

The Effects of Poor Sanitation on the People of Sagnarigu in Northern Region of Ghana

Abdul-Rahaman Issahaku^{1,*}, Abukari Wumbei²

¹Desert Research Institute, University for Development Studies, P. O. Box 1350, Tamale, Ghana

²Institute for Interdisciplinary Research and Consultancy Services,
University for Development Studies, P. O. Box 1350, Tamale, Ghana

*Corresponding author: irahaman2@uds.edu.gh

Received December 15, 2019; Revised January 30, 2020; Accepted February 19, 2020

Abstract Poor sanitation in Sagnarigu Municipality of Northern Region was conducted from January to October 2018. Three communities (Fuo, Kpalsi and Sognayili) 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 (APHA, AWWA, WEF, 1998) was used to analyse physicochemical and bacterial load of leachate from unapproved dumpsites and wastewater from the engineering landfill site. While Gbalahi had 5.2×10^4 coliform units, Fuo, Kpalsi and Sognayili respectively had 6.8×10^4 , 8.0×10^4 and 7.6×10^4 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; smelly and poor hygienic condition of the toilets, distance and cost of using them. The study recommends that, the Municipal Assembly should intensify education and sensitization of open defecation and enforce by-laws regarding open defecation.

Keywords: physicochemical, bacterial, leachate, dump sites, Sagnarigu

Cite This Article: Abdul-Rahaman Issahaku, and Abukari Wumbei, "The Effects of Poor Sanitation on the People of Sagnarigu in Northern Region of Ghana." *American Journal of Environmental Protection*, vol. 8, no. 1 (2020): 17-26. doi: 10.12691/env-8-1-3.

1. Introduction

In Ghana, among the development functions of the Metropolitan, Municipal and District Assemblies (MMDAs) as stipulated by the Legislative Instruments which established them and the Local Government Act, 1993 (Act 462) are the provision of sanitation facilities and services and waste management. The Municipal Assembly Ordinance of 1943 was established as public health boards for Cape Coast, Accra and Kumasi with the mandate to ensure hygienic living conditions within settlements. These boards operated with inspections of premises and sanction those who flouted the law [1]. 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 poor sanitation. The World Health Organization [2] defines sanitation as the maintenance

of hygienic conditions by creating physically closer facilities offering less waiting time and safer disposal of human excreta [2]. Poor sanitation has resulted in 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 [3]. 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 [4]. Vulnerable groups such as the poor, children, women and disabled as well as the aged mostly suffer from poor sanitation [5]. Diarrhea diseases are the leading cause of deaths among children under 5 years in Ghana and account to nearly 19 percent of deaths in children who are less than 5-years [5].

Poor sanitation in Ghanaian cities and towns has not been accompanied by the requisite public and private sector engagement in the collection and subsequent disposal [5]. 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 [6].

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 demands that globally all nations must have access to clean water and sanitation to all her citizens by 2030 [7]. 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 [1]. 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 [1]. Due to the increasing comprehensiveness in waste management and planning, coupled with the need for the application of Environmental Impact Assessment (EIA), 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 citing, public participation, education, and program evaluation ([6].

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 [8]. 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 percent of the total population which translates into one in every five people practice open defecation [9]. It is

estimated that Ghana as a developing country is losing \$290 million US Dollars a year as a result of poor sanitation [9]. 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 [10].

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 [11]. At the illegal dumping sites, plastic bags containing excreta are found a situation that suggests that, households do not have household latrines. Even though, the municipality is not industrialized, the consumption and disposal of metallic substances such as lead and aluminum products could introduce harmful substances into the waste stream. This study therefore sought to assess the effects of poor sanitation in the Sagnarigu Municipality from January to October 2018.

2. Study Area and Methodology

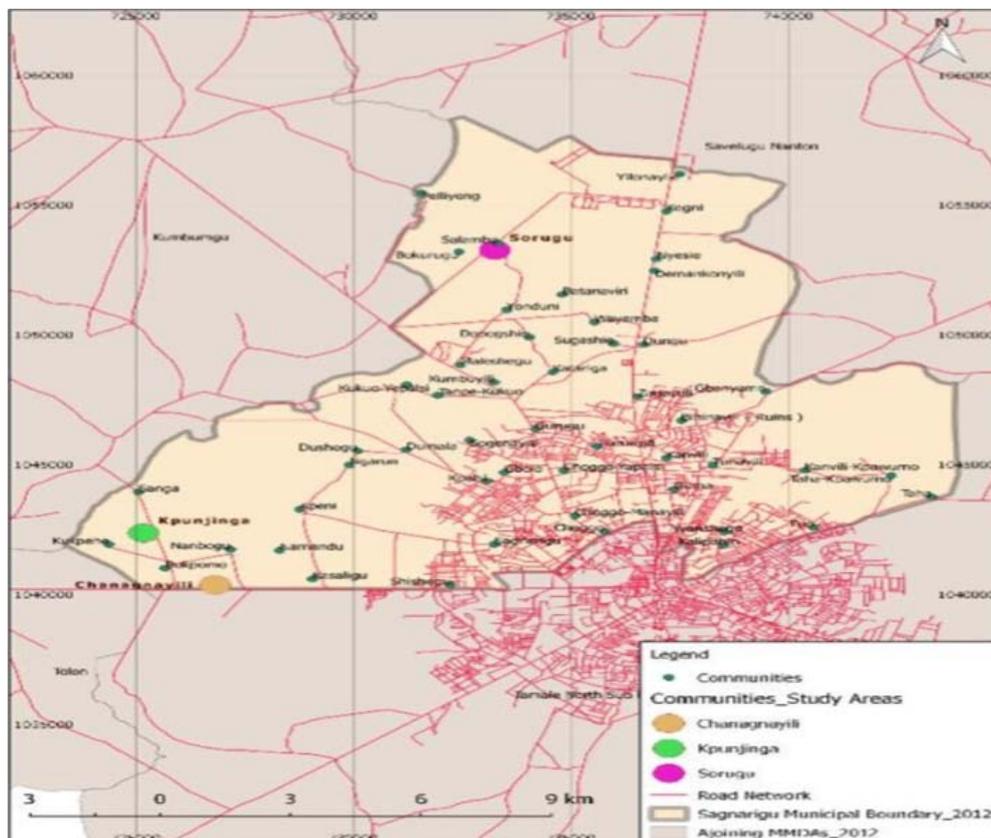


Figure 1. Map of Sagnarigu Municipality (Author's sketch)

The Sagnarigu Municipality was one of the newly created districts carved from the then Tamale Metropolis in 2012. It was carved out of the Tamale Metropolis by a Legislative Instrument (LI 2016). 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 (Figure 1} [11].

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%) [12]. 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% [11]. 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 [13].

The Sagnarigu Municipality experiences one rainy season from June 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) [13].

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 [13].

2.1. Study Design

The study employed a mixed method research design of qualitative and quantitative. Mixed method research design is a methodology for conducting research that involves collecting, analysing and integrating qualitative and quantitative research in a single study or a longitudinal program of enquiry [14]. 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.

2.2. 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.

2.3. Sampling of Respondents

According to [15] a sample size is determined by:

$$S = X^2 NP(1-P) / d^2 (N-1) + X^2 P(1-P) \quad (1)$$

where:

S=Required sample size?

X²= 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=20+28+53=23447

P=The population proportion (Assumed to be 0.5 since this would provide the maximum sample size)

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

From the information above;

$$S = 3.841(23447)(0.5)(1-0.5) / (0.05)^2(23447-1) + (3.841)(0.5)(1-0.5)$$

$$S = 22514.98175 / 58.615 + 0.96025$$

$$S = 22514.98175 / 59.57525$$

$$S = 377.925$$

$$S = 378$$

Therefore, surveys of 378 household heads were surveyed. 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 [14]. 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.

2.4. 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), Sognayili

(Low Income) and Gbalahi (Control). The samples were collected in the dry season (November to May) and the beginning of rainy season (June to October) [12]. 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 three (3) different spots at the same depth during the rainy season and repeated during the dry season. The samples were air-dried, ground mechanically and sieved to obtain < 2 mm fraction. 30 g sub-sample was drawn from the bulk (< 2 mm fraction) and reground to obtain < 200 μm fraction using mortar and pestle [16].

2.5. Analytical Techniques

The method used to measure metals and non-metals was the USEPA approved method, which was developed by the HACH Corporation [17]. It was a Reactor Digestion Method #8000 utilizing prefabricated 3-150mg/L digestion vial, the HACH DR2500 reactor, and the HACH photo spectrometer (HACH Company, 2003). 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 preheated 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 μm filter were digested with 1:10 mixture of concentrated HNO_3 and 30% H_2O_2 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 [17].

The ability to breakdown data and to classify the nature of the component part and the relationship between them is termed as analysis [14]. The primary ways of analysing 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 version) 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.

3. Results

3.1. Age of Respondents

The age of respondents for the study was categorized into seven (7) main groups. Those between 21-25years, 26-30years, 31-35years, 36-40years etc (Table 1).

Table 1. Age Group of Respondents.

| Age group | Frequency | Percentage (%) |
|-----------|-----------|----------------|
| 21-25 | 50 | 13.2 |
| 26-30 | 21 | 5.6 |
| 31-35 | 103 | 27.2 |
| 36-40 | 35 | 9.3 |
| 41-45 | 46 | 12.2 |
| 46-50 | 25 | 6.6 |
| 50 Above | 98 | 25.9 |
| Total | 378 | 100.0 |

Source: field survey, 2018

From Table 1, majority of the respondents (27.2%) were within 31 to 35-year group. The next group was those above 50 years representing 25.9%. The household heads in these categories were those who have retired from active service and were the household heads. The construction and ownership of household latrines largely depends on the household heads. The respondents were made of male (70%) and female (30%). Also the women in the community 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 respondents were either married, single or divorce (Figure 2).

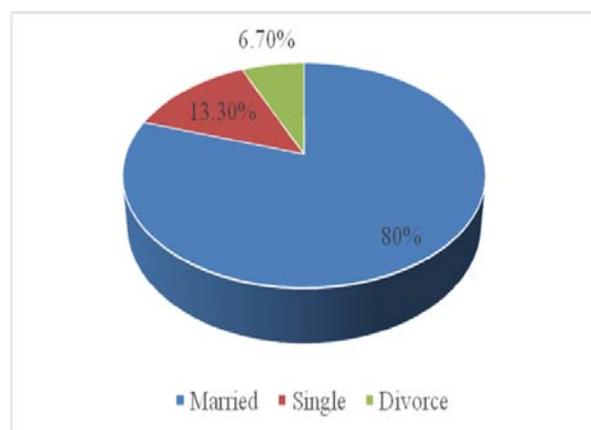


Figure 2. Marital Status of Respondents Source: field survey, 2018

Figure 2 indicates that, 80% which constituted majority of the respondents interviewed were married. 13.3% were single and 6.7% were divorced. Concerning their religious background, Muslims were the majority and represents 85% of the households' sampled whiles Christians were

15%. 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 [12].

3.2. Educational Status of Respondents

Figure 3 below indicates the educational status of respondents ranging from basic education, Senior High or O- Level education and Tertiary level education.

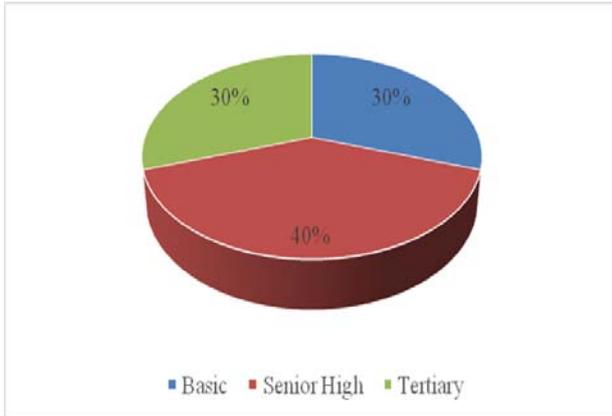


Figure 3. Educational level of respondents Source: field survey, 2018

From the figure above, 30% of the respondents had basic education, 30% had tertiary education while 40% had senior high or O-level education. 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.

3.3. Waste Storage before Disposal

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 (12.7%) (Table 2) which has holes and leachate can drain through before disposal, the rest (87.3%) 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.

Table 2. Storage containers of solid waste at households

| Storage Container | Frequency | Percent (%) |
|-------------------|-----------|-------------|
| Pan/Bucket | 97 | 25.7 |
| Basket | 48 | 12.7 |
| Plastic Container | 128 | 33.9 |
| Dust Bin | 75 | 19.8 |
| Polythene Bag | 30 | 7.9 |
| Total | 378 | 100.0 |

Source: Field survey, 2018

The study also revealed that, after storing waste in the household for a couple of days, it is disposed either in the skip buckets (14.8%), burnt (11.9%), dropped at the refuse dump (21.7%), dropped at any available open space or

gutters (37.8%) or dropped at their backyards (13.8%) (Table 3).

Table 3. Waste disposal methods after storage

| Method of disposal | Frequency | Percent (%) |
|--------------------|-----------|-------------|
| Skip buckets | 56 | 14.8 |
| Burning | 45 | 11.9 |
| Refuse dump | 82 | 21.7 |
| Open space/gutters | 143 | 37.8 |
| Backyard | 52 | 13.8 |
| Total | 378 | 100.0 |

Source: Field survey, 2018

The waste service providers found in the Sagnarigu Municipality were the Zoolion Ghana Limited, Havanna Waste Services Limited and the Savanna Waste Collectors. Majority of the respondents (57.7%) indicated that they were not satisfied with their services (Table 4).

Table 4. Satisfaction of households in waste service providers

| Satisfaction of waste service providers | Frequency | Percent (%) |
|---|-----------|-------------|
| Not satisfied | 218 | 57.7 |
| Partially satisfied | 119 | 31.5 |
| Totally satisfied | 41 | 10.8 |
| Total | 378 | 100.0 |

Source: Field survey, 2018

During a focus group discussion, a respondent 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.

3.4. Residential Status of Respondents

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

Table 5. Residential status of respondents

| Residential Status | Frequency | Percent (%) |
|--------------------|-----------|-------------|
| Family Owned | 120 | 31.7 |
| Tenant | 70 | 18.5 |
| Care taker | 34 | 9.0 |
| Owner | 154 | 40.8 |
| Total | 378 | 100.0 |

Source: field survey, 2018.

From the table, each family either owns a house (40.8%), a tenant (18.5%), a family facility (31.7%) or a care taker (9.0%). The least was care takers and were houses that were put up by absentee family members or relatives.

3.5. Places of Convenient of Respondents

Places of convenient of respondents were the various places in which respondents in the community defecate. The delivery and management of sanitation is poor and many segments of the population still use un-improve toilet facilities [18]. The situation was more serious as

state and local governments are looking for non-traditional sources of financing sanitation infrastructure and operation needs [19]. Good sanitation improves the quality of lives [19] however, open defecation is dehumanizing and reduces the quality of lives.

Places where respondents defecate in Sagnarigu were categorized into household latrines, public latrines and bush/open spaces. The study revealed that sixty-five (65) percent were engaged in open defecation. This 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. Nearly twenty-three (23.3) percent use household latrines as their places of convenient whiles 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. Majority of the respondents (89.0%) cited "no funds" as the major reason why they do not own a household latrine. 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. It is for this reason that [20] suggested the need for private sector support in the provision of household latrines. Very small percentage 6.0% and 5.0% 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 [19].

Among the critical challenges in using public toilets were; smelly, 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 [21]. The contribution of community members in stopping open defecation is important if Ghana is to achieve the SDG 6. Figure 4 shows pictures showing the poor state of some public toilets in Sagnarigu Municipality.

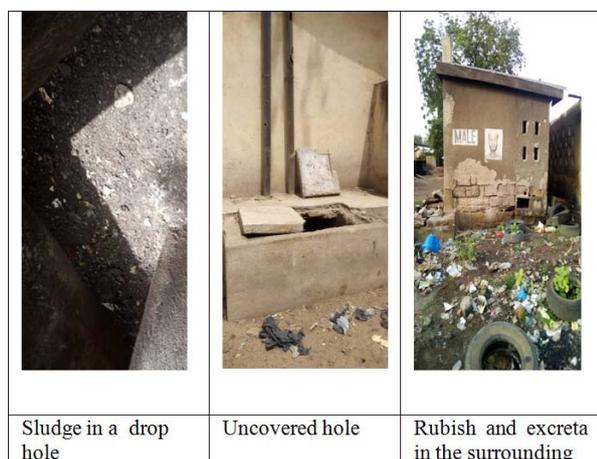


Figure 4. State of public toilets in Sagnarigu Source: field survey, 2018

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 [13]. 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 Environmental Protection Agency (EPA) and the various security agencies to implement their programmes on sanitation but there is no coordination between them and their efforts are often duplicated [22]. According to [19], institutional inefficiencies lead to duplication of functions, gaps in service delivery and waste of already scarce resources. Lack of political will is a cause of open defecation in Sagnarigu Municipality. Municipal Assemblies in Ghana seem to lack the political will to ensure the construction of household toilets as stipulated in building permits [19]. 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 respondent 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. Information on open defecation in the Municipality was heard from different sources. Table 6 is the various media information on open defecation was heard.

Table 6. Source of information on open defecation

| Information source | Frequency | Percent (%) |
|-----------------------------|-----------|-------------|
| Television | 32 | 8.5 |
| Environmental health worker | 90 | 23.8 |
| News print | 51 | 13.5 |
| Radio | 122 | 32.3 |
| Information van | 19 | 5.0 |
| NGO | 64 | 16.9 |
| Total | 378 | 100.0 |

Source: field survey, 2018

Table 6 suggest that most (32.3%) of the 378 respondents heard of open defecation from the radio. This was expected because; there are many radio stations in the Municipality. The next was environmental health workers (23.8%) from the Municipal Assembly. The contributions of nongovernmental organizations were 16.7%. The rest were news print (13.5%), television (8.5%) 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. Apparently, it is this same forest 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.

3.6. 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 percent of the respondents had no knowledge of the organizations that helps in latrine construction while 23.3 percent of the 384 respondents had knowledge of the organizations. They mentioned a popular organization called SamaSama 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.

3.7. 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 50 Ghana pesewas. This was agreed by all respondents. A family size of six therefore spends an average of Three Ghana Cedis (GHC 3.00) per day for use of toilet and Ninety Ghana Cedis 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 in the mornings and evenings each day. This implies that each person visits the toilet twice a day.

With regards to the income levels of respondents, 75% of the respondents received monthly earnings of less than GHC250. Only 25% gets monthly income of over GHC250.00. This presents a clear evidence of high

poverty rate in the community and agrees with the Ghana living survey conducted by the Ghana Statistical Service in 2010 [12]. 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 [23] that poverty was responsible for the practice of open defecation in Ghana.

3.8. 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 [24]. 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 up 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.

Majority of the respondents, representing 51 percent cited non-availability of toilet facilities as the major reason why they engaged in open defecation. Twenty-two percent cited poor hygienic condition of existing toilets, 20 percent cited poverty, 6 percent cited convenient and airy nature of the bush while only 1 percent cited cultural beliefs.

It is evident that physical factors responsible for the practice of open defecation constituted the majority. Seventy-three percent 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. Twenty percent 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.* Only seven percent cited socio-cultural beliefs as a barrier. The seven percent of respondents who cited socio-cultural beliefs as a barrier is an indication that ancient cultural beliefs negatively affect modernization. This agrees with [24] that socio-cultural beliefs influence the practice of open defecation.

3.9. Places of Convenient by Residents

The stakeholders admitted that while 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 categories of people were involved in this practice, one stakeholder answered that *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 stake holders found in the Municipality.

3.10. Physicochemical and Bacterial Load of Dump Sites

A value of pH less than 7.0 is acidic and more than 7.0 is alkaline. Excessive decrease or increase pH in water is corrosive. The values obtained were slightly alkaline (>7.0 and <8.0) (Table 7) and could not injure health when consumed.

Table 7. Physicochemical parameters of solid waste in Sagnarigu

| Community | pH | EC ($\mu\text{S}/\text{cm}$) | 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 |
| Sognayili (Low income) | 7.85 | 889.00 | 62.90 | 1.91 |

Source: Field survey, 2018

Heavy metals are generally referred to as those metals which possess a specific density of more than $5 \text{ g}/\text{cm}^3$ and adversely affect the environment and living organisms [25]. Metals that were found are shown in Table 8.

Table 8. Metallic concentrations of solid waste in Sagnarigu

| Community | 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 |
| Sognayili (Low income) | 13.01 | 3.5 | 2.3 | 0.03 | 0.06 |

Source: Field survey, 2018

These metals are essential 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 (Table 9) that were found in the leachate indicated the presence of human and animal excreta in the refuse dumps. The values of coliform bacteria that was found were above WHO acceptable levels.

Table 9. Bacterial load of solid waste in Sagnarigu Municipality

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

Source: Field survey, 2018

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. The presence of coliform bacteria in drinking water is an indication treatment was ineffectiveness, loss of disinfectant, breakthrough intrusion of contaminated water into the potable water supply [26].

4. Discussion

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.

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.

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.

4.1. 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 SamaSama organization. As a result, little was known about the existence of this organization. While others answered yes, some answered no. Those who answered yes mentioned the same organization (SamaSama) 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.

4.2. 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 degradation [27]. The wet fraction of the waste was not separated before disposal. According to the [1], 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 imperforated 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 [28] domestic waste contains high content of organic matter. Households indicated that, this waste was dominated by organic fraction which can easily decomposed 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 [29].

According to [30] 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 [28].

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 [30]. Heavy metals enter the surroundings by natural means and through human activities. Various sources of heavy metals include urban runoff, sewage discharge and pesticides [31]. 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. [32]. The main sources of lead exposure are lead based paints, gasoline, cosmetics, toys, household dust, contaminated soil, industrial emissions [33]. Lead poisoning can occur from drinking water [34]. According to the Environmental Protection Agency (EPA), lead is considered a carcinogen and has major effects on different parts of the body [35]. 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 [32].

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 [32]. Cadmium is carcinogenic for humans [36]. 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 [37].

5. 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 and 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 therefore pollutes surface waters such as dugouts and open wells.

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.

Acknowledgements

The authors would like to thank the residents and staff of the Sagnarigu Municipality for granting permission for

this study and their valuable contributions. The authors further wish to express their profound gratitude to Mr. Anthony Abutiati of the Centre for Scientific and Industrial Research for the laboratory analysis of both physicochemical and bacterial loads.

Declaration

We hereby state that, this paper has not been published or under consideration for publication anywhere.

References

- [1] EPA, MES, MLGRD. Ghana Landfill Guidelines. Best Practice Environmental Guidelines. Accra: Ghana: EPA, MES, MLGRD, Ghana Landfill Guidelines; 2002.
- [2] WHO. *Health topics, Sanitation*, 2017. <http://www.who.int/topics/sanitation/en/>
- [3] UNICEF. *India. Eliminate open defecation*. Retrieved 31st July 2018. <http://unicef.in/whatwedo/11/eliminate-Open-Defecation>
- [4] Bartram J and Cainscross S. Hygiene, Sanitation and Water: forgotten Foundations of health. *PLoS Med*, 2010. 7(11), 1-9, e1000367.
- [5] Osei FB and Duker AA. Spatial dependency of V. Cholera prevalence on open space refuse dumps in Kumasi, Ghana: a spatial statistical modeling. *Inter J Health Geog*. 2008; 7: 62.
- [6] Armah, NA. Private sector participation in waste management in Accra: A case study. Unpublished report submitted to *Carl Bro. International*, 2001. Accra.
- [7] Fobil JN. Factors to be considered in the design of an Integrated Municipal Solid Waste management in the Accra Metropolis. (MPhil. Thesis), 2001. *University of Ghana*, Legon.
- [8] UNICEF. Basic Sanitation, The UNICEF Ghana *Internal Statistical bulletin*, 2015. Accra.
- [9] Fobil JN. Municipal waste collection and urban environmental Management in Accra, Ghana: Proceedings of the *International Symposium on Environmental Pollution Control and Waste Management (EPCOWM)*, 2002. January 7-10, 2002, Tunis, Tunisia. Pp 193-206
- [10] Robert B and Julio D. *The peri - urban interface; A tale of two cities*. The Bartlett, UCL Faculty of the Built Environment, 2001. ISBN: 1 84220011 1. London.
- [11] Sagnarigu Municipal Assembly. *District Environmental Health Office*, DESSAP, Profile of the district, 2017a. (p 36).
- [12] Ghana Statistical Service. *Population and Housing Census: Summary Report of Final Results*. Accra: Ghana Statistical service, 2014.
- [13] Sagnarigu Municipal Assembly. Municipal Health Directorate, *1st quarter report*, 2017b, (p 10)
- [14] Neuman LW. *Social research methods: Qualitative and quantitative approach*, 2014. Edinburgh, UK. Pearson Education Limited. <http://unicef.in/whatwedo/11/eliminate-Open-Defecation>
- [15] Krejcie RV and Morgan DW. 1970. *Determining sample size for research activities*. Educational and psychological measurement; 30 (607-610), Texas A and M University
- [16] Carboo D, Christian C and Fobil JN. Waste stream analysis of MSW in the Accra Metropolis, proceedings of the *10th faculty colloquium*, Faculty of science, University of Ghana, 2001 pp 34-42 CV
- [17] APHA, AWWA, WEF. *Standard Methods for the Examination of Water and Wastewater*. Washington, DC. 1998. 20th edn.
- [18] Awortwi N. 2004. Getting the fundamentals wrong: Woes of public private partnerships in solid waste collection in three Ghanaian cities. *Public Administration and Development*, 2004. 24 : 213-224
- [19] Fobil JN, Armah NA, Carboo N. 2006. The influence of institutions and organizations on urban waste collection systems: An analysis of waste collection systems in Accra, Ghana (1985-2000). *J Environ Manage*. 2008; 86: 262-271.
- [20] Osumanu, I. K., & Kosoe, E. A. (2014). Where do I answer nature's call? An assessment of Accessibility and utilisation of toilet facilities in Wa Municipality. *Ghana journal of Geography*, 2014. 5 (1). 17-31.
- [21] Routray, P. Schmidt, W. P. Boisson, S. Clasen, T. & Jenkins, W. M. Socio Cultural and Behavioral Factors Constraining Latrine Adoption in Rural Coastal Odisha: An exploratory Qualitative Study. *BMC Public Health Journal*, 2015.
- [22] Sagnarigu Municipal Assembly. *District Environmental Health Office, RING 1st quarter report*, 2018, Test Findings. (p 13)
- [23] Songsore J. and Stephens C. (2013). The Accra Waste Project: From Urban Poverty And Health to Aid And Trade. *Ghana Geographical Association*, Accra 2013.
- [24] WaterAid. *Abandoning Open Defecation: Comparism and Adaption Of Social Change Dynamics*, 2014. www.wateraid.org/documents/social_transformation_study_briefing_note.pdt.23/07/2012
- [25] Järup L. Hazards of heavy metal contamination. *Br Med Bull*. 2003;68 (1): 167-182.
- [26] Clark RM., Geldreich EE, Fox KR, Rice EW, Johnson CH, Goodrich JA, Barnick JA, Abdesaken F. *Journal of Water SRT-Aqua*, 1996. 45: 171-183.
- [27] Achankeng E. Globalization, Urbanization and Municipal Solid Waste Management in Africa. University of Adelaide: *African Studies Association of Australasia and the Pacific Conference Proceedings - African on a Global Stage*, 2003.
- [28] Miller D. [ej/principles.htm](http://ej.net/principles.htm). 1999. Retrieved from www.ejnet.org.
- [29] Mensah A and Larbi E. Solid Waste Disposal in Ghana. Accra: Resource Centre Network for Water, Sanitation and Environmental Health; 2005.
- [30] Lambert M, Leven BA and Green RM. New methods of cleaning up heavy metal in soils and water; *Environmental science and technology briefs for citizens*; Manhattan, KS: Kansas State University; 2000.
- [31] Morais S, Costa FG, Pereira ML. Heavy metals and human health. In: Oosthuizen J, editor. *Environmental health - emerging issues and practice*. 2012. pp. 227-246.
- [32] Martin S and Griswold W. Human health effects of heavy metals. *Environmental Science and Technology Briefs for Citizens*. 2009; (15): 1-6.
- [33] Gerhardsson L, Dahlin L, Knebel R, Schütz A. *Blood lead concentration after a shotgun accident*. *Environ Health Perspective*. 2002; 110(1): 115-117.
- [34] Brochin R, Leone S, Phillips D, Shepard N, Zisa D, Angerio A. The cellular effect of lead poisoning and its clinical picture. *GUJHS*. 2008; 5(2): 1-8.
- [35] Papanikolaou NC, Hatzidaki EG, Belivanis S, Tzanakakis GN. And Tsatsakis AM. Lead toxicity update. A brief review. *Med Sci Monitor*. 2005; 11(10): RA329.
- [36] Henson MC. And Chedrese PJ. Endocrine disruption by cadmium, a common environmental toxicant with paradoxical effects on reproduction. *ExpBiol Med* (Maywood) 2004; 229 (5): 383-392.
- [37] Bernard A. Cadmium & its adverse effects on human health. *Indian J Med Res*. 2008; 128(4): 557-64.

