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ANALYSIS OF THE PIT LATRINE TOILETS SITUATION AND THEIR EFFECTS ON LOW INCOME RESIDENTIAL OF THE HILLSIDE BUILT ENVIRONMENT IN BOTSWANA
- IN THE CASE OF PELENG, LOBATSE -

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***Abstract*— Most of the hillside developments in many countries especially developed countries are owned by high income earners due to the challenges and high expenses incurred during construction. However Peleng neighborhood in Lobatse has a very special and unique situation as the low income earners managed to develop on the hillside regardless of the challenges of infrastructures such as sewer connections by succumbing to the use of pit latrines. The paper then analyzed the use of pit latrines and their effects on the hillside built environment and suggested potential mitigation.**

***Index Terms*—Pit Latrines, Hillside, Regulations, Built Environment, Low income residential**

I. INTRODUCTION

Peleng neighborhood in Lobatse town is situated in the hillside. Although hillsides are commonly occupied by wealthy people, this site is occupied by low income earners. It is evident that the residents are facing problems in responding to the challenges that come with inhabiting the hillside. This is because hill regions are the most difficult, yet the most interesting and challenging terrains, to carry out any developments work as development in hilly region is constrained by difficult terrains, step gradients, complex geological structures, climatic conditions and rich flora (Kumar & Pushplata, 2014).

One of the most pertinent necessity in the neighborhood development perhaps after water system is sewer system. Due to the constraints already mentioned, it is expensive and challenging to connect sewer system on the rocky hillside of Peleng. In any case this did not stop the residents of Peleng to inhabit the Peleng hillside. The residents implemented the use of pit latrines as a solution. Pit latrine is basically a toilet which is detached from the main dwelling unit as an ancillary building. It is cheaper to construct and maintain as compared to the indoor toilet which uses water and advance technology. Although is cheaper to maintain, in Peleng, pit latrines have been associated with effects on the environment leading to unconducive living environment for the residents. The intent of the paper then is to investigate and analyze the effects of pit latrines on the environment per each slope category then seeks mitigation ways.

II. LITERATURE REVIEW

There is no study which specifically addressed pit latrine effects in Peleng, Lobatse. However Jacks et al., (1999) did a study on pit latrines in Mochudi and Ramotswa villages in Botswana. Their study discussed nitrate pollution of groundwater and concluded that it was due to the use of pit latrines but did discuss about other problems identified in this paper. Gwebu (2003) discussed about environmental problems among low income urban residents whilst analyzing old Naledi neighborhood in Gaborone city, Botswana. According to Gwebu, due to overcrowding, the cleaning and maintenance of latrines in the low income areas is so poor that the facilities have become a poor health hazard that which people avoid getting close to, Gwebu (2003). Pit latrines also fill up and due to their inadequate facilities for their regular drainage, they overflow, Gwebu (2003). Gwebu study is relevant to this topic but different because it did not discuss hillside pitlatrines. Nakagiri et al., (2016), discussed the performance of pit latrines in Sub-Saharan Africa by reviewing usage, filling, insects and odour nuisances. The article concluded that enforcement of minimum pit latrine design standards are important while the importance of hygienic latrines should also be emphasized.

Only Seno, Lyamuya and Ogura 2018 discussed that hillside pit latrines in Pelng. The paper focused on Effects of Unplanned Multifamily Dwellings on the Hillside Built Environment of Botswana focusing on sanitary problems.

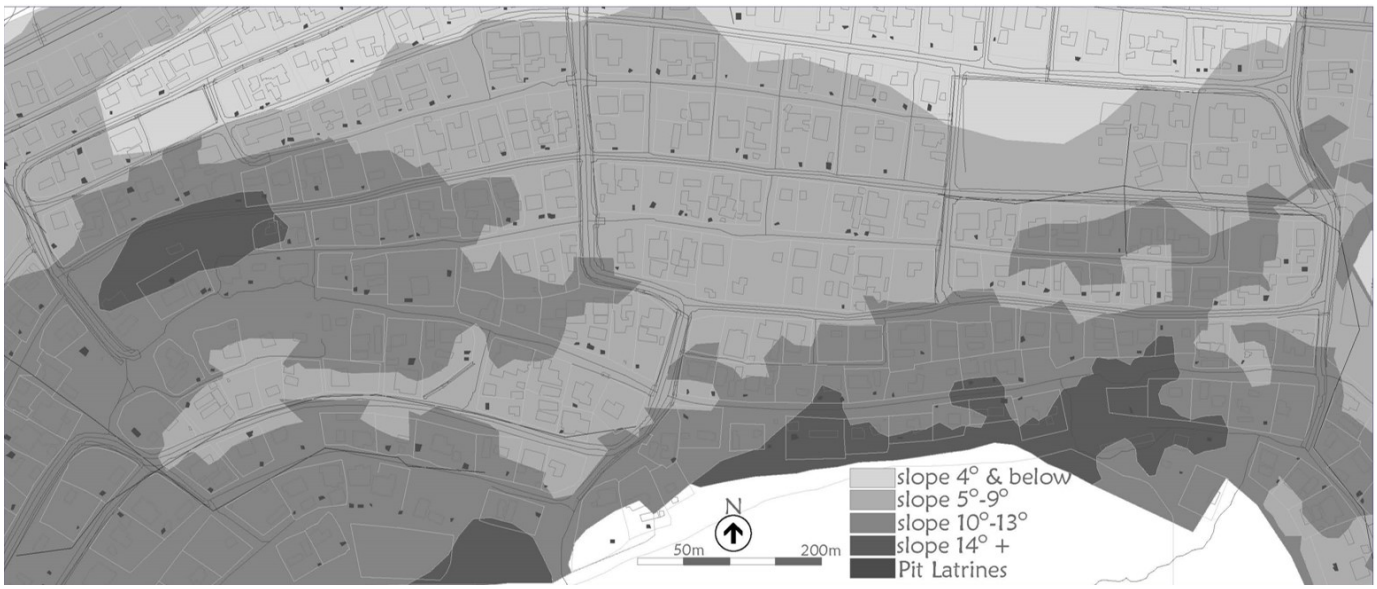

Fig.1. Part of area surveyed showing Pit Latrine Toilets footprints

The study of the paper demonstrated the need to investigate more problems associated with pit latrines other that multifamily dwellings.

I. BACKGROUND/HISTORY

Before the use of Pit latrines, residents of Peleng used to climb up the hill and just hide in the bush or behind rocks to relief themselves as per some of Peleng old residents explained. When Lobatse got urbanized, the edge to develop the living environment aroused. That is when the use of pit latrines became common but even up to this date some plots do not have toilets. This is because they never had them and some because the ones they had collapsed. It is a historical trend in Botswana that the pit latrine toilet was positioned at the back of the yard, either on the left or on the right depending on circumstances or choice. The same trend is visible in Peleng hillside developments, hence the setup has been reported to be inconvenient when it is time for the sewer trucks to empty the pit latrine toilets.

II. METHODOLOGY AND AIM

The research method used to investigate these problems was through 160 house to house site inspection and inquiry from residents with open and close ended questionnaires. For the accuracy of these analyses out of the 160 questionnaires, equal number of answered questionnaires per each slope category for pit latrines usage and effects were recorded in graphs and the results were tabulated. The investigation findings were categorized as per the 3 slopes categories which were slope 4º & below, slope 5º-9º and slope 10º-13º. Slope 14º & above was not developed hence it is not included. To determine these slopes site coordinates obtained from Botswana department of surveys and mapping were plotted on Revit software to create a model of the hillside.

Then Dynamo Visual Programming was used to determine different slope categories. Map with plots and footprints of houses was then superimposed on top of the slope map to identify plots per each slope category and presented as in Fig.1 below Seno and Ogura (2018). Map of Peleng was also analyzed and plot with pit latrines were identified as in fig.1.

The intent of the paper then is to analyze the pit latrine toilets conditions in Peleng in order to identify the effects they have on the environment that compromise conducive living for residents. This will be achieved by relating the pit latrines toilets conditions with environmental pollution such as air pollution. Unpleasant pit latrine conditions identified include leakage, not deep enough and being full.

The study will then seek and propose mitigation through suggesting standards to add to Botswana Development Control Code which is currently lacking development guidelines for hillside developments. The guidelines shall be implemented to improve future hillside developments in Botswana.

III. BASIC CONSTRUCTION OF PIT LATRINES

Pit latrine toilets are relatively small but a little bigger than the indoor toilet because they are independent buildings. They are constructed by digging a hole as deep as 2-4 meter depending on the soil condition and the desired depth by the owner. Residents of Peleng reported that their toilets were not that deep due to rocky land making it difficult to dig deep. They also reported that it is the reason they get full easily. The toilet walls are made of bricks, and a brick size hole on the sides above 2m from floor level is created for cross ventilation. The toilets are roofed with corrugated iron roofs.

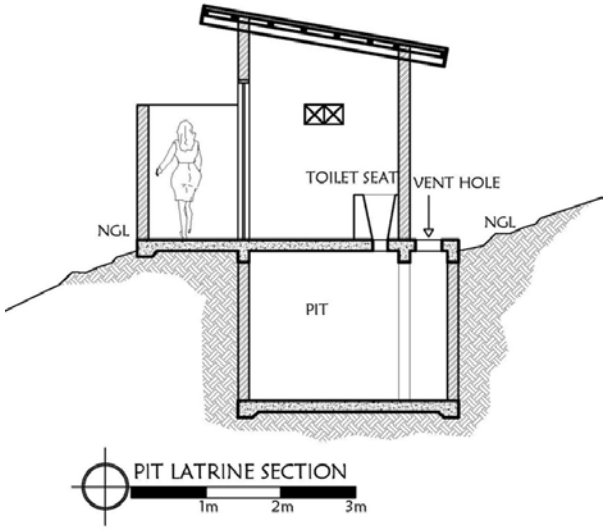

Fig.2. Image of a typical pit latrine in Peleng hillside

IV. PIT LATRINE TOILETS SITUATION IN PELENG

The survey conducted in Peleng indicated that the usage of pit latrine toilets is very high as compared to the usage of other types of toilets. From 160 house to house interviews conducted, 126 residents reported that they use pit latrine toilets. It was also observed that majority of houses that were not surveyed also had pit latrine toilets. Table.1 below indicate the number and percentage of pit latrines toilets as compared to other types of toilet users. Other residents used both inside and outside toilets explaining that when there is water cut the indoor toilet cannot be used hence pit latrines becomes handy that time, Seno, Lyamuya and Ogura (2018).

Table 1. Number and percentage of people that use different kinds of toilets

Types of Toilets used	No. of People	Percentage
Pit latrines	126	79%
Indoor toilet	11	7%
Both (sewer system & Pit latrines)	8	5%
Without toilet	15	9%

Table.2 indicates that all the pit latrine problems reported by the residents. Some problems are related to each other, for example full pit latrines and air pollution, hence other problems are independent. The paper will later analyze this relation.

Table 2. Number of people that reported the mentioned problems

Problems of Pit latrines	No. of People	Percentage
Air pollution	64	40%
Land Pollution	4	2.5%
Full Pit latrines	32	20%
Leaking Pit latrines	6	3.75%
Becomes full easily	34	21.25%
No access for trucks to empty the Pit latrine	9	5.6%
No Problem	19	11.9%

Fig.4 indicates that the percentage number of people using pit latrines is low on the lower slope and increase gradually with the higher slope. It is linked to the fact that it is easy for residents on the lower slope to connect to sewer lines hence difficult for residents on the upper slope.

Fig.3. Typical images of pit latrine condition in Peleng

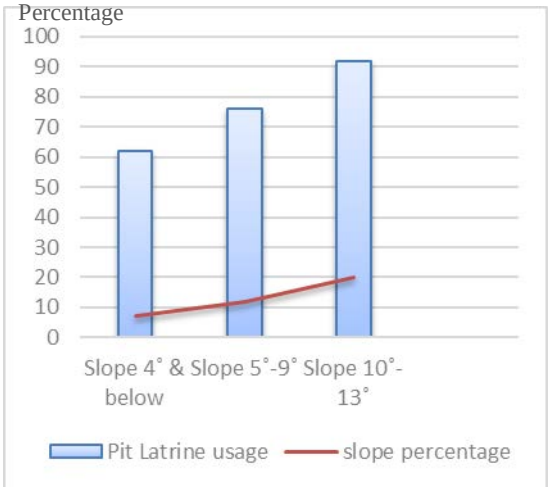

Fig.4. Percentage of Pit Latrines used per each slope category

A. Full Pit Latrine Toilets

Many residents reported that their pit latrines are full which resulted in some of them not being able to use them. Majority of them said the reason is that it is very expensive

to pay for the sewer truck to come and empty the pit latrines. Others linked the problem to the fact that sewer trucks cannot access their plots to empty their pit latrine toilets (Seno, Lyamuya and Ogura). Fig.4 shows the percentage of residents that reported full pit latrine toilets.

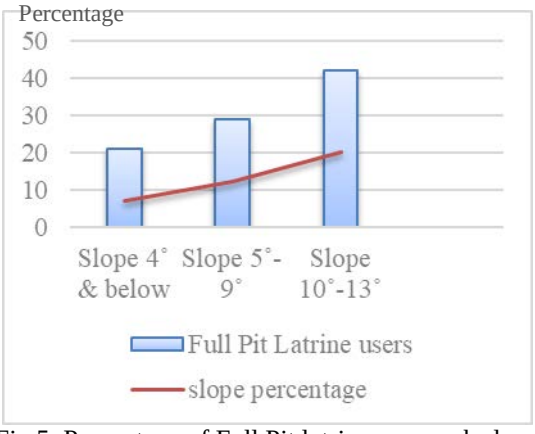

Fig.5. Percentage of Full Pit latrines per each slope category

B. Pit Latrines that get full easily

Due to rocky conditions of the hillside especially the upper part, it is difficult if not impossible to dig a deep hole for pit latrines toilets as per the report by residents. This contribute to pit latrines getting full easily. Another reason reported by residents causing pit latrines to get full easily is that there are many people residing in one plot, hence each plot only has one pit latrine toilet. Fig.6 indicates that pit latrines get full easily on the upper part of the hill which is related to the difficulty in digging deep for pit latrines pit.

Fig.6. Percentage of litter not regularly collected per each slope category

C. Leaking pit latrines

About 4% of residents reported that their pit latrines are leaking. They explained that when it is raining flowing storm water is collected by the pit latrines due to leakage and when the pit latrines gets full, the water is spilled out of the toilet into the living environment. This has resulted into air pollution and land pollution.

D. Air pollution

Residents reported that their toilets were causing bad odors on the living environment because they were either full or they got full easily. Fig.7 indicates 40% reports of air pollution distributed per each slope category.

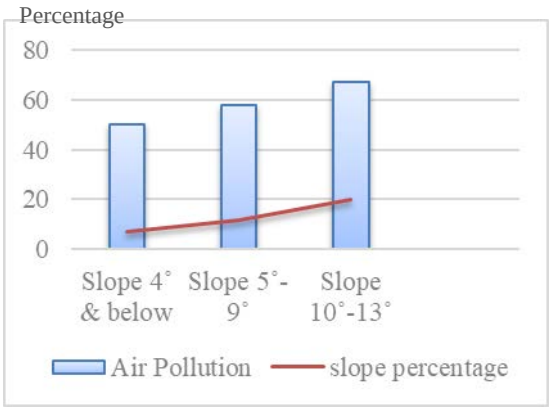

Fig.6. Percentage of litter not regularly collected

V. ANALYSIS OF PIT LATRINE SITUATION AND HILLSIDE PROBLEMS

A. Poor access

Residents reported that poor access had an impact in pit latrines getting full easily because the sewer trucks emptying the pit latrines could not access their plots.

Fig.8. Pit latrine problems against air pollution

B. Expensive to drain

Besides poor access, the other reason for the pit latrines being full and not being drained was because it is expensive for the residents to pay for the sewer trucks to come and empty their pit latrine. 22 residents out of 126 who used pit latrines reported that it is expensive to drain the pit latrines

TABLE.3. Indicate the effects of Hillside problems on Pit latrine situations

	Pit Latrine Situation			
Hillside Problems	Full Pit latrines	Easily becomes full	Leaking Pit Latrines	Air Pollution
Poor Access	o	o	x	o
Expensive to drain	o	o	x	o
Many Users	o	o	o	o
Non-durable Pit latrine Structures	x	x	o	o

Key:
Affected by hillside problems = o
Not affected by hillside problems = x

because the price to drain dramatically increased from $2 to $60 in a short period of time. One of the residents explained that the amount is more than her monthly salary.

C. Many Users

Peleng is a high density area and average no. of people recorded were 7.9 per plot with the maximum number of people being 25 residents per plot, Seno, Lyamuya and Ogura (2018). That being the case in plots where there is only one pit latrine toilet per plot, it becomes a challenge for the pit latrines to handle the waste of many users for a long time.

D. Non-durable Pit latrines structures

Some of the Pit latrines structures were reported to have collapse before with reports coming from those who did not have toilets. Others reported that their pit latrines were leaking. This situations can be linked to the poor durability of the pit latrines. Ventilation of the structures was also poor as most of the toilets did not have doors and most of the toilets sits did not have lids.

VI. PROPOSAL TO MITIGATE PITLATRINES PROBLEMS

Botswana Building regulations do not have standards for building pit latrines especially on the hillside. The mitigation proposal is to suggest standards related to the use of pit latrine problems for the government to adopt and enforce.

A. Poor Access

In future construction of pit latrines toilets on the hillside, within a plot, pit latrines shall be positioned in near or convenient to the access road. In situation where plots are back to back it will be recommendable to place pit latrines in the front. If the plots are not back to back, and there is access road from the back of the plot, then the pit latrine can be situated at the back of the plot.

B. Expensive to drain

Residents who cannot afford to pay for the sewer trucks to empty the pit latrines can exercise cheaper methods like the use of chemicals to drain or burn waste in the pit latrine toilets.

C. Many Users

According to Botswana Building Control Code, (2013) each unit in a plot shall include a toilet, a sink and a bath tab. In the case of Peleng hillside, 1 pit latrine shall be allocated to minimum of 2 units. This is because Peleng is a low income area and most of the residents find it difficult to maintain the pit latrine toilet, for example; paying for it to be emptied.

D. Non-Durable Pit latrine Structures

Pit latrine toilets structures in Peleng are very old hence they are susceptible to leakages. In terms of construction pit latrine toilets shall have a minimum of 2m deep hole and a minimum of 1.5m wide in all sides. The pit edges shall be enveloped with concrete all around to prevent leakages and shall have a vent at the back for ventilation. The walls of pit latrines shall be made of bricks and well plastered and painted. It shall be well roofed with proper lockable door and air hole on two sides or on all 3 sides for ventilation.

VII. CONCLUSION

The main intent of the study was to discuss the situation of pit latrine toilets in Peleng and analyze their relation to hillside problems then propose relevant mitigation. Prevailing pit latrines situations encountered were that of full pit latrines, pit latrines that becomes full easily, leaking pit latrines and pit latrines causing air pollution. Problems linked to this pit latrine situations were poor access, expensive to drain, many users and non-durable structures. The analyses indicated that hillside problems had an impact on the pit latrine situation especially air pollution. The mitigation proposal was through suggesting improvements for the current building regulations which does not provide any standards for building pit latrines. Hillside pit latrine regulations were suggested as a form of mitigation.

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