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(RESEARCH ARTICLE)

A Landlord/lady Perspective on Emptying and Transportation of Faecal Sludge in informal settlements of Eldoret town, Uasin Gishu County, Kenya

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Abstract

Emptying, transportation and disposal of faecal sludge in informal settlements of Eldoret Kenya is still a big challenge. This study aimed to identifying actors and factors determining emptying costs and constraints limiting improvement in service provision with the use of a questionnaire and a review of secondary data. A total of 35 respondents were issued questionnaires. The data showed that most of the households were using septic tanks as the preferred method of Onsite Sanitation Systems (OSS). The study also noted that there were no price regulations for faecal sludge emptying services. Through the study, it was found that the private exhausters were charging the customers exorbitantly and there was a need to create a regulatory framework to manage the costs. It was also found that due to the high-water table within the environs of Eldoret and Uasin Gishu County at large, there was a risk of groundwater contamination, especially for the neighbors who solely depended on water from their wells for their daily household use. It was established that the emptying charges were directly proportional to the capacity of the exhauster and the haulage distance to the wastewater treatment plant. In summary, the paper recommends adequate allocation of funds, the involvement of all key stakeholders, the creation of awareness and education in the FSM and the creation of a legal framework or policy governing the management and disposal of FS as we move towards the realization of SGD 6.

Keywords: Faecal Sludge Management (FSM); Low income settlement; Eldoret; Sanitation Value Chain; Onsite Sanitation Systems (OSSs); Pit Latrines; Cost of Service; Willingness to Pay

1. Introduction

Globally, it has been established that approximately 2.7 billion people are reliant on on-site sanitation systems (OSS), mainly septic tanks and pit latrines. The number is expected to rise to 4.9 billion people by 2030 (Cairns-Smith, 2014).

Faecal Sludge (FS) is a mixture of human waste, water and any other materials, either raw or partially digested, a slurry or semisolid and is disposed of and stored in pits, tanks, or vaults of OSSs (Strande, Ronteltap, & Brdjanovic, 2014). The mixture (FS) should be properly contained and managed safely to minimize environmental pollution and reduce public health risks. Faecal Sludge Management (FSM) is a systematic approach of dealing with FS and it includes storage, collection, transport, treatment and safe disposal, making up the five components of the sanitation service value chain as illustrated by Figure 1.

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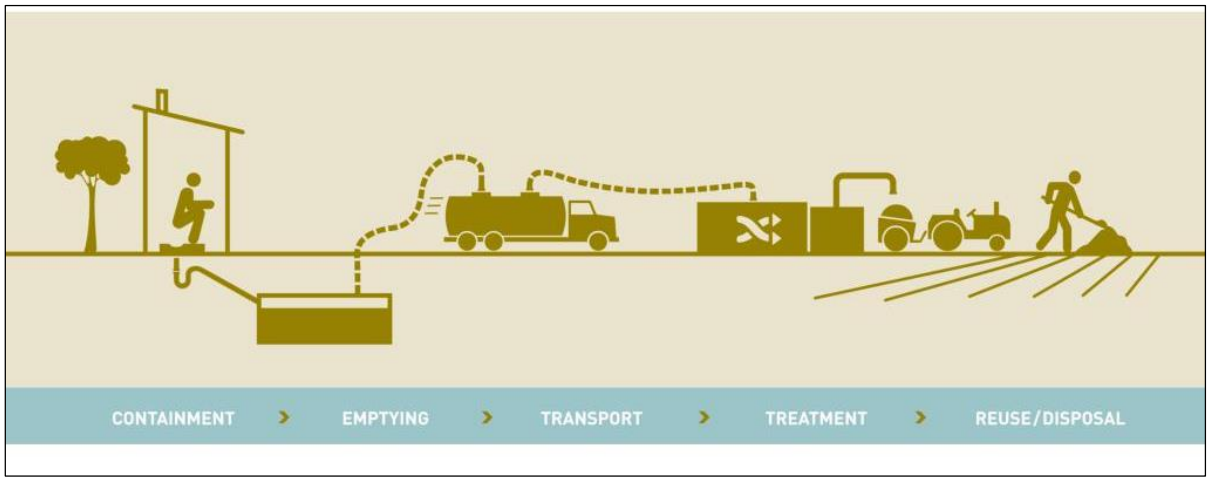

Figure 1 Faecal Sludge Management Service Chain (Source: (Strande, Ronteltap, & Brdjanovic, 2014))

The current need for FSM worldwide, particularly in lower and middle-income countries, is large and inequitably distributed amongst the poorest households in both rural and urban areas (Berendes, 2017).

A study conducted in different cities in countries around Asia and Africa, majorly focusing on the extraction and transportation of faecal sludge, indicates that most of the households in the cities surveyed were found to be off-the-sewer networks and use on-site sanitation facilities (Chowdhry & Kone, 2012). This study was carried out in several countries across Africa, i.e., Kenya, Ethiopia and others. In countries surveyed, some three cities with varying populations ranging from one hundred thousand to five million were chosen to provide insight into a variety of situations related to urban faecal sludge emptying and transportation. While under the direction of a global coordinator, a group of local consultants assisted each nation.

About 30% of the households participating in the survey use manual services to empty the on-site facilities because this is a manual or mechanical process. There are about 5 million households in the different cities that have installed on-site sanitation. During the survey period, approximately 2 million households relied on a manually operated sludge management system. The other remaining households utilize mechanically operated emptying services provided by private operators (Chowdhry & Kone, 2012).

Private businesses that run the emptying services in most cases do this as a supplementary, not as their main focus, to add to their revenues. They acquire vacuum-emptying trucks after saving their income for some years or by seeking loans from acquaintances. About 20% of the mechanical emptying operators surveyed took commercial loans to purchase a truck. It was observed that the cost and sourcing of trucks are the biggest impediments for entrepreneurs (Chowdhry & Kone, 2012). For instance, the average cost of a locally assembled truck for emptying faecal sludge in Asia is approximately $14,000.00. The common trend in Africa is to acquire second-hand vacuum trucks from around Asia and maybe Europe that are refurbished and launched to operate on the road.

For the sanitation service value chain to be effective, proper containment, emptying and subsequent transportation of FS to treatment, safe disposal and/or reuse are required (Klingel F, 2002). A successful service chain ensures that FS is safely collected and disposed of properly and not simply relocated from OSS to the immediate environment. The important components of the FSM provided by different stakeholders, i.e., the private sector, the informal sector, non-governmental organizations (NGOs), local governments, etc., is emptying and transportation (E&T) of FS.

Lack of governing policies and regulatory frameworks on FSM sanitation value chain services has led to the provision of FS E&T services without adequate technology, regulations and safety precautions (Jayathilake, Drechsel, Keraita, Fernando, & Hanjra, 2019).

In order to meet sanitation goals, the Kenyan government emphasized non-sewered sanitation in urban areas and achieving a full sanitation value chain through proper faecal sludge management techniques (WASREB, 2019).

The call to meet global and national targets of adequacy and equity in sanitation requires the need to expand the growing and emerging secondary city interventions. These interventions should be aligned with the prevailing conditions and/or build upon already existing efforts.

In Kenya, detailed documentation has been provided on the prevailing conditions, particularly concerning faecal sludge management in low-income settlements. The lack of local-level data across African cities has been deemed to be a hindrance to sanitation programming. Such data enable identifying priorities and interventions that work and measure progress in terms of faecal sludge management.

Two methods can be used to empty faecal sludge: (a) manual emptying and (b) mechanized emptying. Each of the above methods has its pros and cons that make it favorable or unfavorable when used. For manual emptying some of the advantages include the creation of income and employment; the pumps can easily be built and repaired; they are less capital intensive; they can provide services in areas that are difficult to access, which have on-site sanitation and provide more affordable services to the less privileged (Harada, Strande, & Fujii, 2016). Some of its shortcomings include bad odor, consumption of a lot of time, increased environmental and public health risks, difficult and unpleasant work to carry out and increased health risks to the people who are conducting the emptying (Englund & Strande, 2019).

For mechanized emptying, its advantages include the creation of jobs locally, reduced health and environmental risk and fast and effective emptying of faecal sludge (Singh, Gupta, Alamgir, & Brdjanovic, 2021). The shortcomings include difficulty accessing on-site sanitation technology sites; the cost may not be affordable to all the households; the mechanical systems cannot pump thick sludge; the depths the pumps can suck are limited to about 3 meters, pumps should be located at approximately 20m; a high cost of operating and maintenance and there may be difficulty in accessing some on-site sanitation (Englund & Strande, 2019).

In this paper, we aim to provide an analysis of the real situation experienced at the "ground level" of how faecal sludge is managed, especially in low-income settlements in urban areas with more insights on Eldoret town in Kenya. This study will assess the general practices and the sanitation value chain shortcomings that are related to the management of faecal sludge (Singh, Mohan, Rathi, & Raju, 2017). This study has the core objective of disseminating the different methods of transportation of faecal sludge, circulating the results and sharing with the interested entrepreneurs and then recommending policy formulation to guide faecal sludge management (Mikhael, Robbins, Ramsay, & Mbeguere, 2014).

2. Material and methods

2.1. Study Area

Eldoret Municipality is the fifth largest town in Kenya and serves as the headquarters of Uasin Gishu County with a population of 475,716 (2019 Kenya Population and Housing Census). The current growth rate of Uasin Gishu County is 3.5% and is projected to reduce to 1.25% in the year 2045 (Kenya National Bureau of Statistics, 2019). Currently, the plans to upgrade the municipality to city status are in advanced stages of approval.

The town is administratively divided into Moiben, Soy, Turbo, Ainabkoi, Kesses and Kapseret constituencies (County Government of Uasin Gishu, 2024). Most of the population live in low-income areas which include Langas, Huruma, Munyaka, Sogomo, Sugunanga and Kipkaren. Living conditions in these areas, just like other low-income areas across the country, are characterized by poor quality housing and inadequate provision of services such as poor solid waste management, water and sanitation.

Figure 2 below shows the general study area:

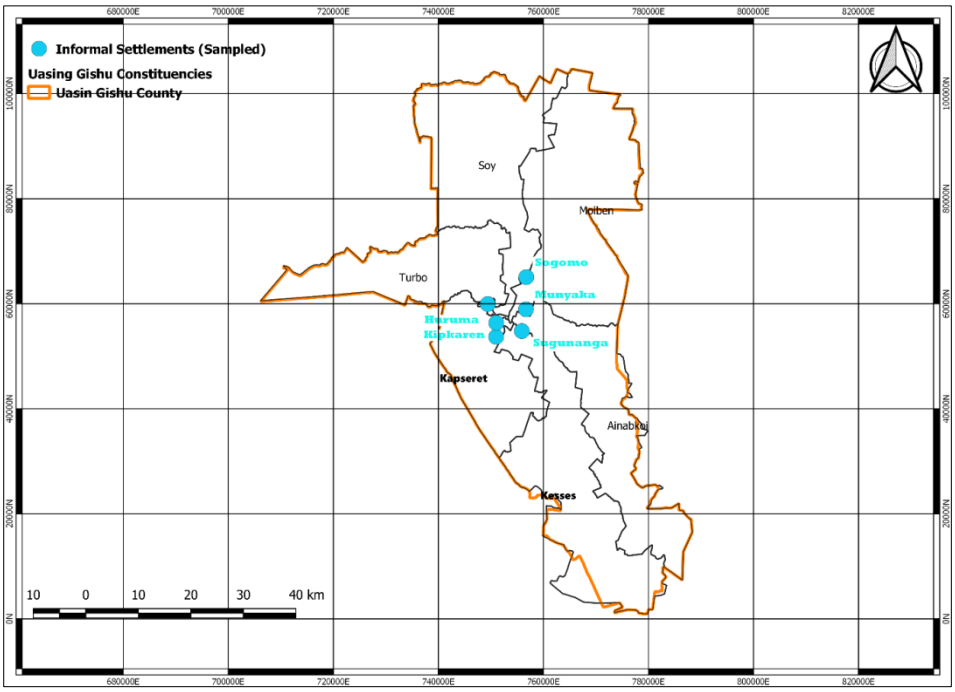

Figure 2 Location of Eldoret Municipality Informal Settlements within Uasin Gishu County

2.2. Methodology

Due to the large number of residential units in the study area, a total of thirty-five (35) representative residential units across different estates within the study area were selected randomly. To collect the data, the research methodologies adopted included administering semi-structured questionnaires to the owners and physical observation of the onsite sanitation facilities. The questionnaires were preferred as they are efficient, cost-effective, versatile and present uniform data gathering for systematic analysis. Upon designing the questionnaire, it was subjected to a pre-test on five (5) participants. The five participants were chosen in a manner similar to that adopted for the main target group. This resulted in minor improvements in aspects of the questionnaire such as the wording, sequence and flow of questions.

A physical examination of the existing on-site sanitation solutions was made to verify and supplement the data obtained from the questionnaire.

2.2.1. Operation Process and Cost of Emptying

Private contractors are mainly involved in emptying services in informal settlements within Eldoret Municipality. There are no registered private companies providing emptying services, but rather individuals with their trucks who have registered with Eldoret Water and Sanitation Company Ltd (ELDOWAS) to empty in the existing WWTPs. The individual private providers determine their charges depending on the trucking distance to the WWTP and the volume of faecal sludge being desludged.

The emptying services provided by the private contractors are based on a demand-driven approach based on an individual request. Under this arrangement, a person who needs the emptying service makes a call to the nearest service provider or the service provider that charges on the least cost basis. On average, an individual member pays approximately US$ 50 (KES 7,342.86) per trip**.**

2.2.2. Challenges faced by Landlords/Landladies due to onsite sanitation facilities

The common challenge faced by the Landlords/Landladies during the interview was the high-water table within the municipality, which enables frequent desludging and the average desludging period was found to be 9 months. The high-water table leads to overflowing of the on-site facilities, more so during the rainy season, leading to groundwater contamination.

The other challenge is the high cost of emptying being charged by the private contractors. There is no regulation on the charges preferred by the service providers.

It was also raised by the landlords and landladies that the challenge with the on-site facilities is the foul smell experienced by the users especially those who use pit latrines and flies which in most cases lead to contamination of food, leading to the spread of diseases.

In addition, there is a delay in service provision by the private contractors when called upon to provide emptying services. The service providers take a long time to respond to the calls and some of the providers take on jobs beyond their capacities.

2.2.3. Service provision by ELDOWAS

ELDOWAS is a corporate entity established under Cap. 486 of the laws of Kenya. The County Government of Uasin Gishu is the principal shareholder (ELDOWAS, 2024).

ELDOWAS is responsible for the wastewater collection, treatment and safe disposal in Eldoret Town and its environs. The company operates two state-of-the-art sewerage treatment plants located in Huruma and Kipkenyo in the western part of the town (ELDOWAS, 2024).

3. Discussion

A summary of the results from the information collected from the respondents is summarized in Table 1 in the Appendix.

The study was undertaken by interviewing 35 landlords and landladies within the municipality with a distribution of 25 males and 10 females, representing 71% and 29% respectively. This shows that there is a high ratio of landlords as compared to the landladies interviewed.

The age distribution of the landlords and landladies was considered and a majority of the landlords and landladies fall between the ages of 25 and 45 representing 60% of the respondents. The study discovered that a younger population below 25 years is comprised of minority landlords and landladies, with 6% of the respondents, while the rest are landlords and landladies above 45 years of age, with 34% of the respondents.

The study was carried out on landlords and landladies with the following types and numbers of rooms owned: one-bedroom, single-room self-contained, two bedrooms and three bedrooms, representing 22%, 74%, 3% and 1% of the types of houses owned by the landlords and landladies, as depicted in Figure 3:

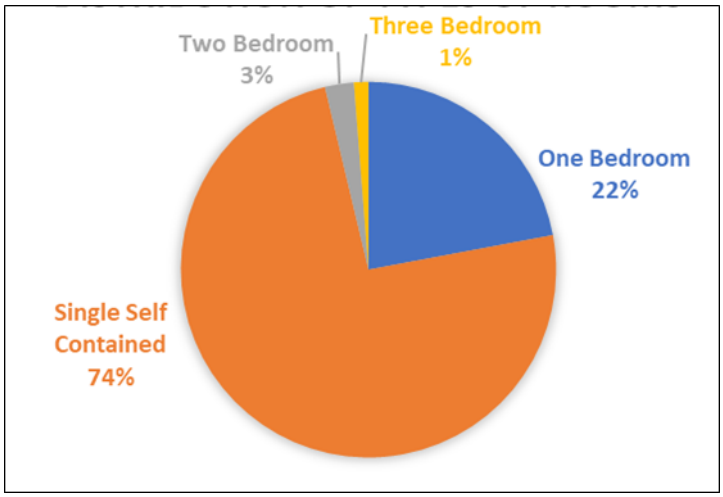

Figure 3 Distribution of types of room

The study also found out that most of the landlords and landladies use septic tanks as their preferred onsite sanitation facilities. Few of the landlords and landladies use pit latrines as their onsite sanitation facilities. It was found that none of the landlords and landladies have constructed biodigesters within their premises. The distribution of the on-site facilities in terms of percentages is as follows: 0%, 80% and 20% represent biodigesters, septic tanks and pit latrines respectively. Figure 4 shows the distribution of the onsite facilities being utilized by the landlords and landladies within the municipality:

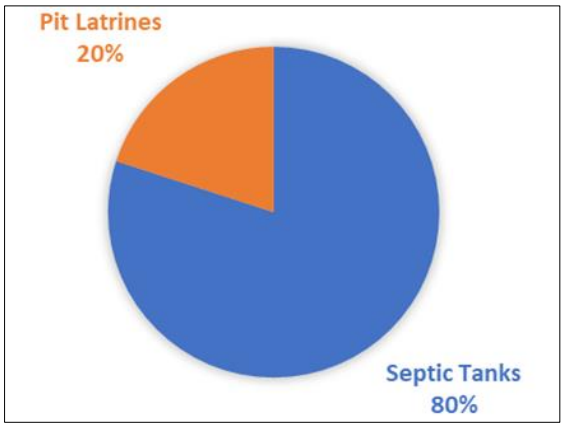

Figure 4 Distribution of type of onsite sanitation facility

It can be observed from the results that the majority of the landlords and landladies preferred the use of septic tanks as their onsite sanitation facilities. This is attributed to the lack of or inadequate sewer systems within the informal settlements. Many landlords and landladies cited that one of the reasons for not embracing the use of biodigesters, though they can produce methane gas as a source of energy for household use, is that the biodigesters are more expensive to install than the septic tanks and subsequently, they require specialized knowledge and expertise to operate and maintain. Therefore, most landlords and landladies preferred the use of septic tanks within their premises.

The study also determined that there is no price regulation from the Water Service Provider (ELDOWAS) on the cost levied to the users on emptying services. The private service providers, who mostly operate the vacuum trucks, determine prices according to the trucking distance to the WWTP and the volume of wastewater being desludged.

ELDOWAS is the corporate entity in charge of sanitation service provision within Eldoret Municipality, but they outsource the emptying services to private contractors. This is mainly due to desludging services being quite involving and therefore they opted for private contractors to carry out the work on their behalf. This has created a loophole such that the private operators take advantage of the users to offer prices at exorbitant rates.

In addition, the private contractors have monopolized the emptying business and as such, there is no competition with the government-offered services and no proper regulations have been enacted to engage the private service providers. This has led to the private sector to set charges that will enable them to recover costs or even beyond.

Various approaches have been adopted to ensure that sanitation services are provided in the informal settlements. In the city of Nakuru, the emptying of faecal sludge was done by manually by the pit emptiers, who used buckets or emptying equipment (Gulper and Rama). Further, the emptiers in the city of Nakuru are organized in groups and are also engaged in community activities such as solid waste management. The pit emptying costs varied between KES 1,500.00 and KES 3,000.00 and were determined by the size of the pit, the amount of sludge in the pit, the weather season and whether the pit latrine was lined or unlined (Simiyu, Chumo, & Mberu, 2021).

On the age factor, the elderly landlords and landladies normally did not pay the pit emptiers on time, or sometimes they paid less than the amount required, or they did not pay at all. The triggering reason for such behaviors by the elderly landlords and landladies is that they depended on the rental income from the units they owned to pay the emptiers.

Moreover, transportation of the faecal sludge to the treatment plant was mainly done by the private contractors who provided transportation since the county government had limited transportation services. trucks. The county government owned a few trucks and this presented a business opportunity to the private individuals who had invested heavily in the exhaust trucks for the transportation of sludge to complement the few trucks owned by the county government.

In the city of Kisumu, the Kenya Informal Settlements Improvement Project (KISIP) financed the expansion of the sewer connections in low-income areas. These were part of the pro-poor sanitation programs that aimed at developing sewerage options for the informal settlements. Further in the city of Kisumu, some programs are aimed at improving faecal sludge management in informal settlements. The programs are focused on the development of formal manual emptying organizations that are recognized by the local authorities and employ safety procedures and equipment for

the collection and transportation of faecal sludge to the Kisumu Water and Sanitation Company Ltd (KIWASCO) faecal sludge treatment site (Peletz, et al., 2020).

In Dakar Senegal, there was a need to address the costs of service provision by improving the pro-poor sanitation efforts. The National Sanitation Agency (ONAS) provided training, certified the private operators and created a call to coordinate the mechanized emptying services (Peletz, et al., 2020).

Therefore, there is a need to create an institutional arrangement or framework between the public and private service providers to bridge the gap and develop appropriate measures on the way forward to provide joint partnerships to offer affordable services to users. Further, the Water Service Provider (ELDOWAS) should identify with the private contractor emptiers, provide training to them on emptying techniques, and provide them with protective gear (gloves, goggles, masks, and overalls), disinfectant, and sprays. This approach has been deemed successful by the Nakuru Water and Sanitation Services Company (NAWASSCO), which is the main water utility responsible for water and sanitation service provision in the County of Nakuru. Further, the County Government of Nakuru provided registration to the private trucks, while NAWASSCO provided the permits and licensing to the private trucks (Simiyu, Chumo, & Mberu, 2021). This approach can further be adopted by the County Government of Uasin Gishu in conjunction with ELDOWAS.

We acknowledge, however, that this study is only limited to the low-income settlements within Eldoret Municipality. There is a need to conduct further studies to collect sufficient data, which will complement the information obtained in our study. The information would further be used to complement available data on faecal sludge management within Eldoret Municipality and aid in preparing the Shit Flow Diagram (SFD) for the municipality.

Table 1 Summary of Results

S/No.	Gender		Age			Type and number of Rooms				Type of Onsite Sanitation Facility			Capacity of Onsite Sanitation Facility				Desludging Period (Months)	Cost of Desludging (KES)
	M	F	<25	25 - 45	>45	One Bedroom	Single Self Contained	Two Bedroom	Three Bedroom	Bio-digester	Septic Tanks	Pit Latrines	L (m)	W (m)	D (m)	Volume (m^3)		
1	1			1		0	40	0	4	0	1	0	5	2.7	4	54	6	5,000.00
2	1				1	0	7	0	0	0	0	1	2.5	0.8	5	10	12	5,000.00
3	1			1		16	1	2	0	0	1	1	3	2	5	30	5	8,500.00
4		1		1		8	0	0	0	0	1	0	3	2	5	30	3	5,000.00
5		1		1		0	15	0	0	0	1	0	3	3	4	36	12	5,000.00
6	1			1		7	19	0	0	0	1	0	4	3	3.5	42	6	5,000.00
7	1				1	0	50	0	0	0	1	0	10	4	2.1	84	1	10,000.00
8		1		1		0	21	0	0	0	1	0	5	3	4	60	4	10,000.00
9	1				1	6	0	8	0	0	1	0	5.3	2.5	2.4	31.8	9	12,000.00

10	1		1			0	0	4	0	0	1	0	4.3	2.6	2.4	26.832	6	10,000.00
11	1			1		0	15	0	0	0	1	0	5	2.6	2.4	31.2	12	12,000.00
12	1				1	4	4	2	0	0	1	0	6.2	3.5	2.5	54.25	12	10,000.00
13	1			1		0	15	0	0	0	1	0	5	2.6	2.4	31.2	12	12,000.00
14		1		1		6	4	0	0	0	1	0	4.5	2.3	2.5	25.875	12	12,000.00
15	1			1		11	1	0	0	0	1	0	7	4	4	112	3	5,000.00
16	1			1		9	0	0	0	0	0	0	10	3	2	60	12	5,000.00
17		1			1	0	5	0	0	0	0	1	2	1.2	6	14.4	12	3,000.00
18	1			1		0	8	0	0	0	0	1	2	1.2	8	19.2	6	5,000.00
19	1			1		7	0	0	0	0	1	0	9	2	3	54	60	5,000.00
20	1			1		0	4	0	1	0	0	1	2	3	3	18	1	4,500.00
21	1				1	0	15	0	0	0	0	1	2.5	0.9	5	11.25	8	5,000.00
22		1			1	0	8	0	0	0	0	1	2	1.2	6	14.4	12	3,000.00
23		1		1		0	0	0	1	0	1	0	3	1.5	7.5	33.75	3	5,000.00
24	1				1	22	0	0	0	0	1	0	8	2.8	2	44.8	3	10,000.00
25	1				1	20	4	0	0	0	1	0	6	2	4.5	54	3	8,000.00
26	1			1		0	0	0	1	0	1	0	2.4	1.5	1.8	6.48	6	5,000.00
27		1	1			0	135	0	0	0	1	0	8	2.5	5	100	1	14,000.00
28	1				1	12	0	0	0	0	1	0	10	6	2.2	132	3	8,000.00
29	1				1	0	56	0	0	0	1	0	7	3.5	5	122.5	6	10,000.00
30	1			1		0	15	0	0	0	1	0	3.5	2.5	4	35	12	5,000.00
31	1			1		0	6	0	0	0	1	0	2.5	2.5	3	18.75	3	5,000.00
32	1			1		0	12	0	0	0	1	0	3	2.5	5	37.5	12	10,000.00

33		1			1	0	17	0	0	0	1	0	5	2.5	4	50	12	10,000.00
34	1			1		8	1	0	0	0	1	0	3.5	3.5	4	49	12	5,000.00
35		1		1		6	0	0	1	0	1	0	5	3	4	60	12	5,000.00
SUM	25	10	2	21	12	142	478	16	8	0	28	7	-	-	-	-	-	-
AVG.	-	-	-	-	-	4.057	13.657	0.457	0.228	0	0.8	0.2	4.834	2.554	3.891	45.54	8.971	7,342.86
%	71%	29%	6%	60%	34%	22%	74%	2%	1%	0%	80%	20%						

4. Conclusion

Eldoret Municipality is growing at a fast rate in terms of population and urbanization and is soon gaining city status, hence the likely growth of more informal units. As a result, the sanitation situation in the municipality is projected to worsen if proper measures are not put in place. Therefore, there is a need to develop and implement policies that will limit the growth and development of informal units with proper consideration of sanitation needs.

Both the national and county governments need to allocate enough resources for water and sanitation development to meet Sustainable Development Goal (SDG) number six by 2030. Most informal settlements in Eldoret Municipality use on-site technologies, especially septic tanks and pit latrines and almost zero percent of the population uses off-site technologies. Hence, there is a need to have enough resources to develop the sewerage system for these areas and reduce the many challenges associated with the use of pit latrines and septic tanks.

The national government and other county water service providers need to be key participants in the sanitation agenda. There is a need to provide policies to regulate pricing and set up faecal sludge management departments in the two arms of government. This will enhance the coordinated approach to dealing with the sanitation issue and ensure the private sector is regulated by the government through various policies. Additionally, the government should improve sanitation services by purchasing vacuum trucks, employing technical staff and providing financial aid to this department.

In summary, this study sought to understand the containment, emptying, transportation and disposal of faecal sludge in informal settlements within Eldoret Municipality.

Therefore, there is a need to develop appropriate and sustainable measures to address the sanitation challenge, especially for those who use onsite sanitation services such as pit latrines. Hence, there is a need to bring together all stakeholders dealing with faecal sludge management to develop and implement sustainable policies, provide education to slum dwellers, improve sanitation services and provide financial aid to navigate the sanitation menace. Additionally, the government needs to fully participate in the sanitation agenda as a key stakeholder to help improve the sanitation situation in informal settlements and help Kenya as a country move towards the realization of SDG goal number 6.

Areas of further research

This research paper provides a comprehensive analysis of faecal sludge management challenges in the informal settlements within Eldoret Municipality. The research paper has highlighted the absence of regulatory frameworks and the dominance of private contractors in faecal sludge emptying services. Future research should focus on comparative studies across different Kenyan municipalities to generalize findings, investigate the long-term impacts of faecal sludge management practices on public health and the environment and evaluate the effectiveness of public-private partnerships in enhancing service delivery and infrastructure development in sanitation management.

Compliance with ethical standards

Disclosure of conflict of interest

The authors have not declared any conflict of interest.

References

[1] Berendes, D. M. (2017). Safely Managed Sanitation for all means faecal sludge management for at least 1.8 billion people in low- and middle-income countries. Environ. Sci. Technol., 51, 3074-3083.

[2] Cairns-Smith, S. H. (2014). Urban Sanitation: Why A Portfolio of Solutions Is Needed. Boston, MA, USA: The Boston Consulting Group.

[3] Chirwa, C., Hall, R., Krometis, L.-A., Vance, E., Edwards, A., Guan, T., & Holm, R. (2017). Pit Latrine Faecal Sludge Resistance Using a Dynamic Cone enetrometer in Low Income Areas in Mzuzu City, Malawi. International Journal of Environmental Research and Public Health 14, 87.

[4] Chowdhry, S., & Kone, D. (2012). Business analysis of faecal sludge management. Emptying and transportation services in Africa and Asia.

[5] County Government of Uasin Gishu. (2024, February 5). The County Government of Uasin Gishu. From uasingishu.go.ke: https://uasingishu.go.ke/index.php/explore-uasin-gishu

[6] ELDOWAS. (2024, January 15). Eldoret Water and Sanitation Company Limited (ELDOWAS). From eldowas.or.ke: https://eldowas.or.ke/about/

[7] ELDOWAS. (2024, January 15). Eldoret Water and Sanitation Company Limited (ELDOWAS). From eldowas.or.ke: https://eldowas.or.ke/our-services/sewerage-services/

[8] Englund, M., & Strande, L. (2019). Faecal sludge management: highlights and exercises. Dübendorf, Switzerland: Eawag: Swiss Federal Institute of Aquatic Science and Technology.

[9] Harada, H., Strande, L., & Fujii, S. (2016). Challenges and opportunities of faecal sludge management for global sanitation. Towards future earth. challenges and progress of global environmental studies. Tokyo, Japan: Kaisei Publishing.

[10] Jayathilake, N., Drechsel, P., Keraita, B., Fernando, S., & Hanjra. (2019). Guidelines and regulations for faecal sludge management from on-site sanitation facilities. Anand, India: International Water Management Institute (IWMI).

[11] Klingel F, M. A. (2002). Faecal Sludge Management in Developing Countries: A Planning Manual; Water and Sanitation in Developing Countries. Duebendorf, Switzerland: Swiss Federal Institute for Environmental Science and Technology (EAWAG).

[12] Mikhael, G., Robbins, D. M., Ramsay, J. E., & Mbeguere, M. (2014). Methods and means for collection and transport of faecal sludge. In L. Strande, M. Ronteltap, & D. Brdjanovic, Faecal Sludge Management: Systems Approach for Implementation and Operation (pp. 67 - 96). London, UK: IWA Publishing.

[13] Muoghalu, C., Semiyaga, S., & Manga, M. (2023). Faecal sludge emptying in Sub-Saharan Africa, South and Southeast Asia: A systematic review of emptying technology choices, challenges, and improvement initiatives. Frontiers in Environmental Science.

[14] Murungi, C., & Dijk, M. P. (2014). Emptying, Transportation and Disposal of faecal sludge in informal settlements of Kampala Uganda: The economics of sanitation. Habitat International 42, 69 - 75.

[15] Peletz, R., Feng, A., MacLeod, C., Vernon, D., Wang, T., Kones, J., . . . Khush, R. (2020). Expanding safe faecal sludge management in Kisumu, Kenya: an experimental comparison of latrine pit-emptying services. Journal of Water, Sanitation and Hygiene for Development 10.4, 744 - 755.

[16] Semiyaga, S., Okure, M. A., Niwagaba, C. B., Katukiza, A. Y., & Kansiime, F. (2015). Decentralized options for faecal sludge management in urban slum areas of Sub-Saharan Africa: A review of technologies, practices and end-uses. Resources, Conservation and Recycling, Volume 104, Part A, 109 -119.

[17] Simiyu, S., Chumo, I., & Mberu, B. (2021). Faecal Sludge Management in Low Income Settlements: Case Study of Nakuru, Kenya. Frontiers in Public Health.

[18] Singh, S., Gupta, A., Alamgir, M., & Brdjanovic, D. (2021). Exploring private sector engagement for faecal sludge emptying and transport business in Khulna, Bangladesh. International Journal of Environmental Research and Public Health.

[19] Singh, S., Mohan, R. R., Rathi, S., & Raju, N. J. (2017). Technology options for faecal sludge management in developing countries: Benefits and revenue from reuse. Environmental Technology & Innovation.

[20] Strande, L., Ronteltap, M., & Brdjanovic, D. (2014). Faecal Sludge Management: Systems Approach for Implementation and Operation. London, UK: IWA Publishing.

[21] WASREB. (2019). A Performance Report of Kenya's Water Services Sector – 2017/18. Nairobi, Kenya: WASREB.

[22] Yesaya, M., & Tilley, E. (2021). Sludge bomb: The impending sludge emptying and treatment crisis in Blantyre, Malawi . Journal of Environmental Management 277.