

## Poor Sanitation in the Sagnarigu Municipality of Northern Region of Ghana

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Citation: Issahaku A (2019) Poor Sanitation in the Sagnarigu Municipality of Northern Region of Ghana. J Environ Pollut Control 2(1): 104

Received Date: May 28, 2019 Accepted Date: December 18, 2019 Published Date: December 20, 2019

### Abstract

Poor sanitation in Sagnarigu Municipality of Northern Region was conducted from January to October 2018. Three communities (Fuo, Kpalsi and Sogonayili) in the municipality were studied and compared with the engineered land field site at Gbalahi in the municipality as the control site. The sampling techniques used were cluster and purposive. The USEPA approved method for wastewater analysis [1] was used to analyse physicochemical and bacterial load of leachate from unapproved dumpsites. While Gbalahi had  $5.2 \times 10^4$  coliform units, Fuo, Kpalsi and Sogonayili respectively had  $6.8 \times 10^4$ ,  $8.0 \times 10^4$  and  $7.6 \times 10^4$  coliform units and showed that unapproved dump sites had more excreta content than engineered landfill sites. However, Cu (18 mg/l) and Zn (8 mg/l) at Gbalahi were more than those at the study sites and so electrical conductivity at Gbalahi (3589.00  $\mu\text{S}/\text{cm}$ ) was more than the average 1597 EC ( $\mu\text{S}/\text{cm}$ ) electrical conductivity of the study sites. The study concludes that, lack of public toilets and the absence of household latrines were the factors responsible for open defecation in Sagnarigu. The challenges in using public toilets were; smell poor hygienic condition of the toilets, distance and cost of using them. Household waste at unapproved dump sites contains metals in minute quantities but large quantities of faecal matter.

**Keywords:** Physicochemical; Bacterial; Leachate; Dump sites; Sagnarigu

### Introduction

Poor sanitation has led to diarrheal diseases which is the second leading cause of death among children under five globally. As at 2015, diarrheal disease kills 531000 children globally per annum [2]. The cost of poor sanitation globally cost about 260 billion dollars per annum [3]. This unfortunate development has led World leaders to make commitment to ensure access to adequate and equitable sanitation and hygiene for all and end open defecation by 2030 (Sustainable Development Goal (SDG 6)). According to the World Health Organization/UNICEF Joint Monitoring Team (JMT) a facility that is shared by two or more households is not basic and is referred to as shared [4]. Even when households are not able to achieve basic sanitation, ending open defecation or improving on sanitation can impact on health and wellbeing of the people [5].

There is low sanitation and water coverage in Sub Saharan Africa. However, coverage is not the same as accessibility and therefore sanitation and water access in Sub Saharan Africa is poor even though it is essential to wellbeing [6,7]. The United Nations (2015) has observed that, of the 663 million people living with an improved water supply about 50% people in Sub Saharan Africa and about 30% still use unimproved water and sanitation facilities [8]. Poor sanitation has led to fecal borne diseases and the situation can be averted through community cleaning, cleaning of water storage facilities, proper waste storage and disposal methods and treatment [9,10]. It has been observed that, communities that enjoy good water and sanitation facilities are located in urban communities [11] but this assertion largely remain contestable since this does not apply to all urban communities.

The municipal ordinance of 1943 was established as public health boards in Cape Coast, Accra and Kumasi with the mandate to ensure hygienic living conditions within settlements. This board operated with inspections of premises and sanctions those who flouted the law. Later, extensions of the boards were made to other towns and cities with the establishment of the Environmental Health and Sanitation Units under the Metropolitan, Municipal and District Assemblies (MMDAs) to ensure environmental health and safety in all communities.

The major challenge of the environmental health workers in Ghana had been sanitation. The World Health Organization (WHO) defines sanitation as the maintenance of hygienic conditions by creating physically closer facilities offering less waiting time and safer disposal of human excreta. Poor sanitation has resulted to open defecation in which people go out in fields, bushes, forests, open bodies of water or other open spaces rather than using the toilet to defecate. The practice has also led to indiscriminate dumping of waste. Unsafe disposal of waste and excreta can cause diseases such as Giardiasis, Endemic Cholera, Trachoma, Intestinal helminthes, schistosomiasis and other communicable and infectious diseases [12]. Vulnerable groups such as the poor,

children, women and disabled as well as the aged mostly suffer from poor sanitation. Diarrhea diseases are the leading cause of deaths among children under 5 years in Ghana and account to about 19% of deaths in children who are less than 5.

Poor sanitation in Ghanaian cities and towns has not been accompanied by requisite public and private sector engagement in the collection and subsequent disposal [13]. Increase waste generation due to population growth, changing lifestyles of people, development and consumption of products with materials that are less biodegradable have led to the diverse challenges in various cities [14].

Both the Millennium Development Goals (MDGs) and the Sustainable Development Goals (SDGs) of the United Nations captures sanitation as one of the goals desired to be achieved. The SDGs goal six captures a clean water and sanitation. Under goal six, the first three key targets include water supply, sanitation and open defecation.

The sanitation sub sector in Ghana is comprised of Water, Sanitation and Hygiene (WASH). This is based on the fact that these three are inter-connected in relation to the health of the people. To achieve SDG6, local governments assumed the responsibility of dealing with urban waste while the Ghana Water Company Limited is in charge of urban water supply. Waste services are provided either directly by governments or by private scavenging companies [15]. Due to the increasing comprehensiveness in waste management and planning, coupled with the need for the application of Environmental Impact Assessment, waste management became a significant planning issue. Planners have played an increasingly important role, cooperating with engineers, in dealing with waste-related projects such as treatment facility siting, public participation, education, and program evaluation [16].

Integrated Waste Management (IWM) allows managers to systematically manage waste. In practice, it has been recommended as an effective approach for both developed and developing countries [17]. The concept of IWM has also evolved over time and expanded beyond the mere combination of treatment methods.

In Ghana, an estimated five million people representing 19% of the total population practice open defecation daily translating into one out of every five people. It is estimated that Ghana as a developing country is losing \$79 million dollars a year as a result of open defecation. It is quite common to see heaps of waste dotted in most parts of the Sagnarigu Municipality. Ineffective waste management can cause contamination of surface water, groundwater, soil and air which brings more problems to humans, other species and the ecosystem. Additionally, there is attraction of insects and rodents which provides haven for yellow fever, gastrointestinal parasites, worms and various adverse human conditions. Several diseases as well as cancers are caused by exposing humans to certain municipal waste.

Community-led Total Sanitation was introduced in the Sagnarigu Municipality of the Northern Region in 2015. Irrespective of several interventions by Government, Civil Society and Non-Governmental organizations, little has been achieved in improving sanitation in Sagnarigu Municipality. The Sagnarigu Municipal Assembly under which this study is focused scored zero in the 2015 open defecation free rankings league table in the Northern Region and shows the magnitude of filth in the Municipality [4]. At the illegal dumping sites, plastic bags containing excreta are found a situation that suggests that, households do not have household latrines. As a result, the Sagnarigu Municipality continue to be at the bottom among the 28 municipal and district assemblies' open defecation free league tables that was instituted in 2016 to create competition among assemblies' and reward best performing districts.

Even though, the municipality is not industrialized, the consumption and disposal of metallic substances such as lead and aluminum products were present and could introduce harmful substances into the waste stream. A situation that can pollute water sources.

The objective of the study was therefore to evaluate the physicochemical and biological composition of solid waste in illegal dump sites and their potential effect on human health from January to October 2018. More specifically to examine the socio-demographic characteristics and the sources of information on open defecation to the residents of Sagnarigu Municipality. The study would also assess the places of convenience that are available to the residence for use and the reasons that accounts for their inability to construct household latrines in the municipality.

## Study Area and Methodology

The Sagnarigu Municipality is one of the newly created districts carved from the then Tamale Metropolis. The Sagnarigu Municipal Assembly with its capital at Sagnarigu is one of the Districts created in the Northern Region during the first half of 2012. It was carved out of the Tamale Metropolis by a Legislative Instrument (LI) 2016. It was inaugurated on 24<sup>th</sup> June 2012. It is located in the Northern Region and has its capital at Sagnarigu. The Municipal covers a total land size of 200.4km and shares boundaries with the Tamale Metropolis to the south and east, Tolon district to the west, Kumbungu district to the north-west and Savelugu Municipal to the north. The Municipal lies between latitudes 9°16' and 9°34' North and longitudes 0°36' and 0°57' West geographically. According to the 2010 population and housing census, the Municipal has a population of 148,099 and represent 6% of the Region's total population. Males constitute 50.6% while females constitute 49.4%. The proportion of literate males is higher (68.3%) than that of females (52.0%). The Municipal has a total number of 23,447 households. The average household size in the Municipal is 6.3 persons per household. Children constitute the largest proportion of the household composition accounting for 43.3%. A greater proportion (46.2%) of households in the Municipality does not have toilet facilities. These households resort to public toilets or open defecation. The three main sources of water in the Municipality are pipe-borne, dug-outs, and rain.

The Sagnarigu Municipality experiences one rainy season from May to October with a peak in August. The mean annual rainfall is 1100mm within 95 days of rainfall in the form of tropical showers. The dry season is usually from November to early April. It is influenced by the dry North-Eastern winds (Harmattan) while the rainy season is influenced by the moist South-Western winds. The mean dry temperature ranges from 28 °C (December to mid-April) to 43 °C (March to early April) while the mean night temperature ranges from 18 °C (December) to 25 °C (February to March). (www.en.wikipedia.org).

The Sagnarigu Municipality lies within the Savannah Woodland of Ghana. The trees are short scattered wood lots in nature. Major tree types are the Dawadawa, Nim, Acacia, Mahogany and Baobab among others. There are naturally grown tall grasses during the rainy season that are used to make “Zanamat” and for roofing (Figure 1). (www.ghanadistricts.com).

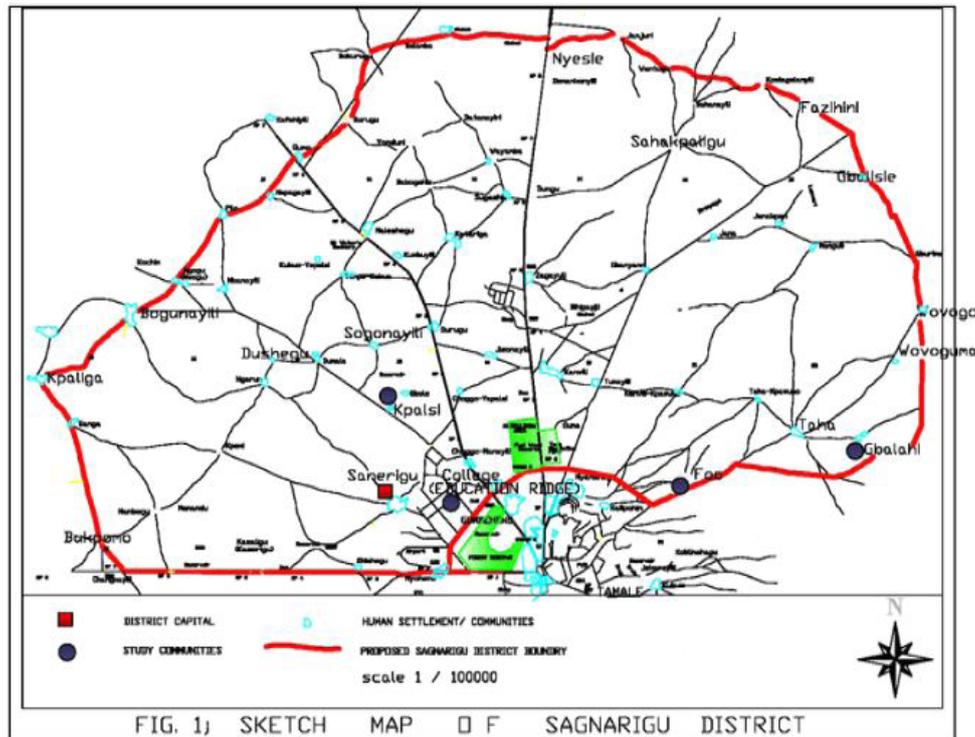


Figure 1: Map of Sagnarigu Municipality

## Study Design

The study employed a mixed method research design. Thus; qualitative and quantitative. Mixed method research design is a methodology for conducting research that involves collecting, analyzing and integrating qualitative and quantitative research in a single study or a longitudinal program of enquiry. The purpose of this type of research was to combine and give a better understanding of a research problem rather than either research methods alone. A stratified random sampling was employed to divide Sagnarigu Municipality into three subgroups called strata. Stratification brings about a more precise estimate of the characteristics of the population. Secondly, a simple random sampling was used to select the households from each stratum. In simple random technique, each household in each stratum stands an equal chance of being selected. Finally, a convenient sampling was used to select any member of the household who is of sound mind and is readily available for the survey questions.

## Sources of Data

A variety of data and information on the issues of solid waste were gathered from different sources which includes; the library, internet, journal and other relevant publications. This was to help acquire and establish a broad knowledge on the project topic, to plan the research methodology, data collection and data analysis. The study used structured questionnaire which contained definite items. The items in the structured questionnaire were either close or open. The closed items gave a series of alternative responses whereas the open items gave no guidance on answering. Data considered in this study were obtained from direct measurements, field assessments, survey from households and interviews from Zoomlion Ghana, Environmental Health Officers, Assembly Members, Chiefs, Opinion Leaders and Town and Country Planning Department.

## Administering Questionnaire

According to Kredcie and Morgan [18] in an article “Small Sample Techniques,” the formular  $S = X^2NP(1-P)/d^2(N-1) + X^2P(1-P)$

Where:

S= Required sample size

$X^2$ = The Table value of Chi-square for 1 degree of freedom at the desired confidence level (3.841 or  $1.96 * 1.96$ )

$N$ = The population size

$P$ = The population proportion (Assumed to be 0.050 since this would provide the maximum sample size)

$d$ = The degree of accuracy expressed as a proportion (0.05)

It was concluded that as the population increases, the sample size increases at a diminishing rate and remains relatively constant at slightly more than 380 cases. Therefore, a sample size of 384 was recommended for larger population size (23,447 households). The sampling techniques used were cluster and purposive sampling. The study area was grouped into a low, middle and high income waste generating communities. A community each was chosen from each income group through random sampling. Purposive sampling technique was used to select household heads or representatives for the administering of the questionnaire and for stake holder meetings [19]. These participants had the necessary information, adequate knowledge and experience on solid waste management in the study area. The data obtained from the analysis were cleaned, coded and subjected to descriptive statistical analysis and presented in tables and graphs using Microsoft Excel.

### Sampling Sites, Collection and Preparation

Samples were taken from four (4) randomly selected communities within the Municipality which include Kpalsi (Middle Income), Foo (High Income), Sogonayili (Low Income) and Gbalahi (Control). The samples were collected in three different phases in the dry season and the beginning of rainy season (February 2018 to April 2018). A shovel was used to scoop the soil from 10-15 cm depth and put into pre-cleaned polyethylene bags. At each sampling site, the soils were sampled at different spots at the same depth and composited giving a total of fifteen soil samples for the study. The samples were air-dried, ground mechanically and sieved to obtain < 2 mm fraction. 30 g sub-sample will draw from the bulk (< 2 mm fraction) and reground to obtain < 200  $\mu$ m fraction using mortar and pestle.

### Analytical Techniques

Heavy metals are generally referred to as those metals which possess a specific density of more than 5 g/cm<sup>3</sup> and adversely affect the environment and living organisms [20]. The method used to measure metals and non-metals was the USEPA approved method, which was developed by the HACH Corporation [1]. It was a Reactor Digestion Method #8000 utilizing prefabricated 3-150mg/L digestion vial, the HACH DR2500 reactor, and the HACH photo spectrometer. This method was used to reduce waste and time. In this method, 2mL of each leachate sample was added to a digestion vial, with the proper reagents already in them. Then the vials were capped securely and wiped clean with a lint free paper towel. Next, they were placed into the HACH reactor, which was pre-heated to 150 °C, for a period of two hours. After allowing the vials to cool to room temperature and entering the proper program, the blank is used to zero the photo spectrometer. Then each sample was placed into the photo spectrometer, and its concentration is displayed as mg/L. The pH meter was used for pH measurement and Conductivity meter was used for testing Conductivity

The acidified leachate samples (100 ml) after filtration with preconditioned plastic Millipore filter unit equipped with a 0.45 $\mu$ m filter were digested with 1:10 mixture of concentrated HNO<sub>3</sub> and 30% H<sub>2</sub>O<sub>2</sub> to concentrate and convert metals associated with particulate matter to the free metal ions. The solutions were then determined for Cd, Pb, Zn, Mn, and Cu levels using Perkin Elmer Analyst 400 Atomic Absorption Spectrophotometer (AAS). 100 ml of leachate samples were filtered into a membrane filter using a sterile filtration unit. After filtration, forceps were used to place the membrane filter on M-Endo Broth in invert plate. The plate was then incubated in an incubator at a temperature of 45 °C for 24h. The plates were then checked for bacteria colony growth. The same method was followed in total coli form count but after filtration, forceps were used to place the membrane filter on an MEC Broth in invert plate and the plate was then incubated in an incubator at a temperature of 37 °C for 24h. Growing bacteria colony was then checked for growth [1].

The ability to breakdown data and to classify the nature of the component part and the relationship between them is termed as analysis. The primary ways of analyzing data are the quantitative and qualitative data analysis. Data collected was subjected to statistical analysis using the Statistical Package for Social Sciences (SPSS) Version 21 and Micro Soft Excel (2016) for data entry. All collected data was coded and keyed into a computer via SPSS template and then run to generate figures, tables, bars, graphs and inferential statistics to describe the phenomenon and analysis of the variable of the study.

## Results

### Introduction

In this section, the socio-demographic characteristics and waste storage and disposal methods were presented. Also, the residential status of residents and places of convenience that determine the choice of residence defecation methods were also presented. The information on open defecation awareness creation, physicochemical and bacterial load of illegal waste dump sites in the Sagnarigu Municipality were also presented here.

### Socio-demographic Characteristics

**Age of Respondents:** The age of respondents for the study was categorized into eight (8) main groups. The minimum age recorded in the study was 22 years while the highest was 55 years. The mean age was 39.2 years. Table 1 gives a breakdown of the distribution of the ages.

Socio-demographic characteristic		Frequency	Percent (%)
Sex	Male	279	70.0
	Female	115	30.0
	Total	384	100.0
Age groups (years)	21-25	50	13.1
	26-30	21	5.5
	31-35	109	28.3
	36-40	35	9.1
	41-45	46	12
	46-50	25	6.5
	>50	98	25.5
	Total	384	100.0
Marital status	Married	307	80.0
	Single	51	13.3
	Divorce	26	6.7
	Total	384	100.0
Educational status	Basic	115	30.0
	Second cycle	154	40.0
	Tertiary education	115	30.0
	Total	384	100.0
Religion	Islam	326	85.0
	Christianity	58	15.0
	Total	384	100.0

Source: Field Survey, 2018

Table 1: Socio-demographic characteristics of respondents

From Table 1, 109 of the respondents representing 28.3% were within 31 to 35-year group. The next group which was 98 were those above 50 years and represents 25.5%. The household heads in these categories were those who have retired from active service. The construction and ownership of household latrines largely depends on the household heads. The respondents were made of 279 male representing 70% and 115 female representing 30%.

**Marital Status of Respondents:** The respondents were either married, single or divorce. No respondent was cohabitating. The study indicated that, 307 of the respondents representing 80% interviewed were married, 51 respondents representing 13.3% were single and 26 respondents representing 6.7% were divorced. Concerning their religious background, 326 respondents representing 85% were Muslims and while 58 respondents representing 15% were Christians (Table 1). There was no respondent practicing African Traditional Religion. The domination of Muslims in the community is in line with the results of Population and Housing Census (PHC) that Muslims form the majority religious denomination in the Sagnarigu Municipality.

**Educational Status of Respondents:** The educational status of respondents ranges from basic education (30%), Senior High or O- Level education (40%) and Tertiary level education (30%) (Table 1). Cumulatively, those who either had tertiary education or senior high education stood at 70% while those who had basic education stood at 30%. The results suggest that issues of sanitation were known to at least 70% of the residents since it is taught in schools and they can also read about it.

## Waste Management

This section is about the management of waste in the municipality. It is made up of the storage of wastes at households and the disposal of waste at a dump site. These dump sites were other approved or unapproved by the municipal authorities.

**Waste Storage:** The method of waste storage before disposal was key in this study. The study revealed that, waste is initially stored in the household in pans or buckets, baskets, plastic containers, dustbins and polythene bags. The study indicates that apart from the use of basket (12%) (Table 2) which has holes and leachate can drain through before disposal, the rest (88%) did not have any holes in them and so wastewater that was collected with the waste will remain in the container and is finally disposed at the refuse dumps.

Storage Container	Frequency	% (%)
Pan/Bucket	97	25.2
Basket	48	12.6
Plastic Container	134	35.0
Dust Bin	75	19.4

Storage Container	Frequency	% (%)
Polythene Bag	30	7.8
Total	384	100.0

Source: Field Survey, 2018

Table 2: Storage containers of solid waste at households

**Waste Disposal:** The study also revealed that, after storing waste in the household for a couple of days, it is disposed either in the skip buckets (14.6%), burnt (11.7%), dropped at the refuse dump (21.4%), dropped at any available open space or gutters (38.8%) or dropped at their backyards (13.6%) (Table 3).

Method of disposal	Frequency	% (%)
Skip buckets	56	14.6
Burning	45	11.7
Refuse dump	82	21.4
Open space/gutters	149	38.8
Backyard	52	13.6
Total	384	100.0

Source: Field Survey, 2018

Table 3: Waste disposal methods after storage

### Satisfaction of Respondents on Waste Service Provision

The waste service providers found in the Sagnarigu Municipality were the Zoomlion Ghana Limited, Havanna Waste Services Limited and the Savanna Waste Collectors. Majority of the respondents (58.3%) indicated that they were not satisfied with their services (Table 4).

Satisfaction of waste service providers	Frequency	% (%)
Not satisfied	224	58.3
Partially satisfied	119	31.0
Totally satisfied	41	10.7
Total	384	100.0

Source: Field Survey, 2018

Table 4: Satisfaction of households in waste service providers

During a focus group discussion, a responded reported that:

“Our waste is not collected regularly and sometimes the stench from the waste is so disgusting”. The stench was as a result of decomposition of organic matter.

### Residential Status of Respondents

In the Municipality, residents either own houses, rent, lives in family houses or are care takers. Table 5 is the distribution of the residential status of residents.

Residential Status	Frequency	% (%)
Family Owned	120	31.3
Tenant	70	18.2
Care taker	34	8.9
Owner	160	41.6
Total	384	100.0

Source: Field Survey, 2018

Table 5: Residential status of respondents

From the table, each family either own a house, a tenant, a family facility or a care taker. The least was care takers (8.9%). These were houses that were put up by absentee family members or relatives. Since of the houses were occupied their owners or family members, the failure to put up household latrines implies lack of will and not because were either not informed of have no money.

### Places of Convenient of Respondents

Places of convenient of respondents were the various places in which respondents in the community defecate. Places where respondents defecate in Sagnarigu were categorized into household latrines, public latrines and bush/open spaces. The study revealed that 250 (65%) were engaged in open defecation. About 90 (23.3%) use household latrines as their places of convenient whiles 50 (11.7%)

resort to public toilets. No respondent considered neighbor's toilet as a place of convenient. The respondents considered neighbors' toilet as unfit and morally wrong as a place of convenient.

Respondents gave reasons why they do not have household latrines. Most of the respondents (89.0%) cited "no funds" as the major reason why they do not own a household latrine. 23 (6.0%) and 19 (5.0%) respondents respectively said there was no need to own a toilet and no one told them to construct a toilet in the house respectively. Awareness creation with the involvement of nongovernmental organizations is improving but their efforts on the need for residents to own household latrines must be intensified.

Among the critical challenges in using public toilets were; smell poor hygienic condition of the toilets, distance and cost of using them. Some respondents indicated that they were unable to breathe well anytime they are defecating in public toilets due to excessive smell. As a result, some resort to smoking in other to neutralize the smell of the toilet with the scent of the cigarette. Community effort in which residents support each other has dwindled. This social solidarity spirit must be rekindled so that the vulnerable among the community can be supported to build household toilets. The contribution of community members in stopping open defecation is important if Ghana is to achieve the SDG 6. Figure 2 shows pictures showing the poor state of some public toilets in Sagnarigu Municipality.



Source: Field Survey, 2018

Figure 2: State of public toilets in Sagnarigu (a)Sludge in a toilet drop hole; (b)Uncovered hole; (c)Rubish and excreta in the surrounding

The stakeholders admitted that whiles people defecate in household and public latrines, a great number of people also defecate in the open. They said it was common to find residents defecating in the nearby forest, drainage channels and any other open space in the community including school fields. Asked which category of people were involved in this practice, one stakeholder answered

Men, women, children and the aged are guilty of the practice. Some people even drove cars to the forest just to defecate.

The stakeholders indicated that open defecation was more practiced in the night and at dawn. This is because such people know it is wrong but will not stop.

An official of the Environmental Health Unit of the Sagnarigu Municipal Assembly lamented that, they are confused as they have done a lot to reverse the trend but the people will not change. According to him the unit has graduated from education to prosecutions but to no avail. He reported that:

Any time the offenders are summoned before the Municipal Assembly, immediately they run to our land lords to eject us from their homes.

This assertion indicates that there is the need for a collective effort in the attempt to stop open defecation in the Sagnarigu Municipality. Public education is necessary but must be supported by Chiefs, Imams, Assembly members and all relevant stakeholders found in the Municipality.

### Sources of Information on Open Defecation

Information on open defecation in the Municipality was head from different sources. Table 6 is the various media information on open defecation was heard.

Information source	Frequency	% (%)
Television	32	8.3
Environmental health worker	90	23.3
News print	51	13.3
Radio	128	33.4
Information van	19	5.0
NGO	64	16.7
Total	384	100.0

Source: Field Survey, 2018

Table 6: Source of information on open defecation

Table 6 suggest that most (33.4%) of the 384 respondents heard of open defecation from the radio. The next was environmental health workers (23.3%) from the Municipal Assembly. The contribution of nongovernmental organizations (16.7%). The rest were news print (13.3%), television (8.3%) and information van (5.0%). Respondents indicated that the information van is used mostly when there is an outbreak of diarrheal related disease such as cholera. Since the number of Muslims dominates the study area, it is expedient that, education on open defecation must be disseminated in Mosque and churches. The involvement of the church is important because the forest which is located at Northern School of Business (NOBISCO) is used by churches for prayers.

**Organizations Supporting Household Latrine Construction:** This uncovers respondent's awareness or knowledge on organizations that support household latrine construction in Sagnarigu. The study revealed that 76.7% of the respondents had no knowledge of the organizations that helps in latrine construction while 23.3% of the 384 respondents had knowledge of the organizations. They mentioned a popular organization called Sama Sama that support household latrine construction with loans. The high proportion of those who said they had no knowledge of any support in latrine construction suggests that the publicity level of the organization was very low. According to a respondent the loans are subsidized but the subsidy is inadequate and so not many people could afford it. The high proportion of those who said they had no knowledge of any support in latrine construction suggests that the publicity level of the organization was very low.

**Cost of using Shared Latrine in Sagnarigu Municipality:** This is the amount of money charged per each use of a public latrine in Sagnarigu Municipality. The average charge per use of a public latrine was 30 Ghana pesewas. This was agreed by all respondents. A family size of six therefore spends an average of One Ghana Cedi Eighty Pesewas (GHC 1.80) per day for use of toilet and Five Ghana Cedis Forty Pesewas per month. This was not possible for those who are not employed. The money was collected by the caretakers of the shared latrines for onward submission to the Municipal Assembly. Those who cannot afford therefore defecate in the surrounding forest or around the public toilets at night. According to the respondents, they visit the toilet mornings and evenings each day. This implies that each person visits the toilet twice a day. The use of shared latrines each day by an individual was GH¢0.60.

With regards to the income levels of respondents, 75% of the respondents received monthly earnings between GH¢70.00 to GH¢250. Only 25% gets monthly income of over GH¢250.00. This presents a clear evidence of high poverty rate in the community.

**Why do Residents Engage in Open Defecation?:** There are varied reasons why open defecation is practiced. Some of these reasons are attitudinal, ignorance and socio cultural factors. In places where animals such as pigs and dogs are kept in the open, open defecation is not easily notice because such animals feast on excreta soon after it is dropped. However, in communities and towns where these animals are not available, it is only the solar radiation that can dry it up. Between the time of dropping of excreta and the time it is dried by the sun, domestic fowls and flies could sit or step into it and eventually transfer any bacterial to our food and water. Diseases that are associated with these excreta eventually attacks unsuspecting members of the municipality. This is the reason why open defecation is not good and must be stopped. This presents a wide range of factors such as; no toilet facilities, cultural beliefs, poor hygienic condition of existing toilets, no money to pay for use of a toilet facility, convenience and airy nature of the bush to be responsible for engaging in open defecation in the municipality.

Most (196) of the respondents representing 51% cited non-availability of toilet facilities as the major reason why they engaged in open defecation. 85 respondents representing (22%) cited poor hygienic condition of existing toilets, 77 representing 20% cited poverty, 23 representing 6% cited convenient and airy nature of the bush while only 4 (1%) cited cultural beliefs.

It is evident that physical factors were responsible for the practice of open defecation. 280 (73%) of the respondents were of the view that physical barriers compelled them to defecate in the bush and other open fields. The physical barriers include non-availability of toilet facilities, smell and poor hygienic conditions of the toilets. 77 (20%) of the respondents cited poverty as a barrier compelling them to defecate in the open. More over some residents cannot afford the cost of using a public latrine. One participant reported that, the situation is worrisome because:

The central government has abandoned the construction of public toilets and there is no support anywhere for the construction of household toilets.

The study also shows that 27 (7%) cited socio-cultural beliefs as a barrier which negatively affect development.

### Physicochemical and Bacterial Load of Dump Sites

According to literature, values of pH less than 7.0 are acidic and more than 7.0 is alkaline. The values obtained from all study communities and the control site were slightly alkaline (>7.0 and <8.0) (Table 7) and could not injure health when consumed.

Community	pH	EC ( $\mu\text{S/cm}$ )	P (ppm)	K / 100g	-
Gbalahi (Control)	7.44	3589.00	22.16	2.30	-
Fuo (High income)	7.98	657.00	81.56	1.72	-
Kpalsi (Middle income)	7.69	3245.00	16.98	4.41	-
Sogonayili (Low income)	7.85	889.00	62.90	1.91	-
	Cu (mg/l)	Zn (mg/l)	Ni (mg/l)	Cd (mg/l)	Pd (mg/l)
Gbalahi (Control)	18.0	8.0	2.3	0.02	0.09
Fuo (High income)	13.2	4.4	2.1	0.04	0.05
Kpalsi (Middle income)	12.4	2.0	2.4	0.01	0.05
Sogonayili (Low income)	13.01	3.5	2.3	0.03	0.06

Source: Field Survey, 2018

Table 7: Physicochemical parameters of solid waste in Sagnarigu

The pH of the study communities was slightly higher than the control community. Conductivity was more in the control community than the study communities and indicates the presence of metals at the control community. As such Cu, Zn and Pd which are heavy metals and can be toxic at high concentrations were lower in the study communities when compared with the control community. The difference between Ni and Cd could not be noticed easily in all study communities and the control community. These metals are quintessential to maintain various biochemical and physiological functions in living organisms when in very low concentrations; however they become noxious when they exceed certain threshold concentrations.

Coliform bacteria that were found in the leachate indicated the presence of human and animal excreta in the refuse dumps. The study indicated that, coliform bacteria in all the study communities were higher than that of the control community and that showed that excreta was dumped in un approved dump sites in the Sagnarigu Municipality. The values of coliform bacteria that were found are shown in Table 8.

Community	% Organic matter	Total Coliform (CFU/100ml)	Faecal coliform (CFU/100ml)
Gbalahi (Control)	8.28	$52.0 \times 10^4$	$5.2 \times 10^4$
Fuo (High income)	15.93	$57.0 \times 10^4$	$6.8 \times 10^4$
Kpalsi (Middle income)	9.38	$65.0 \times 10^4$	$8.0 \times 10^4$
Sogonayili (Low income)	7.96	$58.0 \times 10^4$	$7.6 \times 10^4$

Source: Field Survey, 2018

Table 8: Bacterial load of solid waste in Sagnarigu Municipality

The presence of coliform bacteria in drinking water is a threat or indicative of microbiological water quality deterioration. Positive total coliforms found in the samples indicated a presence of human excreta in the solid wastes in all study sites.

## Discussion

The women in the study communities were mostly busy preparing food and other household activities at the time of the researcher's visit and could not respond to the questionnaires. Most instances the women direct the researcher to the men or seek permission from their husbands before attending to the researcher because the male is considered the head of a household.

The reasons why residents engage in open defecation were categorized into physical, economic and socio-cultural. Respondents during the interview admitted that the available public toilets were woefully inadequate considering the increasing population in the municipality. They recounted how sometimes residents defy the poor hygienic conditions of public latrines and form very long queues in order to access the facility. Apart from the physical barriers, stakeholders also cited poverty as a reason people defecate in the open. They explained that residents do not have money to construct their own household latrines. This affirms the contribution of poverty to compelling people to defecate in the bushes, forests, and other open spaces and public latrines without a choice. This explains why some of the respondents want the use of public latrines to be free. The people were therefore compelled to focus their attention on daily survivors of food, water and shelter at the expense of using the money on toilet. This agrees with that poverty was responsible for the practice of open defecation in Ghana. It is for this reason that suggested the need for private sector support in the provision of household latrines and confirms the fact that open defecation is practiced widely in Sagnarigu and results in a high social costs such as loss of dignity, privacy, risk of physical attack and sexual violence.

In defense of the government action the Municipal coordinator retorted that, the government cannot be faulted. According to him, the people who engage in open defecation own houses. They were able to purchase land and built their homes and cannot afford GHC 2000.00 to build a toilet. Their actions are deliberate and only when they are arranged before the courts that they can change. Apparently, it is in open places and forested lands that, people drive cars, ride motor bikes, bicycles or walk to defecate. The question one may ask is that, how can you drive a car to defecate in the forest but cannot build a latrine. This is an indication that, open defecation is not due to poverty as peddled by some of the respondents but attitude. Most residents are capable of constructing household latrines and the laws of the land must be allowed to work. The security agencies most especially must be involved in the stopping of residents from engaging in open defecation. The Forest Services Commission which has an oversight responsibility of taking care of and protecting the forest should join in the effort to stop open defecation. The Environmental Protection Agency whose offices are located in the forest should not be left out in the fight against open defecation especially as they are charged with protecting the environment.

Only two stakeholders mentioned socio-cultural factors as a reason for residents defecating in the open. They explained that, residents were used to defecating in the open from infancy hence very difficult to change their mindset. The availability of facilities means nothing to them since they considered the bush to be convenient and airy. However, such category of people was few.

The Sagnarigu Municipal Assembly is responsible for environmental sanitation. They ensure that health and hygiene of residents are enhanced. They therefore ensure that, laws and regulations pertaining to sanitation are enforced. However, there is weak enforcement of sanitation by-laws and poor public education. The study showed that, residents were not aware of any law that prevents them from engaging in indiscriminate dumping of waste open defecation. To achieve open defecation free status, laws on sanitation must be enforced and its compliance must be adhered to. The Sagnarigu Municipal Assembly rely on the Department of Urban Roads, the Town and Country Planning, the [15] and the various security agencies to implement their programs on sanitation but there is no coordination between them and their efforts are often duplicated. According to Ogawa institutional inefficiencies leads to duplication of functions, gaps in service delivery and waste of already scares resources. Lack of political will is a cause of open defecation in Sagnarigu Municipality. The Municipal Assembly seem to lack the political will to ensure the construction of household toilets as stipulated in building permits. Sanitation management is ranked low in the priority lists of local authorities in Ghana. The lack of space in homes is also a reason why household toilets were not built by residents of Sagnarigu. A responded reported that,

Most land lords have used all available lands to build rooms and so there is no more space for toilets.

Some land lords did not plan for household toilets because they were engaged in open defecation. Currently they have seen that, open defecation is environmentally not good, spreads diarrheal related diseases and so de-humanizing. However, there is little they can do for lack of space unless some living rooms are converted into toilets since the government has also abolished the construction of public toilets in Ghana.

The action of residents of the Sagnarigu Municipality has a potential of introducing pathogenic bacterial in surface waters. The presence of coliform bacteria in drinking water is an indicates that treatment was ineffectiveness, loss of disinfectant, breakthrough intrusion of contaminated water into the potable water supply [21] or regrowth problems in the distribution system, and, as a consequence, should not be tolerated.

The delivery and management of sanitation is poor and many segments of the population still use improve toilet facilities. The situation was more serious as state and local governments are looking for non-traditional sources of financing sanitation infrastructure and operation needs. Good sanitation improves the quality of lives however, open defecation is dehumanizing and reduces the quality of life.

### **The Existence of Organizations that Support Household Latrine Construction**

There are many nongovernmental organizations (NGOs) in support of household toilets construction using the Community Led Total Sanitation (CLTS) model. Some of these organizations are Global Communities, World Vision, Catholic Relief Services (CRS), USAID and Afram Plains Development Organization (APDO). However, the model was developed as a rural model and so the efforts of all these organizations are geared towards the rural communities. The only organization that was supporting residents of Sagnarigu Municipality in latrine construction was the Sama Sama organization. As a result, little was known about the existence of this organization. Whiles others answered yes, some answered no. Those who answered yes mentioned the same organization (Sama Sama) that was discovered by the researcher during the household data collection. The varied responses were a testimony of the fact that such organization exist but not popular. Most people were not aware of its existence and operations and so more education about the activities of the organization must be given to the populace. The efforts of these organizations are augmented by the local radio stations. This was expected because; there are many radio stations in the municipality.

### **Indiscriminate Disposal of Waste**

The disposal of solid waste at refuse dumps, open spaces or gutters and at the backyards was a potential threat to surface and ground water. The indiscriminate or illegal dumping of waste is a disaster and threat for human health and environmental degra-

dation [22]. The wet fraction of the waste was not separated before disposal. According to the [15] if the wet fraction is separated before disposal, the fraction remains clean and valuable for recycling. However, both wet and solid waste was stored together in unperforated containers thereby making it impossible for the wet fraction to be discharged before disposal. Again, when it rains mineralization is intense and the leachate is carried to surrounding waters in the municipality.

According to a study by [23] domestic waste contains high content of organic matter. Respondents indicated that, this waste was dominated by organic fraction which can easily decompose and turn into soil. This was the main reason why households do not patronize the services of waste service providers in the Sagnarigu Municipality. However not only financial problems affect the availability or sustainability of a waste collection service. Operational inefficiencies of solid waste providers by municipalities can be due to inefficient institutional structures, inefficient organizational procedures, or deficient management capacity of the institutions involved as well as the use of inappropriate technologies [24].

According to [25] water pH between 6.5 and 8.5 were suitable for consumption. High levels of cadmium ( $>5.0\mu\text{g/L}$ ) damage the liver and kidney, cause anemia, retarded growth and death. Values obtained were less than  $5.0\mu\text{g/L}$  and could not affect health. Large concentrations of copper exceeding  $1,300\mu\text{g/L}$  may cause liver damage and lower levels could lead to gastro-intestinal distress. Lead is toxic in small concentrations ( $15\mu\text{g/L}$ ) and may cause loss of appetite, constipation, anemia, abdominal pain, paralysis in the muscles and death.

Leachate from refuse dumps in the Sagnarigu Municipality did not pose health hazards and could be used for composting of organic manure. This is because, the municipality is not industrialized and so contain little doses of trace metals. Since domestic waste is good for composting it must be free from toxic substances so that it can be used to fertilize crops and lawns [21].

The most commonly found heavy metals in waste include arsenic, cadmium, chromium, copper, lead, nickel, and zinc, all of which cause risks for human health and the environment [26]. Heavy metals enter the surroundings by natural means and through human activities. Various sources of heavy metals include urban runoff, sewage discharge and pesticides [27]. Human activity such as fossil fuel burning has resulted in the accumulation of lead and its compounds in the environment, including air, water and soil. Lead is used for the production of batteries, cosmetics, metal products such as ammunitions, solder and pipes, etc. [28]. The main sources of lead exposure are lead based paints, gasoline, cosmetics, toys, household dust, contaminated soil, industrial emissions [29] Lead poisoning can occur from drinking water [30]. According to the Environmental Protection Agency (EPA), lead is considered a carcinogen and has major effects on different parts of the body [31]. Chronic exposure to lead can result in mental retardation, birth defects, psychosis, autism, allergies, dyslexia, weight loss, hyperactivity, paralysis, muscular weakness, brain damage, kidney damage and may even cause death [25].

Soils and rocks, including coal and mineral fertilizers, contain some amount of cadmium. Cadmium has many applications such as in batteries, pigments, plastics and metal coatings and is widely used in electroplating [25]. Cadmium is carcinogenic for humans [32]. Cadmium is released into the environment through human activities such as mining, smelting, tobacco smoking, incineration of municipal waste, and manufacture of fertilizers among others. Cadmium causes bone mineralization and a severe damage to the lungs [33].

## Conclusions and Recommendations

The study concludes that, lack of public toilets and the absence of household latrines were the factors responsible for open defecation in Sagnarigu. The existence of forest and open drains in the municipality and the non-enforcement of laws and regulations were the motivators for the practice of open defecation and indiscriminate disposal of waste in the Sagnarigu Municipality. Leachate from domestic waste and run-off in Sagnarigu Municipality contains heavy metals which in high concentrations is injurious to health when surface waters such as dugouts and open wells are contaminated. Fecal coliforms were also higher in all study communities and the control community and indicates that solid waste generated in Sagnarigu Municipality contains excreta as a result of open defecation.

The study recommends that source separation of solid waste recycling, reuse and reduction in the use of solid waste were necessary to reduce contamination of water sources through leachate in the long term in Sagnarigu Municipality. Waste service providers should be regular in collecting waste at household levels to increase their confidence. Finally, the government through the Municipal Assemblies should as a matter of necessity provide skip baskets to all communities and enforce sanitary laws to improve sanitation in Sagnarigu Municipality.

## Acknowledgement

The author wish to thank the residents and staff of the Sagnarigu Municipality for their contribution to the success of this study. The author further wish to express his profound gratitude to Mr. Anthony Abutiare of the Centre for Scientific and Industrial Research for supporting in the laboratory analysis.

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