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Research Article

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AN ASSESSMENT OF THE IMPACT ON SOILS AND POPULATION BY SOLID WASTE DUMPSITES IN THE BAMENDA URBAN SPACE OF THE NORTH WEST REGION, CAMEROON

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ABSTRACT

Urban settlements generate a lot of wastes that need to be constantly cleared and well-treated. However, when such wastes are poorly located and inadequately treated, they constitute a potent hazard on the environment even after many years of closure of the dumpsite. This paper evaluates the long-term effects of solid waste dumpsites on the immediate environment in the rapidly expanding regional headquarters of the North West of Cameroon. Solid waste dumpsites are within built-up and densely populated areas. With time, the waste undergoes decomposition producing leachate that seeps into soils. To evaluate the impact on soils, 4 composite soil samples were collected at Mbelewa dumpsite, 3 at Mile 6 dumpsites at depths between 0cm to 105cm and analysed. There was a control sample undertaken 300m from Mile 6 dumpsite. Questionnaires were administered to household heads living within 50-300m from the dumpsites using a random sampling approach. Results show that there was more heavy metal pollution at Mile 6 dumpsite while Zinc exhibited a very high level of contamination of 1225.95µg/g at Mbelewa dumpsite. Findings further reveal odour and flies as the most dominant environmental problems within 0.5 km of the dumpsites. Common illnesses such as malaria and typhoid were the most dominant health hazards. Based on the negative impact of the dumpsites on the environment, the study proposes the need for the municipal authorities to always conduct an á priori study of site suitability, analysis and Environmental Impact Assessment (EIA) so as to reduce the impact on the environment.

Keywords: Waste, Dumpsites, Environmental Problems, Heavy Metals, Soils, Pollution.

INTRODUCTION

The world is becoming more urbanized with populations, and consumption rapidly increasing to historic levels. Urban settlements generate a lot of wastes that need to be constantly cleared and well-treated. However, when such wastes are poorly located and inadequately treated, they constitute a potent hazard on the environment [1]. Having effective and sustainable waste management systems in place will help regulate waste disposal and will help alleviate some of the pressure consumption has put on the environment. It is also important to deal with this issue directly because waste can have detrimental effects, if left unmanaged, on both environmental and human health [2].

The first official solid waste dump site in Bamenda was created at Mile 6 Alamatu in 1995. The open dump site was owned and controlled by the Bamenda Urban Council (BUC). However, overtime as the rate of urbanisation increased the location of the solid waste dump site was engulfed by urban settlements and evidently became unsuitable since it was located by the road and a river with solid waste sometimes covering part of the road without any treatment and no daily soil cover. This solid waste dump site was particularly a nuisance to the population and the environment. It was later moved to Mbelewa in 2012 (- distance away). From 2012 to 2024, the dumpsite was moved from Mbelewa back to Mile 6, from Mile 6 to Bangshie, and from Bangshie Nkwen to mile 6 within a period of less than ten years. This paper thus examines the environmental impact of the existing dump sites on the soils and population of Bamenda urban space.

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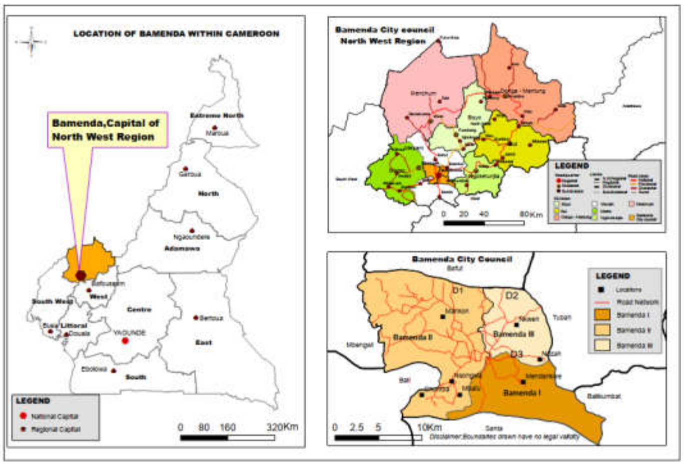
The impacts of dumpsites on their surrounding environment do not end after the landfill has been abandoned. The natural decomposition of waste continues for several years after the waste is disposed of which can contaminate groundwater, surface water, and soil resources [3]. The drastically increasing quantity of the solid waste creates both short- and long- term adverse effects on soil, water resources, air and the environment. The short- term impacts include unsightly atmosphere with flies, stench and mosquitoes. The long-term impacts include soil and water pollution. Also, this paper evaluates the long-term effects of solid waste dumpsites on the immediate environment in the Bamenda urban space of the North West Region of Cameroon.

Bamenda is located between latitudes 5°56" N and 5°58" North of the equator and longitude 10°09" and 10°11" East of the Greenwich Meridian (Map 1). Bamendalies at an altitude of 1430m above sea level. The town is expanding along the Cameroon Volcanic Line and exhibits two very distinct relief environments; that is, the High Lava plateau (Up Station) with an altitude of about 1400m and the Lower plateau (Down Town) with an average altitude of 1,100m above sea level [4]. High temperatures of up to 35^{0}C are sometimes registered in the dry season, with torrential rainfall in the rainy months capable of transporting huge amounts of untreated solid wastes from the dump sites.



Map 1: Location of Bamenda city in the Northwest Region of Cameroon (D1, D2 and D3 represent the dumpsites)

Source: Bamenda City Council, (2014)

MATERIAL AND METHODS

143 questionnaires were administered in two neighbourhoods adjacent the dump sites at Mbelewa and Mile 6. The quantitative part of the study was developed and analysed from close-ended questionnaires, and field measurements of soil samples were collected. Household heads, and urban farmers living or operating within a kilometre of the solid waste dump sites were interviewed to investigate the effects of the dumpsites on their livelihood.

Field measurement of soil samples were carried out at the solid waste dumpsites. Seven soil samples were collected in August 2020 during the transition period from the rainy to the dry season to check the rate of filtration of contaminants through the soil. 3 soil samples in Mile 6 and 4 in Mbelewa solid waste dump sites were obtained using a soil auger. A composite soil sample was collected at different depths of 0-15cm, 30-45cm and 60-75cm depth at Mile 6. A composite soil sample was taken at 0-15cm, 30-45cm, 60-75cm and 90-105cm depth at Mbelewa. A control sample was collected 300m from the Mile 6 dumpsite. These samples were placed in labelled plastic containers and taken to the International Institute of Tropical Agriculture IITA laboratory for analysis. Heavy metal analysis was conducted on soil samples for Zinc, Manganese, Nickel, Copper, Lead, Chromium and Cadmium.

RESULTS AND DISCUSSION

The results are based on the contaminants and polluting agents as determined by laboratory analysis resulting from the soil samples. Also the result from the questionnaire analysis shows the perceived impact of the dumpsite on the health of the population and environment.

Results of Soil Analysis for Heavy metal

Soil samples were collected at different depths from both mile 6 and Mbelewa dumpsites and analysed. The results are illustrated in Table 1

Table 1: Results of soil analysis of heavy metals from Mbelewa and Mile 6 dump sites

Location	Depth (cm)	Pb (µg/g)	Cu (µg/g)	Cr (µg/g)	Ni (µg/g)	Zn (µg/g)	Mn (µg/g)	Cd (µg/g)
Mbelewa								
Mbelawa	0-15	61.39	178.00	97.44	24.93	1225.95	507.77	0.002
Mbelawa	30-45	46.86	103.36	84.14	27.54	368.12	301.81	0.004
Mbelawa	60-75	230.24	109.65	53.50	18.59	617.45	478.87	0.002
Mbelawa	90-105	10.59	103.29	71.51	26.95	340.06	315.35	0.004
Mile 6								
Mile 6	0-15	370.29	79.71	126.11	45.83	476.14	431.89	0.002
Mile 6	30-45	348.72	115.88	101.87	45.40	639.22	515.19	0.005
Mile 6	60-75	3.00	54.12	98.67	41.68	182.54	262.29	0.002
Control		0.05	41.71	3.55	0.05	193.11	6.46	4.72

The following heavy metals were analysed**;**

Lead

Lead is a well-known non-biodegradable toxic metal in the environment. There is some amount of lead found within human environments but an increased amount of it comes from human activities including burning of wastes in open dumps. Domestic lead exposures come mainly from cooking by use of solid fuels like coal. Soil samples were analysed for the presence of lead and the results indicated on Figures 1.1

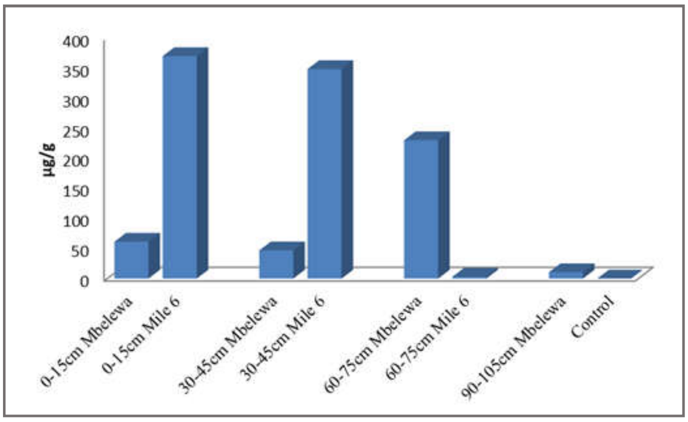


Figure 1.1:- Lead contamination levels at different depths at the Mbelewa and Mile 6 dumpsites

Source: Fieldwork, 2020

The results shown in Figure 1.1 for the Mbelewa dumpsite indicates low contamination of 10.59 µg/g at depth of 90-105 cm, medium contamination of 61.39 µg/g at depth of 0-15 cm and 46.86 µg/g at depth of 30-45 cm; high contamination of 290.24 µg/g at depth 60-75 cm . Also the results for the Mile 6 dumpsite shows low contamination of 3 µg/g at depth of 60-75 cm, and high contamination of 370.29 µg/g at depth of 0-15 cm and 348.72 µg/g at depth of 30-45 cm.The result of the control analysis is 0.05 µg/g; which is far lesser than the results of other depths analysed. This indicates that lead contamination was high in the soils of both dumpsites.

Copper

Copper is released into the environment by both natural sources and human activities. An example of natural source is decaying vegetation. Copper was found in open dumps and waste disposals sites. Usually, water-soluble copper compounds occur in the environment after it has been released through application in agriculture. Figures 1.2 show the distribution of copper by depth in the study area.

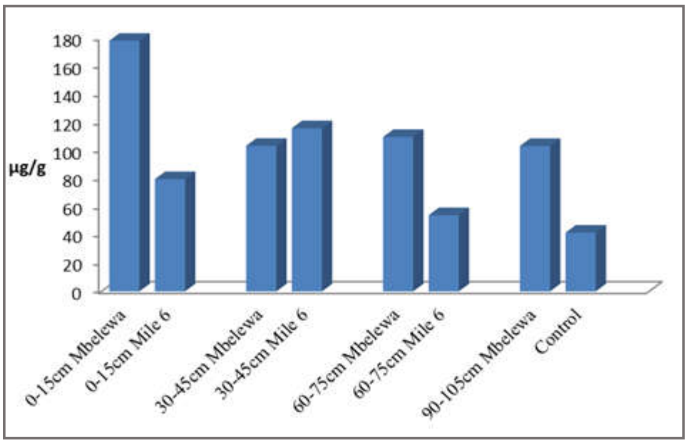


Figure 1.2:- Copper contamination levels at different depths at the Mbelewa and Mile 6 dumpsites

Source: Fieldwork, (2020)

The results in figure 1.2 shows high contamination of copper at all depths in the Mbelewa dumpsite. Copper contamination was high; 178 µg/g at depths of the 0-15 cm (top soil) and low 103.29 µg/g at depths of 90-105 cm.

Also, at the Mile 6 dumpsite results show high contamination of copper at all depths in the Mile 6 dumpsite. The highest contamination of copper was 115.88 µg/g at depths of 30-45 cm. The result of the control sample is 41.71 µg/g which is lower in relation to the copper level of other depths. Therefore the concentration of copper is high in the soils of both dumpsites.

Chromium

Chromium pollution is a significant environmental threat, severely impacting the environment and natural resources such as water and soil. Excessive exposure can lead to higher levels of accumulation in human and animal tissues, leading to toxic and detrimental health effects. Thus, it must be monitored in and around dumpsites especially as farming activities in the vicinity of the study sites were found at close proximity to the open dumps. The samples collected from the field were analysed and the results indicated on Figures 1.3

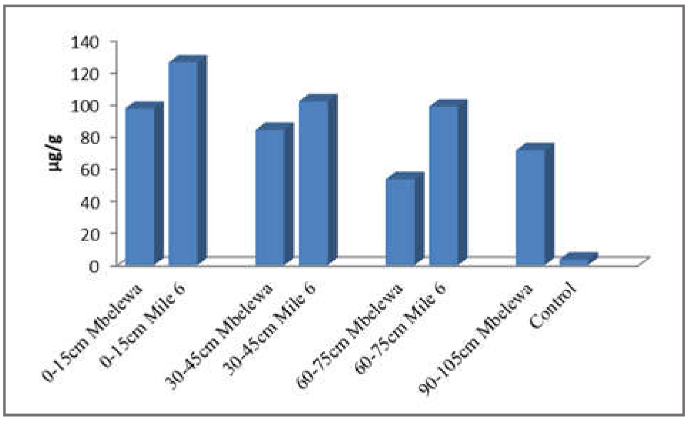


Figure 1.3:- Chromium contamination levels at different depths at the Mbelewa and Mile 6 dumpsites.

Source: Fieldwork, 2020

The results in figure 1.3 show high contamination of Chromium at all depths in the Mbelewa dumpsite. Also, the result shows high contamination of Chromium at all depths in the Mile 6 dumpsite. The highest contamination of chromium is 126.11 µg/g at a depth of 0-15 cm. The result of the control sample is 3.55 µg/g which is lower compared to other depths. Therefore chromium is high in the soils of both dumpsites.

Nickel

Open dumping a method of solid waste in the study area exposes it to environmental pollution around the dumpsite which can indirectly inflict severe damage to human health. The samples collected were analysed for the presence of Nickel and the results presented on Figures 1.4

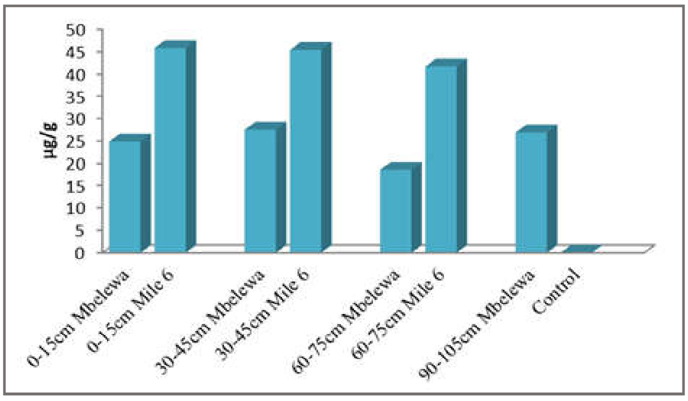


Figure 1.3:- Nickel contamination levels at different depths at the Mile 6 dumpsite

Source: Fieldwork, 2020

The result in Figure 1.4 shows high contamination of Nickelat all depths in the Mbelewa dumpsite. The highest concentration of Nickel was 27.54 μg/g at a depth of 30-45cm. The result of the control sample is 0.05 μg/g; lower than the results of other depths.

Also, there is high contamination of Nickelat all depths in the Mile 6 dumpsite. The highest contamination of Nickel is 45.83 μg/g at a depth of 0-15cm. The result of the control sample is 0.05 μg/g. It implies a high concentration of nickel in the soils of both dumpsites.

Zinc

Soil samples were collected from the Mbelewa dumpsite at depths of 0-15 cm, 30-45cm, 60-75cm and 90-105cm and from the Mile 6 dumpsite at 0-15 cm, 30-45 cm, and 60-75 cm depths. The samples were analysed for the presence of Zinc and the results are indicated in Figures 1.5

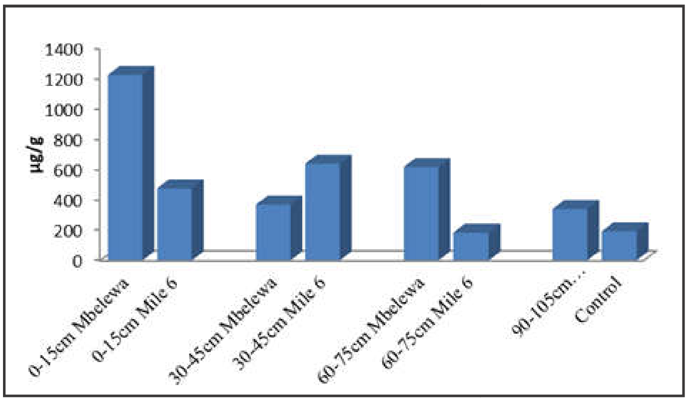


Figure 1.5:- Zinc contamination levels at different depths at the Mbelewa and Mile 6 dumpsites

The results in figure 1.5 show high contamination of zinc at all depths in the Mbelewa dumpsite. The highest contamination of zinc is 1225.95 μg/g at depths of 0-15cm.

Also, there is high contamination of zinc at all depths in the Mile 6 dumpsite. The highest contamination of zinc is 639.22 μg/g at depth of 15-30cm. The result of the control sample is 193.11 μg/g. this indicates high contamination of Zinc at both dumpsites.

Manganese

Soil samples were collected from the Mbelewa dumpsite at depths of 0-15cm, 30-45cm, 60-75cm and 90-105cm. Also, soil samples were collected from the Mile 6 dumpsite at depths of 0-15cm, 30-45cm, and 60-75cm. The samples were analysed for the presence of Manganese and the results indicated in Figures 1.6

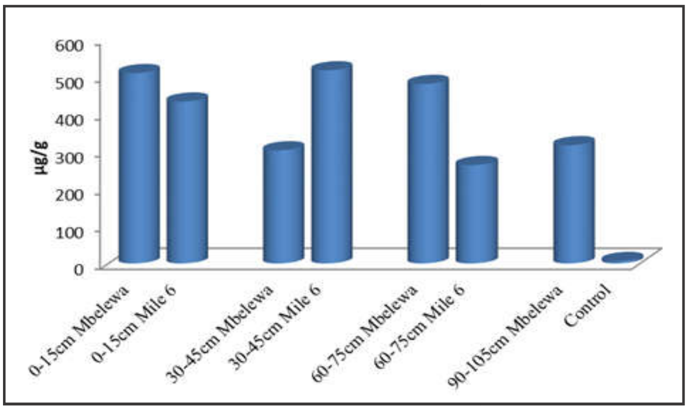


Figure 1.6:- Manganese contamination levels at different depths at the Mbelewa and Mile 6 dumpsite

The results in figure 1.6 show high contamination of manganese at all depths in the Mbelewa dumpsite. The highest contamination of manganese is 507.77 μg/g at depth of 0-15cm, while at debth of 30-45cm, it has low concentration of 301.81 μg/g.

Also, there is high contamination of manganese at all depths in the Mile 6 dumpsite. The highest contamination of manganese is 515.19 μg/g at depth of 30-45cm, while at depth of 60-75cm it has a concentration of 262.29 μg/g. The control sample has a concentration of 6.46 μg/g, which is far less than the results of the analysis of all depths. Therefore both dumpsites are highly contaminated with Manganese.

Cadmium

Soil samples were collected from the Mbelewa dumpsite at depths of 0-15cm, 30-45cm, 60-75cm and 90-105cm. Also, soil samples were collected from the Mile 6 dumpsite at depths of 0-15cm, 30-45cm, and 60-75cm. The samples were analysed for the presence of Cadmium and the results indicated in Figures 1.7

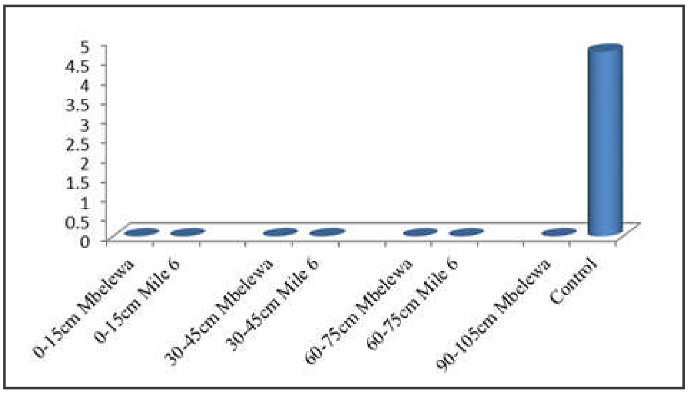


Figure 1.7:- Cadmium contamination at different depths at the Mbelewa and Mile 6 dumpsites

The results in figure 1.7 show low concentration of Cadmium at all depths in the Mbelewa dumpsite . Also, there was low concentration of Cadmium at all depths in the Mile 6 dumpsite compared to the results of the control site for Cadmium which is 4.72 μg/g. Thus both dumpsites have low concentration of Cadmium.

Impact on the Population

Urban dwellers residing adjacent solid waste dumpsites are exposed to environmental problems like flies, mosquitoes, odour, contaminated soil and water. Field findings reveal the levels of pollution and risk exposures as illustrated in Figure 1.8.

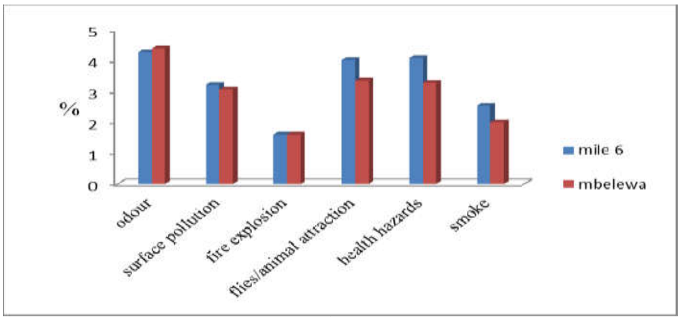


Figure 1.8: Impact of waste dumpsites on the immediate environment

Figure 1.8 shows the negative impacts of dumpsites on the environment with odour, surface pollution, fire/health hazards, attraction of flies, ruminants and smoke highly noticeable. The most dominant in both solid waste dump sites was stench.

Health

The environmental problems associated with poorly sited solid waste dumpsites have negative health impacts on the population. Figure 1.9 illustrates the health impacts experienced by those living near solid waste dumpsites.

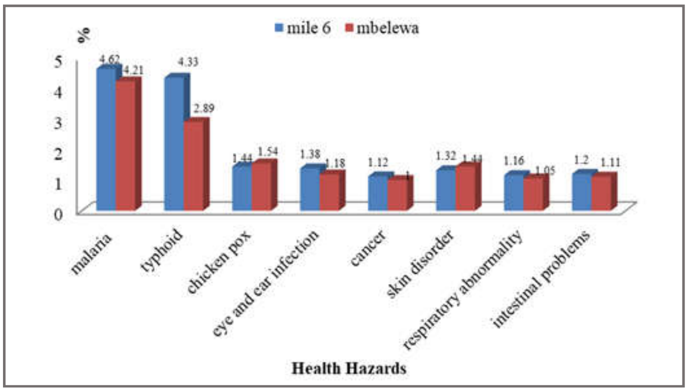


Figure 1.9: Health hazards 500m away from the Mbelewa and Mile 6 dump sites in Bamenda

Source: Health facilities and Fieldwork, 2020

Health problems common to those living at proximity to solid waste dumpsites are malaria, typhoid, chicken pox, eye and ear infection, cancer, skin disorder, respiratory abnormalities and intestinal problems (Figure 1.9). Malaria and typhoid were prominent on both solid waste dumpsites

Discussions

The results of the soil analysis at Mbelewa dumpsite indicate high contamination of the soils by the following heavy metals, Lead, Copper, Chromium, Nickel, Zinc and Manganese Also, the results of the soil analysis at Mile 6 dumpsite shows high contamination of the soil by the following heavy metal, Lead, Copper, Chromium, Nickel, Zinc and Manganese above that of the control site. The results show pollution of soils at all depths in both dumpsites, which can be linked to poor handling of waste and lack of waste treatment. Zinc has an alarming contamination rate of 1225.95 µg/g. This study ties with that of [5].

Also, findings are related to scholarly work of [6] that reveals that the presence of heavy metals (Pb, Cu, Mn, and Cd) in soil sample at open dumpsites indicate that there is appreciable contamination of the soil by leachate migration. [7] opined that open dumping has been reported to have serious long-term damaging effects on environmental factors especially in the soil environment which is as a result of inappropriate landfill sites and poor management techniques.

In this study, the questionnaire analysis reveal odour, flies and health hazards as the most prominent impact on the surrounding population. Health hazards includes the occurrence of malaria, typhoid, chickenpox, skin disorder, in both dumpsites. The most prominent health hazards around both dumpsites are malaria and typhoid. This study ties with the works of [8] who discovered that residents less than 500m from the dumpsite are most affected by the waste dumpsite with victims of malaria, chest pains, diarrhoea, cholera, irritation of the skin, nose and eyes issues.

CONCLUSION

It is evident that there is pollution of soils of dumpsites several years after it has been abandoned. Overtime this can have a negative short- and long-term impact on surface and ground water around the dumpsite. It is therefore imperative for municipal authorities to undertake *á priori* site selection process in selecting a dump site and a regular environmental impact audit to ensure that the impacts on the environment and the population around dumpsites are highly minimised.

RECOMMENDATION

This study was done 1year after the solid waste dumpsite was relocated to Mile 6, projecting the impact till date it may be worse. Therefore the municipality of Bamenda should do a site selection process in the region, carry out an Environmental Impact Assessment on proposed dumpsites as well as an environmental audit to continue monitoring them.

Conflict of interest

There is no conflict of interest

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