

$$Y = 3.553 + 0.350X_1 + 0.891X_2 + 0.348X_3 + 0.517X_4 + 0.318X_5 + \epsilon$$

Where, Y= Promotion, X1 = Education level of the Household head, X2 = Household wealth, X3 = Household size, X4 = Gender roles, X5 = Beliefs and ϵ was the error term.

From the results all the t-values for the independent variables are greater than 2 indicating statistical significance. Household wealth however, had the highest standardized coefficient, suggesting that it had the strongest positive influence on promotion of safe fecal sludge management. Similarly, education level and household size also exert a positive influence, albeit to a slightly lesser extent. In the case of beliefs, while it did have a positive influence, the effect size was moderate.

Conclusion

The findings of this study conclude that social

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	3.553	.752		4.723	.001
Education level	.350	.125	.361	2.804	.008
Household wealth	.891	.197	.374	4.525	.001
Household size	.348	.169	.150	2.062	.046
Gender roles	.517	.059	.517	8.795	.029
Beliefs	.318	.069	.318	4.604	.017

Table 4: Regression coefficients

$Y = 3.553 + 0.350X_1 + 0.891X_2 + 0.348X_3 + 0.517X_4 + 0.318X_5 + \epsilon$ Where, Y= Promotion, X1 = Education level of the Household head, X2 = Household wealth, X3 = Household size, X4 = Gender roles, X5 = Beliefs and ϵ was the error term.

factors had an influence on the promotion of safe fecal management in the study area. Household wealth and gender roles had the greatest impact on the regressor variable with positive correlations of (r =.722; P ≤.022) and (r =.687; P ≤.049) respectively. Household size however had the least effect on promotion of safe fecal management with correlation of (r =.486; P ≤.011). The outcomes are consistent with Bartam & Caiross (2017) who established that households with more educated heads were more likely to construct and maintain sanitary latrines as opposed to those with less education. This argument position is also shared by Simiyu (2017) who found that households headed by individuals with secondary or higher education were more likely to have access to improved sanitation compared to those with less educated heads. In addition, Joshi & Amadi (2016) explained that higher education of family heads results into better economic opportunities making the educated households able to invest more resources in improved sanitation unlike the less educated ones.

Recommendations and future studies

Addressing social factors is essential for enhancing safe fecal management. Community engagement and awareness-raising initiatives can promote behavior change and encourage proper

sanitation practices. This should incorporate educating community members about the importance of safe fecal disposal, hygiene practices, and the consequences of improper waste management. Involving local stakeholders, such as community leaders, sanitation workers, and women's groups, in decision-making processes can ensure that interventions are culturally appropriate and socially acceptable. Additionally, bridging the socio-economic disparities and empowering communities to take ownership of sanitation facilities and fostering a sense of collective responsibility for fecal sludge management can lead to increased access to improved sanitation. In addition, more studies should be carried out to explore the suitable sanitation alternatives for Nyan-do Sub-County which are acceptable to the community to reduce the impact of flooding on sanitation facilities and public health.

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