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Contribution to Improving the Management of Sewage Sludge in the Western Region: Case of Bafoussam 1st

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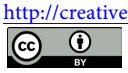

Abstract

Sanitation is a particularly sensitive issue in the world, especially in Africa where local communities are plagued by the problem of managing sludge which is causing a lot of damage in Africa and mainly in Cameroon. This study aims to contribute to improving the management of sewage sludge in the municipality of Bafoussam 1st. For this study, the methodology used is field survey. The questionnaire was submitted to 120 households in the commune of Bafoussam 1st, in particular, we take into account knowledge of the health and environmental risks that can result from improper handling of sludge and its treatment. The results show that the most widespread sanitation system is traditional latrines. Similarly, 79.19% of those surveyed dump, the sludge collected at the landfill against only 14.28% who dump it in fields and 6.53% have no idea about the fate of the sludge from their sanitary facilities. It should also be noted that 55.83% of the people surveyed are not aware of the health and environmental risks of untreated sewage sludge and therefore do not take the precautions to avoid it. Subsequently, 93.75% of respondents say that the current landfill would be a nuisance and the main nuisances identified are water pollution and subsequent fish poisoning. Physico-chemical analyzes of the sludge revealed values much higher than the values provided for by the WHO standards. Thus, total nitrogen and phosphate ions represented respectively 97 mg/L and 47 mg/L against 35 and 30.4 mg/L for the standard; COD and BOD_5 represented respectively 3250 mg/L and 1100 mg/L against 150 and 40 mg/L provided by the WHO standards. It follows the temperature and the MES which gave values of 32.7˚C and 1750 mg/L, values much higher than the standard (30˚C and 50 mg/L).

Keywords

Sewage Sludge, Management, Treatment, Sanitation, Bafoussam 1st

1. Introduction

In the cities of Sub-Saharan African countries, particularly in central Africa, hygiene and sanitation issues face many difficulties mainly due to the lack of adequate health infrastructure (Fall et al., 2017). According to WHO (2018), each year, more than 842,000 people in low- and middle-income countries die from lack of water, sanitation and hygiene. Health practices remain subject to constraints relating to the management of excreta, the lack of equipment, the proliferation of public health diseases, food management and the precariousness of the living environment (Fall et al., 2017).

In Cameroon, more precisely in Bafoussam's first council, autonomous sanitation systems predominate and are mainly latrines. These structures, whether in households or public kiosks, generated sludge which is important to dispose of regularly because they can generate nuisances in the surrounding environment and harm public health (Klingel et al., 2002). However, these problems could be avoided to an adequate management system that takes into account the sources of production, the methods of emptying, transport and the safe disposal or reuse of this sludge (Klingel et al., 2002). Thus, this study aims to propose an approach to sustainable management and recovery of sludge in the municipality of Bafoussam first. More specifically, this involves taking stock of the current management of sewage sludge, identifying the health and environmental risks of poor sludge management, and proposing a sustainable management and recovery strategy for this sludge.

2. Material and Methods

For this study, like equipment, drainage sludge was required (see **Figure 1(a)** A below); a survey sheet, plastic bottles for collecting sludge samples and laboratory equipment (see **Figure 1(b)** below).

A survey was carried out using a questionnaire among 120 households (18 households in the Sacta district, 32 households in the Bamendzi district, 16 households in Banengo, 22 households in Ndiangdam and 32 households in Njingah) chosen for the high concentration of population, proximity to landfills and urbanization. The information collected related to the excreta disposal system

Figure 1. Collection of sludge on the landfill site and presentation of the 3 samples in the laboratory.

within households, knowledge of the environmental and health risks linked to poor sludge management, knowledge of the nuisances caused by the landfill site (odor nuisance, mosquitoes, etc.), the prevalence of waterborne diseases in the household.

Physico-chemical analyzes (Total phosphate, Total nitrogen, Hydrogen potential (pH) and temperature, dry matter (MS), suspended matter (MES), biochemical oxygen demand (BOD) and chemical demand oxygen (COD) a few samples of sludge collected from the emptying truck (on site) were carried out. According to Niwagaba et al. (2014), knowing how and where to take the sample depends on what you are looking for. Several samples will be taken as the truck deposits its sludge and will constitute a composite sample. In order to offer an adequate solution to the treatment of sludge collected by our company, a quantitative study of the sludge collected by the company was carried out. To do this, the Kaonda drained sludge method (2006) was used. For the latter, estimates can be made from the number of empties carried out, the volume of sludge collected per emptying.

3. Results and Discussion

The results presenting the general characterization of the surveyed population are as follows: the female sex is dominant (33.33% of women against 66.66% of men). The most common level of education is that of secondary school (39.16%) and the majority of respondents are in the 31 to 40 age group. This municipality is home for the most part to a population sometimes made up of large families (6 to 10 people), living in houses that belong to them and whose main activity is agriculture (34%).

➢ **Excréta disposal system within households**

The diagram illustrated in **Figure 2** shows the distribution of the excreta disposal system within households.

Here it is clear that the most widespread sanitation system is that of traditional latrines. This result goes in the same direction as that of Tadjouwa (2016), who showed that traditional latrines are the most widespread technology in sub-Saharan Africa. This is further confirmed by the study conducted by Kajyibwami (2018) in Burkina Faso. This excreta disposal method is classified

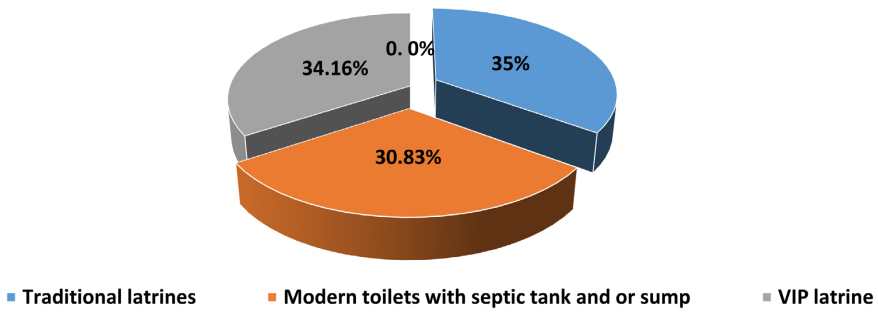

Figure 2. Distribution of respondents according to the type of latrine present in the household.

among a type of sanitation known as non-collective sanitation (ANC) which is the most widespread in central and west Africa according to Fall et al. (2017).

➢ **Distribution of the emptying methods used the population surveyed**

The results obtained with regard to the sludge disposal method within households (**Figure 3(a)**), the type of emptying carried out (**Figure 3(b)**) is illustrated by the diagrams below.

From these results, it emerges that 17.5% have already had to empty their excreta compared to 82.5% who have not yet done (see **Figure 3(a)**). With regard to the proportion of those who have already had to drain, 9 people or a proportion of 42.85% had to resort to manual draining against 12 (57.14%) who did by a specialized truck (see **Figure 3(b)**). Manual emptying is very little recommended because it is a source of nuisance for both emptiers and owners of the pit or the neighborhood (Collignon, 2002).

➢ **Knowledge and advice on the place of dumping of collected sludge**

The diagram illustrated in **Figure 4** shows the places of discharge of the collected sludge (a) and the advice on the landfill (b).

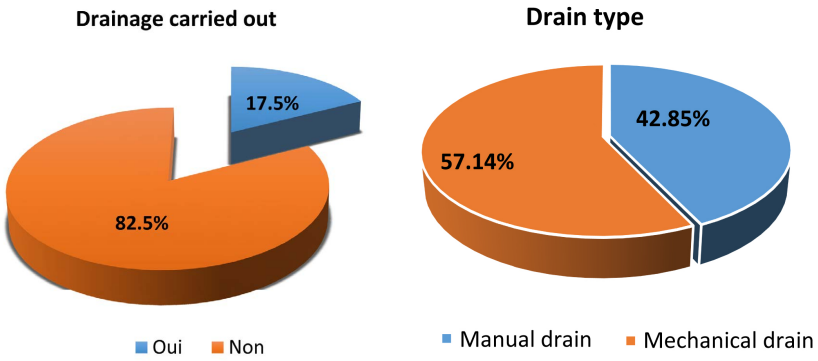

Figure 3. (a): Distribution of respondents according to those who have already had to perform an emptying or not; (b): Distribution of respondents according to the emptying method they use.

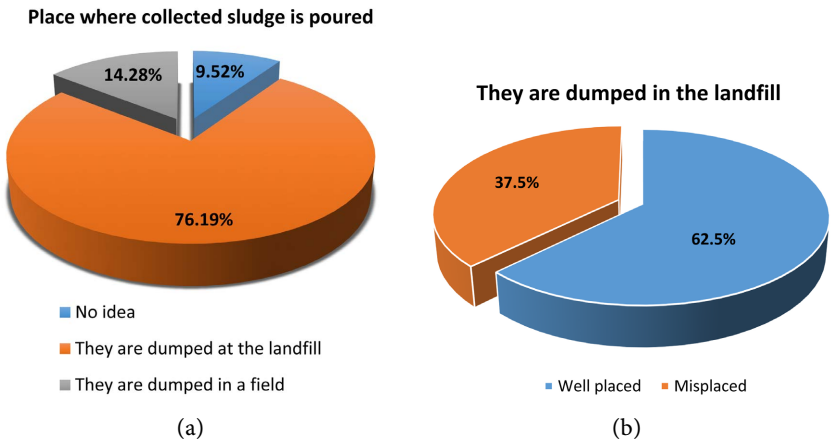

Figure 4. Presentation of the collection sites for the sludge (a) discharge notice, (b) Household.

The results show that 76.19% of those surveyed claim to send the sludge to the landfill, 14.28% discharge into a field and 9.52% have no idea. For those who send their sludge to the landfill, we asked them for their opinions on the location of the latter. 62.5% find this location acceptable and 37.5% find it unsuitable.

These results go in the same direction as those of Kafando (2004) who mentions that the parasites observed in excreta waste cause the spread of diarrheal diseases such as ascariasis, shigelosis, amebiasis, cholera, etc. Therefore, it is wise to proceed with the development of this landfill as a treatment station before discharge.

➢ **Opinion of the population investigated on the state of the landfill**

Figure 5(a) below presents the opinions of respondents on the sources of nuisance represented by the landfill and the one on the right (Figure 5(b)) shows the nuisances noted.

According to the responses recorded, 6.25% of respondents say that the landfill is harmless and therefore not a source of pollution, compared to 93.75% who attest that this landfill is a source of pollution. Since some have declared that this site emits nuisances, the surveys have revealed what type of pollution is involved. So, for 13.33% it is about air pollution and 86.66% mention poisoning of fish (see Figure 5(b)). Studies by Blunier et al. (2004), as well as Niwagaba et al. (2014), have shown that untreated sewage sludge has a high oxygen demand, due to easily degradable organic matter which consumes significant amounts of organic matter; discharged into the environment, this sludge can deplete oxygen from surface waters and destroy all kinds of aquatic life.

According to the survey, of 120 people questioned, only 67 people know the risks linked to poor management of sewage sludge; However, 53 people don't know the risk of poor management, which could accentuate the impacts of sewage sludge on the health and the environment of the area, because they would not already know that they are harmful, therefore, these people do not know the necessary measures to take to limit the risks. For those who have an idea of the

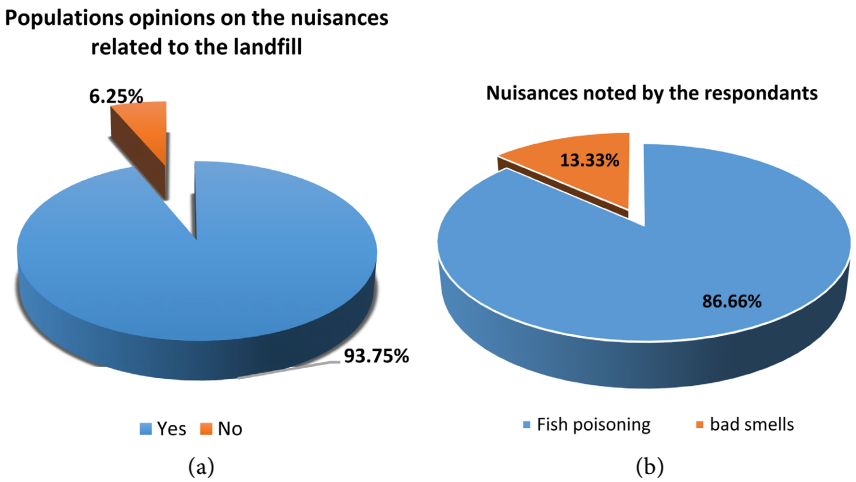

Figure 5. (a) Notice on the nuisance of the dumping site; (b) Presentation of the observed nuisances.

risks that the sludge can present, some respondents mentioned known diseases namely such as cholera, typhoid, dysentery, poliomyelitis. These listed diseases fall within the same framework of results of a study conducted by Tadjouwa (2016) and Montangero et al. (2002), who have shown that untreated sewage sludge contains bacteria, viruses and parasites which can be the cause of diseases such as amebiasis, intestinal infections, cholera, fever typhoid, dysenteric..

Knowledge of people surveyed on the environmental risks associated with sewage sludge

From these results, it emerges from the surveyed population, 35 people, or a proportion of 48.61% have already had to suffer from water-borne diseases. These diseases include typhoid fever (31.42%), intestinal worms (25.71%), dysentery (22.85%) and polio (20%). These results go in the same direction as those of Mpakam et al. (2008) who reveal that the city of Bafoussam is plagued by an increased sanitation problem which is causing the proliferation of diseases such as those mentioned above.

Quantification of the sludge collected by the company

The emptied sludge method (the number of emptying laps according to the capacity of the truck) was used to quantify the sludge. A drainage tower corresponding to 10 m^3 of sludge discharged. To obtain the total volume for the year, we multiplied the number of laps by the capacity of the truck as follows: let n be the number of laps, c the capacity of the truck, V the volume collected per year. The formula $V = c \times n$ was used to calculate. It appears that in 2016 the volume collected was 620 m^3, in 2017 of 730 m^3 and for the year 2018 of 850 m^3. According to these data, the average quantity of sewage sludge collected per year would be estimated at 733 m^3.

Physico-chemical characteristics of sludge

The results obtained after physicochemical analyzes of a sample of sludge emanating from a septic tank are presented in the following Table 1.

Table 1. Presentation of the physicochemical characteristics of the sampled faecal sludge.

Parameters	Résult (this study)	Discharge standards OMS
Temperature	32.7˚C	30˚C
pH	7.40	between 5.5 and 9.5
DCO	3250 mg/L	150 mg/L
MES	1750 mg/L	50 mg/L
DBO	1100 mg/L	40 mg/L
PO_4^{3-}	47 mg/L	30.4 mg/L
MS	30%	/
N_T	97 mg/L	35 mg/L

These results show the strong dominance of the physico-chemical parameters values measured on the sludge sample over those of the discharge standards provided by the WHO. Nutrients such as total nitrogen and phosphate ions have respective values of 97 mg/L and 47 mg/L, but the standard provides for releases of 35 and 30.4 mg/L respectively (WHO, 2006). It turns out that these high nutrient levels are undesirable and harmful because they can pollute the receiving environment and lead to eutrophication as noted by authors such as Nyenje et al. (2010) and Tapsoba et al. (2016). Regarding carbon pollution, the Chemical Oxygen Demand (COD) and the Biochemical Oxygen Demand (BOD) had respective values of 3250 and 1100 mg/L, much higher than the standards which impose respectively 150 and 40 mg/L for these parameters (WHO, 2006). The same is true for the pH, MES and temperature parameters. This fact reinforces the need to treat this sludge adequately, in order to reduce health and environmental risks (Koné & Strauss, 2004). **Table 2** below presents the results of the analysis of the sludge not only from this study but also according to the literature.

Table 2 shows that the pH values are between 7 and 8, thus reflecting the weakly basic character of the sludge collected. Our COD and BOD values appear to be significantly lower than those of Koottatep et al. As for Dème et al.; however, our values are found to be higher than that of Koné et al. The same is true for the MES and PO_4 values, which are very different according to the studies. This can be explained by the influence of certain factors as revealed by the studies of Koné and Strauss (2004), such as the duration of storage, the type of installation and the composition of the sludge (the presence or absence of grease, food waste, non-biodegradable solids, detergents, etc.). They go on to say that the variability of the physico-chemical characteristics of sewage sludge depends on the level of development of the cities.

Proposal for the sludge treatment system

Table 2. Comparison of parameters found with those of other studies.

Paramètres	BAFOUSSAM	Koné et al. (2016) Ouagadougou	Koottatep et al. (2005) Bankok	Cofe & Koné (2009) Dakar
Temperature (˚C)	32.7	31.82	29	
pH	7.40	7.58	/	7.3
DCO	3250	1950	15,700	3853
DBO_5	1100	785	2300	/
N_T	97	/	/	/
MS	30%	/	/	/
MES	1750	/	12,900	2130
PO_4^{3-}	47 mg/L	39.5	/	/

The establishment of a treatment system for sewage sludge in the municipality of Bafoussam 1st would allow: the treatment of sewage sludge itself, the reduction of diseases linked to fecal peril, obtaining quality amendments for farmers, the creation of jobs on the station and the increase of the notoriety of the company in terms of emptying, because the interviewees affirmed that their choice would lean towards a structure which collects and treats their sludge. The proposed technique is very inexpensive and makes it possible to obtain the objectives set: these are non-planted drying beds. It is the most appropriate treatment for producing an amendment frequently and quickly.

4. Conclusion

This study was based on the contribution to improving the management of sewage sludge in the municipality of Bafoussam 1st. As a result, the commune of Bafoussam 1st is home for the most part to a population sometimes made up of large families, living in houses that belong to them and whose main activity is agriculture. The dominant sanitation system is autonomous sanitation and the most widespread excreta disposal system is the traditional latrines, which are found in 35% of the population surveyed. The results show that the majority of households (53.33%) ignore the sanitation laws as well as the health and environmental risks that can result from the uncontrolled management of their household sludge. The sludge produced is collected and directly discharged into fields (by 14.28% of the population surveyed) or sent to the landfill (79.19% of respondents) without treatment before discharge. This practice has harmful consequences both on the health of populations and on the environment.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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