Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2018, 5(9):294-300**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Developing an Appropriate Sanitary Facility to End Open Defecation on the Islands of Uganda (A case study of Koome Island)

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Abstract Developing an appropriate sanitary facility is a potential solution to ending open defecation on the islands of Uganda. The sanitation coverage on the islands of Uganda is 30% and that most of the human waste is discharged in the environment directly. There are abandoned urine dry diversion toilets on the island of Koome and failed ventilated improved pit latrines attributed to the geological conditions, cultural beliefs of the people who believed that applying of ash to feacal matter was witchcraft. Therefore a combination and modifying the existing sanitary facilities to suit the cultural beliefs, geological conditions, economy and technology will help in developing an appropriate sanitary facility that will end open defeacation on the island .thus the facility should be above the ground because of the very low water table and unstable soils. The availability of stone slates, sand, aggregate, timber, polythene will reduce construction costs and the used of ash to enhance feacal decomposition will be replaced with dry vegetation leaves which are readily available.

This paper represents steps that were taken to come up with an appropriate sanitary facility to end open defecation on the islands of Uganda from Kyambogo University.

Keywords Sanitary Facility, End Open Defecation

1. Introduction

The United Nations 2030 agenda for sustainable development seeks to achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of girls and women, and those in vulnerable situations. It also seeks to improve water quality by reducing pollution, to halve the amount of untreated waste water by 2030, and to substantially increase recycling and safe reuse [1]. The Joint Monitoring Program (UNICEF & WHO, 2017), states that 2.3 billion people, worldwide, still lacked even a basic sanitation service and 892 million people worldwide still practiced open defecation. At an average of 0.63 percentage points per year between 2000 and 2015 basic sanitation coverage increased but no SDG region is on track to achieve universal basic sanitation by 2030, with the exception of Australia and New Zealand, where coverage is already nearly universal [2].

Sanitation gaps are particularly critical in rapidly expanding informal urban areas, exacerbating inequalities and unsustainable development processes [3]. This is attributed to the fact that prioritization and investments in improved appropriate sanitation facilities by individuals and governments in most developing countries are limited, creating an imbalance between the population's needs and available facilities. This leads to challenges in proper use and maintenance of the existing facilities [4].

In Uganda, sanitation has slowly evolved from open defecation to pit toilets, somewhat improving Africa's sanitation but the latrine access continues to be a major sanitation problem especially on the islands and lake shores of the country. In a survey conducted by the Appropriate technology Centre for water and sanitation [5], it was discovered that the sanitation coverage on the islands of Uganda is 30% and that most of the human waste is discharged in the environment directly. The report further states that there were abandoned urine dry diversion toilets on the island of Koome and failed ventilated improved pit latrines attributed to the geological cultural

beliefs of the people who believed that applying of ash to faecal matter was witchcraft [5]. The islands are characterised by high water tables and collapsing soils which do not facilitate the construction of the pit latrines.

2. Methods and Materials

2.1. Sanitary needs assessment

2.1.1. Gender

This was done using tabulation tables which helped us determine the gender distribution on the island to enhance equity and inclusion in the research.

2.1.2. Understanding sanitation

Community members were requested to state the roles they played in the society which would show their responsibility and understanding of the sanitary issues within the Island which included District authorities in charge of water and sanitation of Mukono district.

There were focus group discussions targeting local leaders to help understand the social mind set of the people as regards to the sanitary technology facilities available. This also formed the basis for the failure of the different interventions based on the technological, social and cultural obligations of the people. It's from these discussions that the appropriate toilet design was derived taking to mind, social implications in terms of operation and maintenance and therefore, the sustainability and scaling up of the technology in areas of the same setting.

2.1. Design and construction of the sanitary facility.

The information collected from the consultations and the focus group discussions was key in coming up with the appropriate design of sanitary facilities for the people on the islands. There was a study of existing literature on the different exiting facilities to understand their suitability and failure thereof to be suitable for use on the islands in light of the cultural and social norms, capital, operation and maintenance costs, and the applicability in the soil conditions on the island.

2.1.1. Cost

This aspect of the score took in consideration the capital and operation and maintenance of the different designs that were selected to be most applicable in the koome Island scenario

2.1.2. Operability

Scoring the operability of a design took into consideration the particular activities that were required of a user to efficiently use the facility and checking if these activities were in line with the traditional norms and culture of the intended users. Basing on a scale of 0 to 10 the different designs were scored. (0 being most activities and 10 least activities involved in maintenance)

2.1.3. Durability

The scoring on durability considered the sustainability of the facility against the physical actors of the poor soil formations and the high water tables. This also considered the availability of materials used for the construction of the toilet

After reconciling the literature with the collected data from the needs assessment, the designing was done. The architectural designs were then produced in AutoCAD basing on the information that was collected and a model thereafter was developed for purposes of demonstration.

The design was a remodel of the existing sanitation facilities or a change in material and operation and maintenance techniques of the existing ones, not to reinvent the wheel and to keep the costs of the toilet facility low and hence aide its replication, the design facilitated the use of locally available materials that can be easily and cheaply afforded by the community on the islands.

3. Monitoring acceptability of the technology

The technologies sustainability was partially measured basing how quickly it's adopted and replicated. The scalability was measured by how many people choose to adopt it in the early periods.

To check this, there were transacts done through the island after six weeks of construction of the demo facilities to observe and identify replication of the demo facility. There were interviews with key individuals like local leaders and technical people like masons to get the attitude of people in response to the new technology.

4. Results and Discussion

4.1. Needs assessment

4.1.1. Gender of the Respondents

Frequency tabulation was used by the researcher to present the gender distribution categories of the respondents. This was included in the research because it helped us to determine the gender distribution within the organization which would show equality and lack of bias in terms of gender for the research.

Table 1: Gender distribution on Koome Island

Sex	Frequency	Percentage	Cumulative Percent
Male	44	74.6	74.6
Female	15	25.4	100
Total	59	100	

4.1.2 Roles played in the Community

The respondents were asked to state their roles in the community and understanding of sanitation and the answers were quantified and grouped as stated in that table below;

Table 2

	Frequency	Percent	Cumulative Percent
Fish sales/ trader	4	11.1	11.1
LC1	1	2.8	13.9
Youth councilor	5	13.9	27.8
Fisherman	4	11.1	38.9
Leader of elders	5	13.9	52.8
Law enforcement	2	5.6	58.4
Health officer	9	25.0	83.4
Teacher	4	11.1	94.4
Police officer	2	5.6	100.0

In the table above, bearing in mind all the other profession and given the limited number of days the student was given to carry out the research, for the few respondents that we managed to come across, it was put to them to state the roles they played in the society which would show their responsibility and understanding of the sanitary issues within the Island and it was seen that majority of the respondents 25% were health officials who were responsible for the sanitation of the area and thus provided useful insight into the matter while they were followed by 13.9% were in the law enforcement and youth councilors who were responsible for the ensuring that the people were safe and the councillors as the advocates of the people while 11.1% said that they were fish sales/ trader, fishermen and teacher and 5.6% were in law enforcement and police officers and 2.8% was the leadership inform of LC1 leader of the area.

This implies that the respondents had a good understanding of the term sanitation given that most of them were in position where they could read and write and had gone to school therefore they understood the concept of sanitation and given the different sanitation training programs that have taught sanitation and thus the clear understanding of the term.

The respondents were asked if they had toilets in their homes and from the answers given, they can be categorized as yes or no and from the findings, the answers are tabulated and the results quantified as in the table below;

Table 3

Response	Frequency	Percentage	Cumulative Percent
No	52	88.1	88.1
Yes	7	11.9	100
Total	59	100	

In the table above, it was given that majority of the respondents 88.1% said that they did not have toilets at their homes while 11.9% said that they had toilets and therefore most members resorted to open defecation as a means of easing themselves and thus poor sanitation which can easily lead to an outbreak of diseases like cholera. The lack of toilets was mainly attributed to the following reasons;

"the soils are very bad and are not suitable to withhold a pit latrine"

"some pit latrines flood with water from underground and there is a lot of flooding from places with anthills "

It is difficult to excavate deep pit latrine because the water table is high"

"the available building material do not match with the available designs for the area and it is very costly to bring in building materials from inland"

.....*KI*

4.2. Design concept development

The design concepts for the facilities we generated from the existing designs of different ecological sanitation options. These were rated in the aspects of cost, (Capital expenses, operation and maintenance expenses.), operability, and durability given the soil formations and ground water conditions of the island. The different designs were scored using a scale of 0 to 10 on the different aspects that they were being checked against. The score formed the basis for which components of the existing designs would be chosen as useful for the design of the new facilities. This would be an amalgam of components from different toilets designs to give the final design that would work in Koome Island. Each aspect of the scoring is as explained below.

4.2.1. The cost

This aspect of the score took in consideration the capital and operation and maintenance of the different designs that were selected to be most applicable in the Koome Island scenario. From the table, the aberloo and the Fossa alterna are indicated to cost the least compared to the rest. Figure 4: Charts showing the average cost of sanitary facilities on Koome Island.

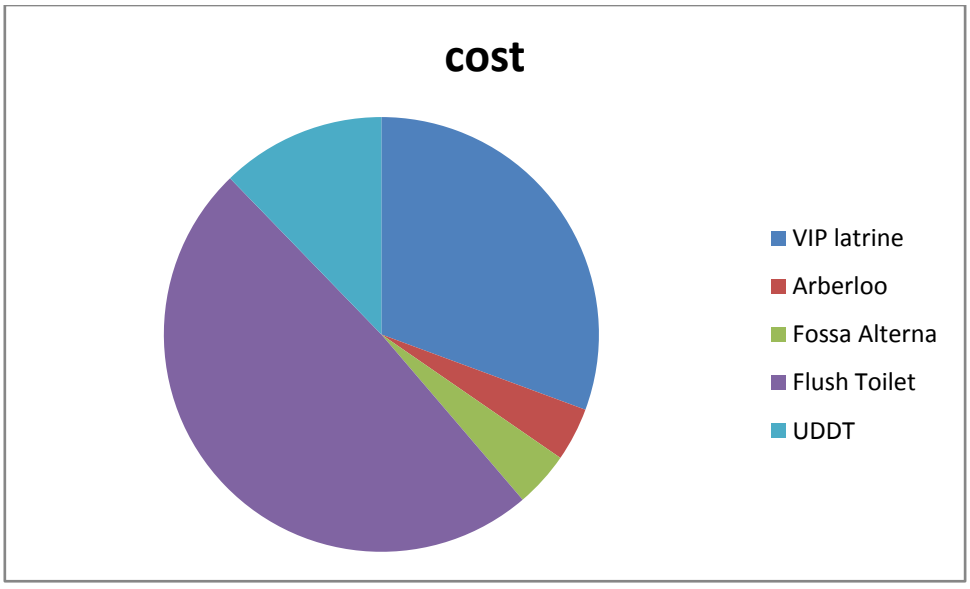

Figure 1

4.2.2. The operability

Scoring the operability of a design took into consideration the particular activities that were required of a user to efficiently use the facility and checking if these activities were in line with the traditional norms and culture of the intended users. It also considered if the intended users of the facility would afford the cost of maintenance and operation of the facility. Basing on a scale of 0 to 10 the different designs were scored.

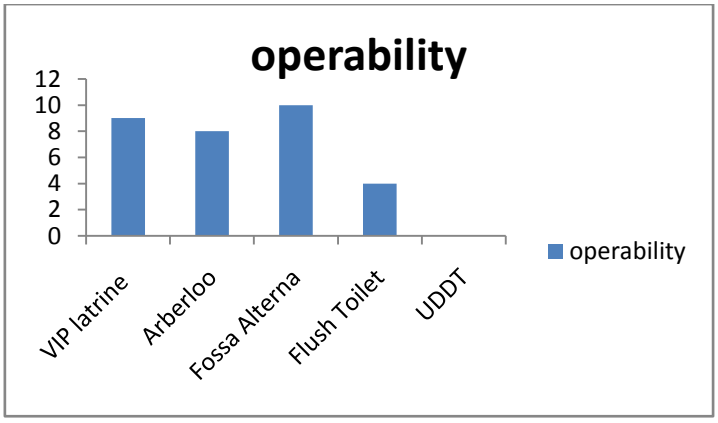

Figure 2: Operability

From the graph, the operability of the UDDT scores lowest because it requires the application of ash after every single use, to kill odour, and aid in the composting of the faecal matter. This goes against the beliefs of the Koome Island community who believe its witchcraft. The facility would straight away be abandoned for fear of being tagged to sorcery.

The fossa alterna on the other hand requires that one applies dry leaves to boost composting and kill the odour at the same time. This makes its use easy and affordable.

The VIP requires frequent cleaning and occasional smoking to kill odour whereas the flush toilet requires the use of water. These activities are not against cultural beliefs of the Koome Island community.

4.2.3. The durability

The scoring on durability considered the sustainability of the facility against the physical actors of the poor soil formations and the high water tables. This also considered the availability of materials used for the construction of the toilet.

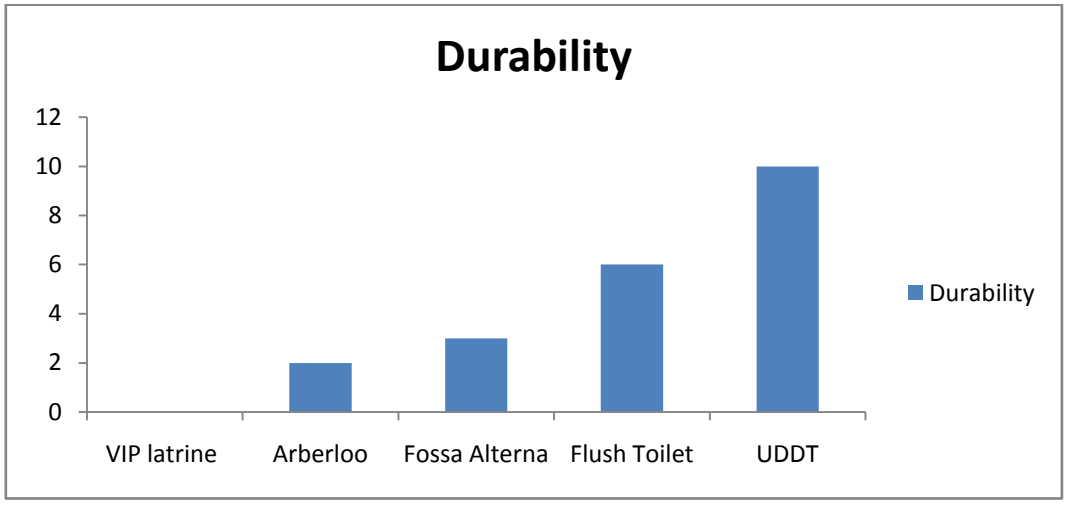

Figure 3: Durability

From the table only the UDDT scored highly on durability due to the complete lining of its pits and the possibility of constructing the pit above the ground. This would be key in a way that there would be seepage of water into or from the pit and there would be no flooding in the pit due to the ground water conditions of Koome Islands.

The VIP latrine requires that the minimum depth excavated for the pit to be 3m and this would be below water level if done in Koome Island. The durability of the fossa alterna also comes to a low score because the pit requires adequate drainage to effectively function. This calls for not lining the bottom of the pit which leaves the pit vulnerable to flooding from ground water seepage into the pit. This applies to the aberloo as well.

Table 4: Sanitary Facility Score Aspects

Estimated capital costs		Operability	Durability	Remarks
Flush Toilet	0	10	0	The cost of setting up the facilities is high but also the continued operation of the facilities requires large amounts of water which also makes the cost of operation and maintenance very high.
Ventilated Improved Pit latrine	2	9	0	The cost of building one is significant and design requires that the pit is at least 3m deep which is impossible given the high water table
Urine Dry Diversion Toilet	4	0	10	The locals had a taste of this facility and they did not agree with the use of ash to expel flies, odour and facilitate composting
Fossa Alterna	10	10	0	The facility requires that the pit is well drained and hence it requires that the bottom of the pit is not lined which makes it susceptible to flooding
Arber Loo	10	10	0	The toilet does not require the lining of the pit and it also requires a lot of space over time

4.3. The design component development

4.3.1. The pit

The pit was designed to allow for construction above the ground, and also prevent seepage of water into the pit or out of the pit and allow for composting hence avoid deliberate liquids like water and urine.

To allow for continuous use of the facility a second pit was constructed next to the first one to allow for compost from the full pit during the course of use of another alternating yearly.

4.3.2. The slab

The slab was designed to be mobile with a drop to have a diversion for urine. This was done in order to keep out urine from the pit that way it would aid in the quick composting of the faecal matter. A second slab was designed to be put on the second pit for safety purposes and to also prevent misuse of the pit. These slabs would be moved interchangeably when one is full to allow for the emptying of the compost and also to allow for the continuous use of the facilities.

4.3.3. The Super structure

The superstructure was designed to be made out of local available materials like Timber, polythene Tumpline and grass thatches.

5. Conclusion

The study presents methods and results from a case study to develop an appropriate sanitary facility to end open defecation of the islands of Uganda. The study was conducted in Koome island in fulfillment of the requirements for the award of a degree of Masters of Science in Water and Sanitation Engineering of Kyambogo University.

The facility was designed based on community consultations and hence modifying the ecosan toilet, fossa alterna andArter Loo technologies. The facility was constructed above the 1m of size 1*1m to accommodate a family of 5 people and dry leaves (use of ash in feacal treatment is not acceptance because of cultural norms) were added to enhance feacal decomposition, each pit is to be used for a year, covered and let to decompose for 10 months before its emptied and can be reused again. The pit were constructed using stone slates, sand, aggregate, poles, cement which are readily available on the island with polythene tumpline, timber, iron sheets for the superstructure. Therefore the facility has catered for the geological conditions, cultural beliefs and norms, economy.

Recommendations

The study was carried out through May to August 2018. To achieve a more reliable estimate of acceptability the facility, more monitoring should be carried out to check for sustainability.

Acknowledgement

The author is gratefulto the co- authors DrKinobe Joel, DrOkhrut Kennan, family and the department of building and civil engineering at Kyambogo University for supporting this research.

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