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Role of societal norms in raw sewage disposal in water sources, Mukuru slums, Nairobi County, Kenya

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ABSTRACT

A sustainable sanitation system is economical, socially acceptable, and environmentally friendly. Raw sewage disposal into water sources is a significant environmental and health concern in many informal settlements in Kenya. Inadequate access to proper sanitation facilities leads to water source contamination. Despite the severe environmental and health impacts, there is limited knowledge about the factors influencing these practices. Therefore, this study`s specific objectives sought to determine the role of societal norms influencing the discharge of raw sewage into water sources in Mukuru slums, Nairobi, Kenya.A cluster proportionate random sampling was used to identify household heads, while key informants were purposively selected. A quantitative study of 246 household heads was conducted using structured questionnaires and analyzed using the Pearson Chi-Square Test at 95% Confidence Interval. Qualitative data collected through FGDs, and KIIs, was transcribed and manually presented in narratives. The study findings revealed that 96.1% of raw sewage was discharged into water sources while 87.7% of the participants witnessed raw sewage disposal practices. Raw sewage disposal had influenced societal norms such as belief that played a role in 85.1% of cases (p=0.046). The study concluded that poor societal norms contributed to raw sewage disposal into water sources. The study recommended community to educate her residents on values such as beliefs, collective responsibilities, the presence of social networks, proper communication, cooperation, and coordination to prevent raw sewage disposal in the area and create an enabling environment for all.

Introduction

Raw sewage is untreated domestic sewage that comprises untreated wastewater and blackwater from toilets, sinks, drains, chemicals, and sanitary products (Collins et al., 2018). (Collins et al., 2018). Untreated municipal sewage is a point source and harmful source of water ecosystem contamination due to the bulk production of organic matter (Collins et al., 2018).Globally, an estimate of 2 million tons of sewage is discharged into water sources in the world with 97% from Venezuela, 75% from Turkey, 71% in European counties 80% in Latin Countries, as well as 68% in, Asia, due to technological development, (Qadri et al., 2020). In Abuja Nigeria, Kado district during emptying of septic tanks for sewage disposal, Lake Jabi serves as a receiver while some

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neighbors dispose of untreated sewage to the open drains when raining (Abubakar et.al., 2017).

In Kenya, the growth of industries, factories, manufacturing plants, residential areas and unplanned informal settlements, has resulted to increased disposal of waste overwhelming sewage treatment plants and septic tanks (Collins et al., 2018). River Ngong which crosses a populated city of Nairobi and serves as a central point of exposure to both human, domestic and industrial generated waste, forms part of the second largest river (Athi River) in Kenya which serves the counties of Kitui, Kilifi and Makueni along (Ngatia et al., 2023).A tremendous effect of water borne outbreak of diseases such as diarrhea, typhoid, cholera, scabies, and alteration of aquatic life such as zooplankton, fish crabs lead to depriving their survival due to decreased oxygen caused by increased algae growth (Humphrey, 2019).

The study by Ferronato et al. (2019) described societal norm as perception from the social community that informs behavior control which has been determined to curb pollution of water sources in Low- and Middle-Income countries. In a similar vein, Doron and Jeffrey (2018) investigated the determinants of perceived harmful behaviors, such as littering, within the cultural context of India. The study found that cultural and religious factors, including norms related to purity, filth, and cleanliness, could exert a profound influence on these perceptions. These norms, deeply ingrained within the societal fabric, are shaped by complex taboos and belief systems. Additionally, Bamlaku et al. (2023) conducted a study in Ethiopia, revealing that individuals with a positive perception of sanitation practices were three times more likely to adopt sanitation measures, such as the use of toilets. Additionally, the perception of latrine use by others was associated with a 2.7-fold increase in the likelihood of adoption, an indication of the possible impact of social norms in influencing sanitation behaviors in villages transitioning away from open defecation. In a related study, Bicchieri (2017) examined the influence of social norms on open defecation practices in Suna West Sub-County, Kenya. The study found, a strong association between community beliefs and expectations surrounding open defecation-free status, further underscoring the role of societal norms in shaping collective behaviors.

Adoption of sustainable raw sewage disposal in water sources as a WASH component are sometimes hindered due perceived risk that behavior will lead to illnesses, believing there is an actual benefit to engaging in healthful WASH behavior, and personal beliefs related to one`s capacity to modify behavior (Kamara et al., 2022). Furthermore, social constructs such as collective efficacy, social norms or traditions, and social identity are vital in sustainable adoption of WASH options which are usually neglected during designing and delivery by sanitation service providers (Kamara et al., 2022). However, different opinion shows that, while most of peri-urban settings experience poor fecal sludge management, community members are responsible for taking care of their environment and health (Angoua et al., 2018).

Social norms exist from the sanctions of empirical expectation, normative expectation and beliefs (Bicchieri et al., 2017). Similarly, for optimal sanitation achievements, social norms have been described to be key in triggering and shaping the community regarding the pros and cons in sanitation (Novotny et al., 2017). Similarly, religious activities could play a role in shaping factors related to water source pollution (Dwivedi et al., 2018). Despite the implementation of various low-cost interventions aimed at addressing WASH (Water, Sanitation, and Hygiene) issues such as the reconstruction of formal sewage systems, provision of water treatment chemicals, and reductions in household levies there remains a concerted effort to pressure slum dwellers into compliance with sanitation practices (Pickering et al., 2019; Ross et al., 2019).

Studies have demonstrated that encouraging a feeling of shared accountability for waste management can result in more long-lasting and neighborhood-driven solutions (Vetter, 2023; Luitel, 2021). For instance, Luitel (2021) study on the impact of collective responsibility in urban settings found that individuals are more likely to actively participate in recycling programs and adopt waste reduction measures when they feel accountable for managing waste. However, while existing research highlights the benefits of shared accountability in typical urban settings, it does not explicitly address the unique waste management challenges faced by informal settlements. Therefore, this study aimed at determining the role of societal norms influencing the discharge of raw sewage into water sources in Mukuru slums, Nairobi, Kenya

Materials and Methods

The study area was Mukuru slums, one of the largest and the longest established slums in Nairobi, Kenya. It stretches along the Nairobi Ngong River in the waste lands in the industrial area of the city, between Outer Ring Road, North Airport Road and Mombasa Road. This study employed a descriptive cross-sectional study design incorporating qualitative and quantitative data. The study population included household heads, WASH public health officers, chief, Muslims and Christian religious leaders, Community Health Promoters and Manual Pit Emptiers.

A cluster proportionate sampling was used to calculate the sample size for each location. Furtherly, simple random sampling was used to identify the household heads. The Purposive sampling was used to identify the key community influencers such as public health officers, chiefs, religious leaders (Muslims and Christians), Community Health Promoters, and manual pit emptiers. The sample size in this study was 246 determined by using the Cochran`s formula and Cochran`s Modified Formula.

The study employed structured questionnaires that sought to obtained quantitative data, and qualitative data employing focused group discussions guides and informant guides

The study administered structured questionnaires to 246 household heads, Key Informant Guides were administered to 3 chief, 6 religious leaders; 3 from Christian community and 3 from Muslim community, and 2 WASH public health officers. Interviews were recorded and transcribed, and those done in Swahili was translated into English.

The data analysis employed descriptive statistics such as percentages and frequencies. The findings were presented in text summaries, tables, figures, charts and graphs.

Results

Demographic findings

The findings in **Table 1**, shows that the majority 50.6% of the respondents were males compared to females 49.4%. These are persons who have migrated from their rural homes to the city in search of job opportunities. Most times these find refuge in cheap and affordable informal settlements.

The study recorded majority 53.2%, 34.9% and 11.9% of the respondents within age bracket of 18-35, 36-50 and 51 and above years respectively. More individuals within ages 18-35 signified that majority of persons in the slum area are youths. When hopes of getting jobs are not yielding, they end up picking on the manual pit emptying jobs and, due to lack of easily accessible designated faecal sludge disposal points, they pick the cheaper option of discharging into rivers and nearby drains. Similar findings have been reported by Mallory et al. (2021) in in slums of Nairobi. The study found that informal pit emptying was often the last resort for unemployed youth in informal settlements like Mukuru and Kibera. The study highlighted that, in the absence of proper infrastructure, pit emptiers are forced to resort to hazardous and environmentally damaging methods of waste disposal.

The majority 75.3% of the participants were Christians, while 24.3% were Muslims. The findings showed composition of religious affiliations, which may differ in teaching and values influencing sanitation behaviours. The differences in religious practices or potential social divides between Christians and Muslims in the community might create challenges in implementing cohesive waste management strategies, as indicated in Focused group Discussion by one of the participants; *"Based on some of sanitation facilities in the slum (Urinary Diverting Dry Toilet), they are hindered from using them, if this is the only option around…, faeces can easily get to the environment."* The findings support conclusions made by Tsekleves et al. (2022) that religious beliefs influence sanitation practices in Sub-Saharan Africa, emphasizing the need for community-led approaches.

The study found that majority 71.1% of the respondents were married while 14.9% were single parents. with 11.1% and 3.0% reported to be divorced and widowed respectively. The married participants, may have larger households to manage. This could mean a greater responsibility for managing waste and ensuring proper sanitation, which might increase the likelihood of engaging in informal or substandard sewage disposal methods. the findings disagree with studies by Kipngeno et al. (2024) in Nakuru Slums and Kariuki et al. (2023) in Nairobi slums. The studies submitted that married couples were more likely to have improved sanitation practices due to shared responsibilities in managing household waste, whereas single parents faced greater challenges due to financial and time constraints.

The most 40.9% of the respondents indicated to have attained secondary education, with 37.9% primary education, and 10.1% had attained tertiary education. A small 11.1% of respondents had no attained any formal education. The study found significant differences in education levels. Highly educated individuals have better access to information and can influence others, while those with less education often use poor-quality sanitation facilities, increasing waste disposal into water sources

As shown in **Table 1**, most households had an average of 3.9 to 4 members (SD=1.678), with the lowest being 1 and the highest 8 members (N=235). An increase in family size may result in a larger volume of human excreta, which can exceed the capacity of existing sanitation facilities. This may lead to more frequent maintenance needs. Due to financial constraints, this situation could contribute to improper disposal practices, such as the release of untreated sewage into water sources.

Variable	Frequency(N=235)	Percent (%)
Gender		
Female	116	49.4
Male	119	50.6
Age bracket in years		
18-35	125	53.2
36-50	82	34.9
51 & above	28	11.9
Religion		
Christian	177	75.3
Muslim	57	24.3
Other	1	0.4
Marital status		
Married	167	71.1
Single-Never married	35	14.9
Widowed	7	3.0
Level of Education		
No education	26	11.1
Primary education	89	37.9
Secondary education	96	40.9
Tertiary education	24	10.2
Household size	235	Mean (3.90, Sd=1.678)

Table 1: Demographic Findings (N=235)

Source: *(Research Data, 2024)*

Raw sewage disposal practices in Mukuru Slums

The study investigated the extent to which respondents had witnessed the disposal of excreta or raw sewage into water sources, with the findings summarized in Table 2. The majority of respondents (87.7%) reported having witnessed such practices, while a smaller portion (12.3%) had not observed any incidents. These findings were largely attributed to the households residing near a river that cuts through the Mukuru slums, as was reported in interviews. The proximity of these residences to water sources enabled landlords to dispose of raw sewage into the river

"... we(tenants), resides along the river……., and more often it's easy to dispose excreta into water sources especially during the night." [Religious leader].

Additionally, the study found that nearly half (49.4%) of the respondents were reluctant to invest in sanitation solutions. In terms of sewage disposal practices as shown in Figure 1, the analysis revealed that 28.2% of households disposed of raw sewage within their nearby environment, 57.8% disposed of it in open drains, and a significant 96.1% of respondents indicated that sewage was disposed of in the river tributaries. These disposal practices could be largely driven by the pressure on households near water sources, where many had installed underground pipes connecting directly to the rivers and tributaries. The congestion in the slums, coupled with a growing population, led to the destruction of existing sanitation facilities. To cut costs and avoid potential repercussions, sewage was often released into water sources at night. This widespread neglect of proper sanitation practices became normalized over time, with many households adopting these improper disposal methods in rivers and open drains.

Descriptive statistics

Beliefs associated with raw sewage disposal

The respondents were tasked to identified their level of agreements with statements associated with beliefs on raw sewage disposal on five-point Likert's scale, and results tabulated in Table 3. The statement asserting that disposing raw sewage into water sources is harmful to the environment received overwhelming agreement, with 85.1% of respondents strongly agreeing and 14.0 % agreeing. Similarly, a large majority 85.1% of respondents strongly agreed on the importance of proper raw sewage disposal, as well 14.9% of participants agreed. For the statement regarding collective responsibility influencing disposal of excreta, the majority 43.4% of respondents expressed disagreement and 18.7% strongly disagreed, while a smaller proportion 13.2% agreed and 18.7% strongly agreed. Regarding pressure from the community influencing disposal of raw sewage/ excreta, a significant number of respondents strongly agreed (46.4%) and agreed (38.3%), with 2.6% expressing neutrality and 5.1% disagreement.

Disposal of excreta into water sources	Frequency(N=235)	Percent (%)
No	29	12.3
Yes	206	87.7
Total	235	100.0

Table 2: *Disposal of excreta into water sources (N=235*

Source: *(Research Data, 2024)*

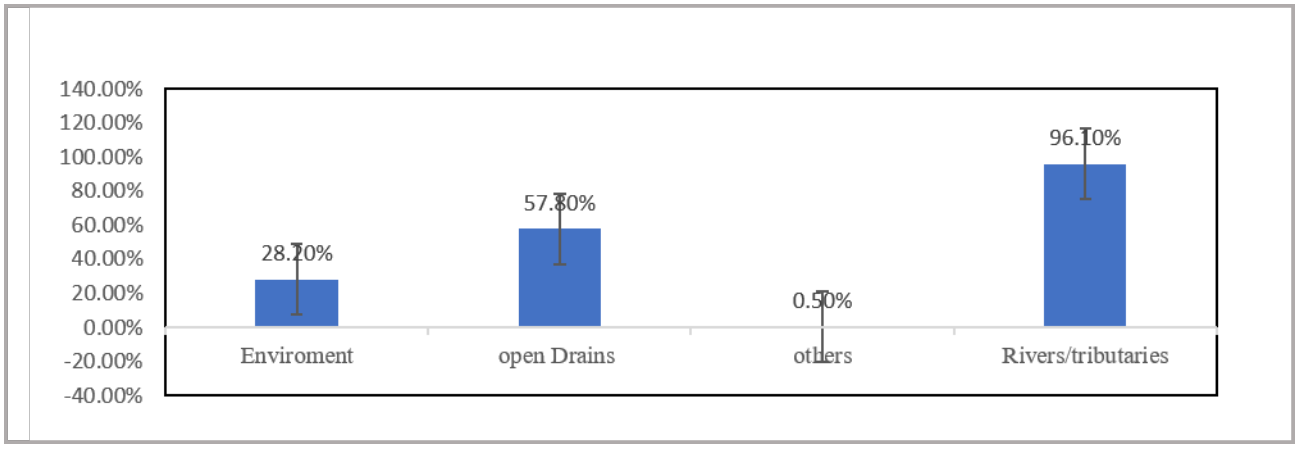

Figure 1 *Disposal sites of raw sewage*
Source: *(Research Data, 2024)*

Level of agreement with statement	Frequency (N=235)	Percent (100%)
Do you believe that it is important to dispose raw sewage properly		
Strongly Agree	200	85.1
Agree	35	14.9
Neutral	0	0
Disagree	0	0
Strong Disagree	0	0
Disposing of raw sewage into water sources is harmful		
Strongly Agree	200	85.1
Agree	33	14.0
Neutral	0	0.0
Disagree	1	0.4
Strong Disagree	1	0.4
Pressure from your community influences disposal of raw sewage		
Strongly Agree	109	46.4
Agree	90	38.3
Neutral	6	2.6
Disagree	12	5.1
Strong Disagree	18	7.7
Collective responsibility influences disposal of raw sewage/excreta in water sources		
Strongly Agree	44	18.7
Agree	31	13.2
Neutral	14	6.0
Disagree	102	43.4
Strong Disagree	44	18.7

Table 3: *Beliefs associated with raw sewage disposal (N=235)*

Source: *(Research data, 2024)*

Households and Society Structures influence on raw sewage disposal

On household involvement as presented in **Table 4,** one-third of respondents reported having a household member who addresses the disposal of raw sewage in water sources from their households. Finally, study on social networks/organizations established a considerable majority 46.4% of respondents affirming the presence of social networks or organizations in their community that promote sanitation

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Willingness to invests and social norms influence on Raw sewage disposal

The study investigated respondents' willingness to invest in sanitations and social norms influences on raw sewage disposal, and findings summarized in Table 5. Despite the pressing need for sanitation improvements, a notable 49.4% of respondents expressed reluctance to utilize their resources for this purpose. Conversely, the overwhelming agreement among respondents regarding the influence of social norms on raw sewage disposal highlights the persistent impact of community dynamics on behavioral patterns. With 41.7% and 43.8% respectively of respondents recording strongly agree and agreed on the significance of communication, coordination and cooperation in shaping sewage disposal practices

Chi-Square Test of associations on Societal norms and discharge of excreta into water sources

The study conducted Pearson Chi-Square Tests at a 95% level of confidence, aimed at investigating the correlations between raw sewage disposal practices and societal norms. The findings presented in Table 6. Participants believed that the importance of proper raw sewage disposal was significantly associated with their actual disposal behavior (X^2 = 3.419, df = 1, p = 0.046). Belief in collective responsibility regarding sewage disposal showed a highly significant association with actual disposal practices (X^2 = 26.217, df = 4, p = 0.000), indicating a strong likelihood that this belief influences behavior in this regard. The presence of social networks or organizations promoting sanitation was significantly associated with proper disposal practices (X^2 = 20.741, df = 1, p = 0.000). The findings on communication, cooperation and coordination influence on raw sewage disposal, a significant association was determined at (X^2 = 16.680, df = 4, p = 0.002).

Variable	Frequency	Percent (%)
Household addressed the improper disposal of raw sewage in water sources from your households		
No	158	67.2
Yes	77	32.8
Total	235	100.0
There existing social networks or organizations in your community that promote sanitation		
No	126	53.6
Yes	109	46.4
Total	235	100.0

Table 5*: Willingness to invests and social norms influence on Raw sewage disposal (N=235)*

Source: *(Research data, 2024)*

Societal Norms	Raw Sewage Disposal		
	Chi-square	df	p-value
Do you believe that it is important to dispose raw sewage properly	3.419	1	0.046
Belief in harmful effects to the environment of disposing of raw sewage into water sources	7.571	3	0.056
Belief in pressure from your community & its influences on disposal of raw sewage/excreta in water sources	_	_	0.000
Belief in collective responsibility & its influence on disposal of raw sewage/excreta in water sources?	26.217	4	0.000
Are there existing social networks or organizations in your community that promote sanitation.	20.741	1	0.000
Has anyone in your household addressed the improper disposal of raw sewage in water sources from your households	0.403	1	0.526
Willing to invest in sanitation	0.985	3	0.805
Communication, cooperation and Coordination	16.680	4	0.002

Chi-square tests or fishers exact used when appropriate

Table 6: *Chi-Square Test of associations of Societal norms and discharge of excreta into water sources (N=235)*

Discussion

Role of Societal Norms in Raw Sewage Disposal

The first objective for this study was to determine the societal norms that influence discharge of raw sewage into water sources by the household members. The study findings showed that 85.1% had belief in properly disposing off raw sewage. There was a significant association of the individual that had belief in properly disposing raw sewage with (P=0.046). Similarly, 85.1% had belief that disposing raw sewage was harmful to the environment. These findings underscore the fact that belief of the both positive and negative impacts of a bahaviour or practices, affects the occurrence of an event. These study findings conquered with a study in India which perceived harmful behavior of littering was influenced by contextual factors of culture and religion such as the norms purity filth, cleanliness which are complex due to taboos and beliefs (Doron & Jeffrey, 2018). The positive perception towards sanitation was 3 times more likely to utilize sanitation measures like use of toilets while the perception of latrine use by others was 2.7 times which clearly showed that social norms influenced the decision to utilize the latrine in a non-open defecation frees villages in Ethiopia, (Bamlaku et al., 2023). The study findings showed a significantly higher association of belief in raw sewage disposal.

Secondly, the study findings showed that 46.4% of the respondents strongly agreed while 7.7% strongly disagreed that that pressure from communities influenced the discharge of raw sewage into water sources. The study found a significant association of pressure from community at (p=0.000). Therefore, the community's conformity to norms determines the adoption of the undesired or desired characters due to group influence. This study agrees with research findings that people frequently adopted behaviors based on their peers as they attempted to adhere to the standards of their social groupings by (Eggen, 2019). Thirdly, 43.4% of the participants disagreed that collective responsibility had influence on discharge of raw sewage in water sources while 18.7% agreed. There was a significant association with a significant association collective responsibility and disposal of raw sewage into water sources. This study findings supported a similar study that stated that communities were more likely to adopt and maintain sustainable practices when they assumed ownership of trash management (Luitel, 2021).

A notable percentage of 32.8% as compared to a substantial 67.2% respondents did not make effort to address the improper sewage disposal. This showed the immense effect that results when there

is lack of individual effort to address raw sewage. These presented the need to utilize household members in addressing sanitation related issues. Interestingly, this study was in agreement with a study conducted in Usoma village that showed that the social capital among the communities, including ability for community members to share information, and build trust to improve behavior as a key aspect on access to proper water and sanitation and reduction of diarrhea infection in children Kamara et al., 2017.

The study on social networks/ organizations, addressing sanitation issues, 46.4% of the participants affirmed that the presence of organizations influenced proper sewage disposal. The presence of social networks or organizations promoting sanitation was significantly associated with proper disposal practices (X^2 = 20.741, df = 1, p = 0.000). These showed the importance of developmental partnership within the society that enable communities to adhere to proper living standards.

The study Findings on willingness to invest on proper sewage disposal, a notable percentage of 49.4% showed reluctance in using their resources to utilize their resources while only 10% were very much willing to use their resources to address sanitation issues. This reluctance underscores the raw sewage disposal practices in the water sources, the environment, open drains, which increases the potential of increased water pollution, stagnation of infrastructure improvement, which in general reduces the quality of lives due to associated disease outbreaks and financial constraints. These findings concurred with findings where beneficiaries have a 'tragedy of the commons' where due to inadequate shared sanitation facility leads to no individual wanting to sacrifice (Angoua et al., 2018). The study further agrees with findings that the ability of people to willingly invest in household sanitation is connected to the history of settlement and land ownership (Hirai et al.,2018). This is clearly reiterated by Awuonyo-Akaba et al., 2016 that with no ownership, minimal investment occurs in sanitation at the household level.

The study findings showed the importance of communication, coordination and cooperation with 43.8 % strongly agreeing while only 2.1% strongly disagreed that it had no influence over raw sewage disposal. The study findings reported a significant association of these communication, cooperation and coordination with raw sewage disposal at (p = 0.002). These findings underscore the critical need for a multi-faceted approach to address the issue of raw sewage disposal. Key components include raising awareness and providing education on proper sanitation practices, fostering community engagement, and promoting shared responsibility. Collective action is essential, with active stakeholder engagement to ensure that all parties contribute to solutions. Additionally, the efficient utilization of resources, without duplication of efforts, is crucial. Effective management of crises, such as water resource pollution, must be prioritized to prevent further environmental degradation caused by improper sewage disposal. These findings were in agreement with study observations by Novotny et al., (2017) that social norms influenced the sanitation outcomes due to the set perception on risks or benefits, and findings by Bamluka et al., 2023 that weaker social norms were associated with behavioral reversal to open defecation practices. These findings showed the essence of frequent effective and clear communications, cooperation and coordination in ensuring sustainability of the sanitation projects.

Conclusion

The study concludes that raw sewage disposal practices are prevalent in water sources found in Mukuru slums. This has been attributed by societal norms such as beliefs on raw sewage disposal, pressure from communities, collective responsibility, existence of social networks, such as organization, communication, cooperation and coordination and the will to invest in sanitation which had influence over the discharge of raw sewage. These societal norms influence the raw sewage disposal practices based on how strong they are adopted by individuals, communities, partners, government in Mukuru slums.

Recommendation

The study recommends that the government, WASH partners, and stakeholders initiate awareness campaigns targeting Mukuru slums residents to educate them on the harmful impacts of disposing raw sewage into water sources and the importance of adopting proper sanitation systems. Strengthened communication and feedback mechanisms are also advised to ensure continuous engagement. Additionally, the study emphasizes the need for cooper-

ation in resource allocation to prevent duplication of efforts and promote efficient use of resources. Improved coordination is essential to enhance community acceptance, foster a sense of ownership, and ensure accountability for sanitation projects within the informal settlements.

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