OPEN ACCESS

Haya: The Saudi Journal of Life Sciences
Abbreviated Key Title: Haya Saudi J Life Sci
ISSN 2415-623X (Print) | ISSN 2415-6221 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Original Research Article

Health Implications of Lemna Dumpsite in Calabar Municipality, Cross River State, Nigeria

Bassey J. Bassey[1*]

[1]Department of Geography and Environmental Science, University of Calabar-Nigeria

DOI: 10.36348/sjls.2023.v08i09.005 | **Received:** 09.09.2023 | **Accepted:** 12.10.2023 | **Published:** 25.10.2023

***Corresponding author:** Bassey J. Bassey
Department of Geography and Environmental Science, University of Calabar-Nigeria

Abstract

Lemna solid waste dumpsites is found within cities of Calabar and due to poor and ineffective management, the dumpsites turn to sources of serious concern to the people living in the vicinity of the site. Polluted air, leachate release from the site to the ground water, activities of scavengers in the site, bad odour, incubation and proliferation of flies, mosquitoes, and rodents; that, in turn, are disease transmitters with their effect on population's health, has its organic defenses in a formative and creative state. This study therefore sought to evaluate the health implication of Lemna dumpsite in Calabar on the residents living around the site. Data were collected from 309 household heads, through the use of self- administered questionnaires. Households' heads were selected through the use of simple random sampling technique. Data collected were subjected to analysis using principal component factor analysis. Result shows that cardiovascular diseases, birth defects, immune system defects, weakening of lungs functions, lung cancer, kidney problems, liver disease, skin cancer, stomach infections, liver failure, kidney failure and polio have the highest loading in factor one meaning that there are not prevalence in the study area although there are in existence as seen from the communalities loadings. Whereas, typhoid, cholera, dysentery, malaria and stomach ulcer were the prevalence sickness in the environment because they have the highest factor loadings in factor two. On the severity if such sickness in the study area, it was seen that households only visit hospital often due to the following health condition; birth defects, immune system defects, kidney problems, liver disease, skin cancer, stomach infections, cholera, malaria, dysentery, stomach, ulcer, and typhoid because the above mentioned sicknesses have the highest loadings in factor one (often visit hospital). Conversely, cardiovascular disease, weakening of lungs functions, lung cancer, liver failure, kidney failure and polio have highest factor loading in factor two, meaning that although there is occurrence of this sicknesses in the study area, households rarely visit hospital because of such health condition. Therefore, the study recommends recycling of solid waste, waste to energy incineration, anaerobic digestion**,** compositing/organic waste recycling, and advanced technologies as waste management control should be encourage in Calabar instead of the use of dumpsite.

Keywords: Dumpsite, health implication, health condion.

INTRODUCTION

Dumpsites receive roughly 40% of the world's waste and they serve about 3.5–4 billion people worldwide. The 50 dumpsites in the world affect the daily lives of about 64 million people directly and indirectly; i.e about total population of size of France. As urbanization and population growth continues sequentially; it is expected that at least several millions of people will be served by dumpsites, mainly in the developing world. Historically, dumpsites have been the most common method of waste disposal and remain so in many places around the world. In some some develop countries; dumpsites are used for waste management purposes, such as the temporary storage, consolidation and transfer, or processing of waste materials (sorting, treatment, or recycling). Conversely, disposal through open dumping with open burning is the norm in most developing countries till present.

Open dumping practices are still being practiced, as the dominant method, in both low-income and upper middle-income countries. The practice tends to be eliminated in the developed world although; there are still reports of illegal dumpsites. A recent report published by Blacksmith Institute (2012) estimates that hazardous industrial/municipal waste dumpsites rank fifth in the Top-Ten Industrial Pollution sources, while

the first and second are lead battery recycling and lead smelting. There are almost 150 industrial or municipal dumpsites in the Blacksmith Institutes database that are polluting local communities, potentially putting almost 3.5 million people at risk. The largest shares of these dumpsites are in Africa and in Eastern European and Northern Asian countries. Combined, these regions make up more than half of the total at risk population in the Blacksmith investigations of dumpsites. However, industrial and municipal dumpsites are prevalent throughout the developing world including in south and Central America and Southeast Asia.

At properly run municipal solid waste dumpsites, hazardous materials considered carcinogenic, corrosive, toxic, or flammable are not accepted and are directed to special treatment or disposal sites (Hunt, 2011). At informal or improperly run sites, all these items are disposed together, creating a toxic stew of waste exposed to heat, rain and air, causing the materials to break down and easily enter the environment. Industrial waste is one of the most toxic wastes at dumpsites and makes up a large portion of the pollution problem at the dumpsites investigated by Blacksmith institute (2012).

The main sources of pollutants from dumpsites are either leachate (contaminated liquids leaching into the groundwater), dust from poorly covered dumpsites and gases. Leachate can contain heavy metals or hazardous organic compounds. These pollutants are carried into aquifers or surface water. Dust from dumpsite may contain metals and human pathogens that come into contact with this pollution through contaminated groundwater and soil, or direct contact with the waste site. Children often are seen playing in and around dumpsites, introducing direct exposure with hazardous waste through dermal contact, inhalation of dust or accidental ingestion. Informal neighbourhoods are often built on top of previous dumpsites where the soil, groundwater and nearby surface water are contaminated, indirectly exposing the local population to leachates pollutants (Betts K., 2008). A notable issue with dumpsites in the developing world is the presence of scavengers-workers and their families at dumpsites who make their living by recovering economically valuable materials in the waste. In such situations, people come into direct contact with the hazardous waste. In the Blacksmith institute's database of industrial or municipal dumpsites, the most pervasive and harmful pollutants are lead and chromium. Combined they are the key pollutants in a third of the sites, potentially affecting almost 1.2 million people.

Like every other dumpsite around the world, Lemna dumpsite has led to series of problems to the immediate communities. The environmental conditions of the affected area give rise to pest like rodents which may find their way to people homes resulting in food contamination. Lemna dumpsite causes soil pollution through infiltration of polluted water into the soil resulting in poor plant growth.

The unfavorable impacts of dumpsite are associated with some of the pollutants (or hazardous substances) that are found in waste streams or with pollutants that are created at the dumpsite through physical-chemical interactions. In general terms, pollutants can move through air, soil and water. They can also settle on or digested by plants or animals, and can get into the air, the food chain and the water.

According to Health Protection Agency (2011), the different ways a person can come into contact with pollutants are called exposure pathways. There are three basic exposure pathways which are inhalation, ingestion, and skin contact. Inhalation is breathing or inhaling into the lungs. Ingestion is taking something in by mouth. Skin contact occurs when something comes in direct contact with the skin. Ingestion can be a secondary exposure pathway after skin contact has occurred.

Organic waste at lemna dumpsite is biodegraded and thus they create conditions favourable for the survival and growth of microbial pathogens. These conditions can be further enhanced if the waste is disposed off with pathogens form human body fluids such as faeces, blood, and so on. Organic waste also provides a food source for carriers of enteric pathogens such as rodents, insects and birds. Increase in the risk of severe health implications such as birth defects and particular cancers have been attributed to chemical substances in individuals living next to the dumpsite area (Kostova, 2006). Other discomfort and self-reported symptoms for people living next to the landfill include sleepiness, headaches and fatigue. The effects are linked with the toxic actions of the chemicals present in the dumpsite. From contamination of the air with harmful gases to water pollution, the outcome is adverse human health effects.

As liquid seeps through the dumpsite landfill and collects decomposed waste components, chemical reactions take place and produce a toxic leachate. Organic materials such as food scraps and yard waste are usually compacted when they are put into a landfill. The problem is that this removes oxygen and causes the material to break down aerobically. Overtime, the process will produce methane: a type of greenhouse gas that is 20 times more potent than carbon dioxide and wreaks havoc on our environment. Methane is also flammable and can be very dangerous in large concentrations. Individuals living near dumpsites are bears the highest burden of an environmental catastrophe in this regard. The most affected are persons who scavenge at the site. These men, women and children, brave the dangers of the dumpsite to escape the ravages of extreme poverty. Scavenging involves sorting and recovery of food and recyclable or reusable materials for sale. Recovery is done manually through laborious

processes involving poorly equipped and protected individuals working in small great expense to their health.

Lemna dumpsite in Calabar metropolis is an open uncontrolled and unplanned (Bassey, Brook, Asikong & Andy 2015) area. This does not only consume much space but maybe a breeding ground to rodents, insects etc. Leachates may contaminate underground water as they seep down thus posing environmental and public health problem. In Lemna dumpsite, wastes are not sorted out (Separated) into biodegradable and non-biodegradable wastes as is the practices in developed countries and in that case bottles and tins are separated at the point of collection in order to facilitate proper handling by authorities. While some of the separated wastes could be recycled. In Calabar, industrial waste which normally contains toxic chemicals including sometimes electronic wastes are dumped together with domestic, market and commercial wastes.

Wastes from the metropolis are conveyed in trucks and trippers to the dumpsite and a great deal of the vehicles are not covered with tarpaulin. This has not helped in significantly reducing aerial spread of particulate substances and odour. At the dumpsite the aerial population appears to be high as wastes are being discharged from trucks/trippers at distance within a few metres from the site. It is also observed that air environment around the waste dumpsite is usually contaminated by particulate substances including dust, sulphur dioxide, carbon monoxide, oxides of nitrogen, hydrocarbons and radioactive substances and so on. The dumpsite has no control of rodents, flies and other pollutants. This poses environmental and public health consequences such as underground water and soil contamination by toxic metals, aesthetic, nuisance, air pollution, surface water contamination, noxious odours and often times a suitable breeding ground for mosquitoes, flies, rodents, sneaks and pathogenic micro organ.

Puri, (2008), observed that management of dumpsite is an important parameter. Adding that waste management practices should be assessed in order to discover dumpsite link with incidence of vector-born disease. To that effect, strategies for waste management should be employed as a practical model to resolve the problems regarding pollution and hazardous health problems. This is eminent because, there are so many biochemical's and physical reactions occurring in dumpsites when solid waste is disposed in them. These causes leachate and gaseous emissions that contaminate surface and ground water resource (Kangsepp and Mathiassion 2009).

Studies conducted on dumpsite other than that of lemna have linked dumpsite with vector-born disease, risks of inborn irregularities, spread of infectious diseases, causing different types of cancer, birth defect and/or other form of unusual illness (Elliott 2001, Alam & Ahmade 2013, Hammer, 1996, and Vriheid, 2000). Other scholars maintained that waste disposal in dumpsite has increasingly caused concern about possible adverse health effects for populations living nearby, particularly in relation to those sites where hazardous waste products are dumped and this has led to pollution including, air pollution, water pollution, land pollution with its accompanied health effect such as: cardiovascular diseases. Landrigan, (2015), birth defects and Immune system defects. Marsili, (2009), weakening of lung function. Russi, (2008), lung cancer. Pukkala, (2001), Premature Deaths. Pasetto, (2013) and Fantini, (2012). kidney and liver disease Martuzzi, (2009), skin and stomach infections. Fazzo, (2014), cholera and dysentery Serggeev, (2005), malaria. Gensyurg, (2009), stomach ulcer. Shannon, (2017), liver failure. Martin, (2017), kidney failure. Solan, (2017), Polio. Garcia (2013) and typhoid Mattiello, (2013).

There is lack of systematic long-term epidemiological studies that fully document the health impacts from Lemna dumpsites. However, existing scientific evidence demonstrates a catastrophic health risks in other dumpsites. The health problems associated with dumpsites are related to their emissions, which usually involve P.O.Ps (persistent organic pollutants), heavy metals and V.O.Cs (volatile organic compounds). According to Porta (2009), the actual health risks depends on the practices followed and on the type of waste disposed off in each dumpsite, as well as on the environmental and social conditions of the area.

Aim and Objectives of Study

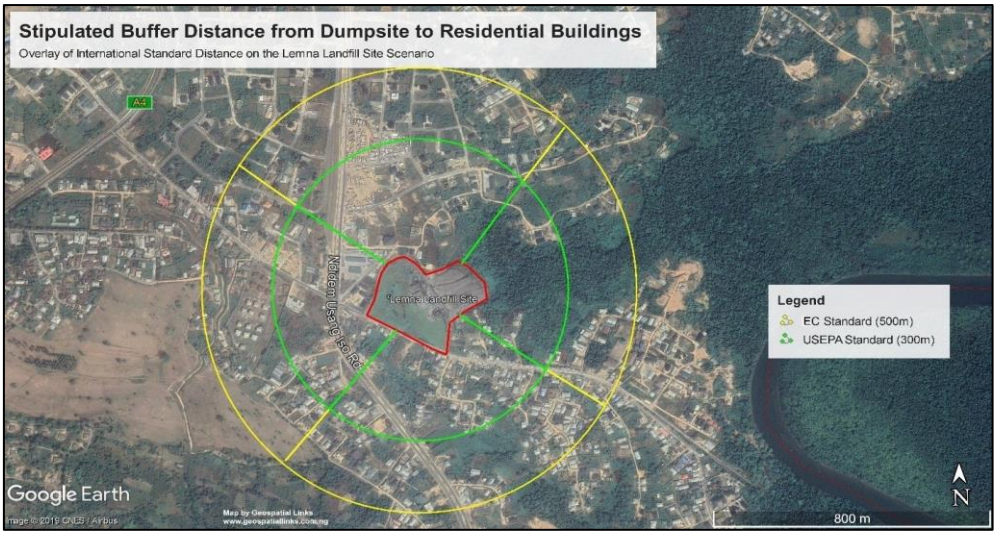
The aim of the study is to investigate the health implication of the Lemna Dumpsite in Calabar Municipality to the immediate communities. The specific objectives of the studies are to:

i. Indentify health challenges or prevalent diseases in the dumpsite area
ii. Ascertain the severity of such health challenges to the community

MATERIALS AND METHODS

Area of Study

Calabar Municipality is a Local Government Area of Cross River State. Nigeria. Its headquarters are in the city of Calabar. It has an area of 142km^2. Calabar Municipality local government area falls under the southern senatorial district of Cross River State otherwise known as Cross River South Senatorial District alongside Calabar South, Akamkpa, Akpabuyo, Bakassi and Odukpani local government areas. Calabar Municipal local government area also forms federal constituency alongside Odukpani local government area.



Population of the Study

The entire communities around the Lemna dumpsite form the population of this study.

Design

The research designs employed in carrying out this study was the descriptive and exploratory research designs. The choice of this design is based on the fact that it enables the use of complete and accurate information and makes provision for protection against bias. The choice of the research design is on it flexibility advantage which permits consideration of many different aspect of the research topic. It allows the researcher make contact with people who have had practical experiences with the problem under investigation.

Sources of Data

The main source of data upon which the whole reliance is made, was the primary data collected in the field. Questionnaire was the main instrument for data collection. The instrument was design y the researcher and validated by expert while the reliability was ascertain through the use of Cronbach alpha reliability estimate. The reliability of the instrument stand at .89 which was high enough for the researcher to conclude that the instrument is was reliable for data collection.

Sample Size and Method of Sampling

350 samples were randomly selected for the study using simple random sampling technique. 350 questionnaires were produced and administered to the head of each selected household. However, the researcher was able to get only 328 back at the expiration of two week. Out of 328 received, 19 were not properly filled of which the researcher discarded them while using the remaining 309 for data analysis

Data Analysis

Data collected was subjected to statistical test Principal component analysis with varimax rotation methods to ascertain the health implication of the dumpsite to the households in the community. Statistical analysis was done using SPSS software for windows (SPSS 25.00)

Presentation of Results

Prevalence health condition in the Dumpsite

To identify the prevalence health condition in the dumpsite, data collected were subjected to analysis using factor analysis. Table 1 present to summary of the results

Table 1: Prevalent health challenges the dumpsite area Rotated Factor Loadings and Communalities

Variables	Factors		Communalities
	1 To a small extent	2 To a large extent	
Cardiovascular diseases	.723	.652	.948
Birth defects	.834	.494	.939
Immune system defects	.798	.543	.932
Weakening of lungs functions	.752	.608	.935
Lung cancer	.741	.613	.926
Kidney problems	.890	.378	.936
Liver Disease	.872	.446	.959
Skin Cancer	.880	.437	.966
Stomach Infections	.811	.532	.942
Cholera	.605	.766	.952
Dysentery	.494	.832	.937

Variables	Factors		Communalities
	1 To a small extent	2 To a large extent	
Malaria	.308	.896	.898
Stomach Ulcer	.560	.787	.934
Liver failure	.866	.428	.934
Kidney failure	.879	.417	.946
Polio	.865	.399	.907
Typhoid	.413	.874	.934
Sum of squares (Eigen values)	9.415	6.508	15.91
Percent of trace[1]	55.35	38.23	93.58
Percent of variance	55.385	38.28	93.66

Extraction Method: Principal component analysis
Rotation method: Varimax with Kaiser normalisation

In these results, a Varimax rotation was performed on the data using the rotated factor loadings. Table 1 show that the sum of square for factor one and two are 9.41 and 6.5 respectively while the total sum of square is 15.91. The percentage of trace for factor one and two are 55.35 and 38.23 while the total percentage of trace extracted for the factor solution is 93.58. The index of the trace shows that 93.58 percent of the total variance is represented by the information contains in the factor matrix, therefore the index for the solution is high and the variables are highly related to each other. Additionally, the least communality is .89 while the highest is .94, this indicate that large amount of variance in all the variables have been extracted by the factor solution. From the factor matrix, it can be observed that, Cardiovascular diseases .723, Birth defects .834, Immune system defects .798, Weakening of lungs functions .752, Lung cancer .741, Kidney problems .890, Liver Disease .872, Skin Cancer .880, Stomach Infections .811, Liver failure .866, Kidney failure .879, Polio .865 have large positive loadings on factor one, so this factor describes the fact that many household in the environment are affected by the aforementioned diseases to a small extent. Conversely, Cholera .766, Dysentery .832, Malaria .896, Stomach Ulcer .787, Typhoid .874 have large positive loadings on factor two, so this factor describes the fact that many household in the environment are affected by the aforementioned diseases to a large extent. Together, all four factors explain 93.66% of the variation in the data.

Frequency of Visiting Hospital Due to Health Challenge

To identify the severity of health condition leading them to be hospitalised, data were collected to ascertain their frequency of visiting hospital, data collected were subjected to analysis using factor analysis. The result of the analysis is presented in table

Table 2: Frequency of visiting hospital due to health challenge Rotated Factor Loadings and Communalities

Variables	Factors		Communalities
	1 Often visit hospital	2 Rarely visit hospital	
Cardiovascular diseases	.282	.888	.868
Birth defects	.815	.534	.950
Immune system defects	.707	.667	.944
Weakening of lungs functions	.381	.875	.910
Lung cancer	.461	.835	.910
Kidney problems	.760	.606	.945
Liver Disease	.847	.494	.962
Skin Cancer	.847	.489	.956
Stomach Infections	.896	.360	.931
Cholera	.893	.377	.940
Dysentery	.853	.463	.942
Malaria	.867	.238	.809
Stomach Ulcer	.837	.502	.954
Liver failure	.619	.742	.934
Kidney failure	.477	.838	.929
Polio	.313	.865	.847
Typhoid	.898	.338	.921
Sum of squares (Eigen values)	8.912	6.742	15.654
Percent of trace[1]	52.423	39.658	92.081
Percent of variance	52.426	39.656	92.082

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalizatiob

The sum of square for factor one and two are 8.912 and 6.742 respectively while the total sum of square is 15.654. The percentage of trace for factor one and two are 52.423 and 39.658 while the total percentage of trace extracted for the factor solution is 92.081. The index of the trace shows that 92.081 percent of the total variance is represented by the information contains in the factor matrix, therefore the index for the solution is high and the variables are highly related to each other. Additionally, the least communality is .809 while the highest is .962, this indicate that large amount of variance in all the variables have been extracted by the factor solution. From the factor matrix, it can be observed that, Birth defects.815, Immune system defects .707, Kidney problems .760, Liver Disease. 847, Skin Cancer.847, Stomach Infections .896, Cholera .893, Dysentery .853, Malaria .867, Stomach Ulcer .837 and Typhoid .898 have large positive loadings on factor one, (Often visit hospital) so this factor describes the fact that many household in the environment visited hospital always because of the aforementioned disease. Conversely, Cardiovascular diseases .888, Weakening of lungs functions .875, Lung cancer .835 and Polio .865 have large positive loadings on factor two (Rarely visit hospital), so this factor describes the fact that many household in the environment rarely visit hospital because of the aforementioned disease. Together, all four factors explain 92.08% of the variation in the data.

DISCUSSION OF RESULT

Prevalence Health Condition in the Dumpsite Area

Factor analysis result shows that there are present of cardiovascular diseases, birth defects, immune system defects, weakening of lungs functions, lung cancer, kidney problems, liver disease, skin cancer, stomach infections, liver failure, kidney failure and polio in the area as shown in the communality loading, however, this sickness were not prevalence because they all have higher loafing in factor one which represent small extent of occurrence of such diseases in the household within the study area. Furthermore, typhoid, cholera, dysentery, malaria and stomach ulcer were the prevalence sickness in the environment. The conclusion was reach as the result of the factor loading. typhoid, cholera, dysentery, malaria and stomach ulcer have higher loading in factor two which represent that the sickness are prevalence in the study area to a large extent. The finding of this study was not surprising, because other similar studies have the similar findings, although the prevalence health conditions were not identified in the previous research studies. For instance, David and Oluyege, (2014), noted that waste streams disposed of at lemna dumpsite are one of the most important factors that determine its health risks. In addition, another researcher found out that there is a relationship between distance to lemna site and disease occurrences and distance to lemna waste dumpsite and death rate. In addition, (Rose Kivi & Matthew Solan, (2017), Secondly, the findings of the study shows that despite the prevalence of aforementioned diseases in the households found in the study area, some family refuse to visit hospital often. It was seen that households only visit hospital often due to the following health condition; birth defects, immune system defects, kidney problems, liver disease, skin cancer, stomach infections, cholera, malaria, dysentery, stomach, ulcer, and typhoid. This conclusion was reach because the above mentioned sicknesses have the highest loadings in factor one (often visit hospital). Conversely, cardiovascular disease, weakening of lungs functions, lung cancer, liver failure, kidney failure and polio have highest factor loading in factor two, meaning that although there is occurrence of this sicknesses in the study area, there are not prevalence and at such households rarely visit hospital because of such health condition. The findings of this study however supported the work of Abul, (2010) who found out that residents are affected by the location of the dumpsite closer to their settlements; and that residents whose houses are less than 200 meters from the dumpsite are victims of malaria, chest pains, cholera, and diarrhea. However, residents whose houses are more than 200 meters are also affected with the chest pain and bad smell from the dumpsite, but mainly when wind is blowing in their direction. Also Babs-Shomoye, & Kabir, (2016). Found out that the location of the dumpsite had an impact on the quality of environment, and that the dumpsite's location affected their health, in terms of the odour emanating from the dumpsite. Moreover, the severity of health impact due to the dumpsite decreased as people moved away from the dumpsite.

CONCLUSION

Research has publicised that solid waste disposed in dumpsite is habitually subjected to chain of multifarious biochemical and physical processes, leading to pollution and the production of both leachate and gaseous emissions. Pollution both air, water and soil are associated with many diseases as seen prevalence in the study area. Assessment of the health implication of the lemna solid waste dumpsite to the community carried out in this study revealed that solid waste dumps have significant health implication to the people living around the site. As a result of this, most of them visited hospital frequently because of some prevalence health condition. Due to leachate in the study area, it can be concluded that continuous use of borehole water in the environment for drinking or other domestic purposes without any form of physical or chemical treatment could pose serious toxicological risk. This study therefore recommended the recycling of solid waste, waste to energy incineration, anaerobic digestion**,** compositing/organic waste recycling, and advanced technologies as waste management control instead of the use of dumpsite

REFERENCES

- Abul, S. (2010). Environmental and health impact of solid waste disposal at Mangwaneni dumpsite in Manzini: Swaziland. *Journal of Sustainable development in Africa*, *12*(7), 64-78.

- Afolayan, T. H. (2012). Sitting MSW Landfills in Lesvos Island with a GIS-Based methodology, *waste Management and Research*. *21* (3), 262-277.
- Aibor, M. S., & Olorunda, J. O. (2006). Environmental Health in the 21st Century. *A Technical Handbook of Environmental Health in the 21st Century for Professional Students. Akure: His Mercy Publisher*.
- Allen, S. V., & Taylor, W. O. (2016). *Some Aspects of Solid Waste Management in Klang Valley.* In Thanh, N. C., (eds). Paper presented at the Waste Disposal and Resources Recovery. 509-520. Bangkok, Asian Institute of Technology.
- Babs-Shomoye, F., & Kabir, R. (2016). Health effects of solid waste disposal at a dumpsite on the surrounding human settlements. *Journal of Public Health in Developing Countries*, *2*(3), 268-275.
- Betts, K. (2008). Environmental Impacts of Solid Waste Land filling, *Journal of Environmental Management*.
- David, H. U., & Oluyege, A. D. (2014). *The generation, disposal and impact of solid house waste in Nassarawa LGA Kano State*. (BSc. Unpublished), Bayero University Kano.
- El-Fadel, M., Findikakis, A. N., & Leckie, J. O. (1997). Environmental impacts of solid waste landfilling. *Journal of environmental management*, *50*(1), 1-25.
- Health Protection Agency, (2010). *New Zealand Landfills. Where to Now?* Paper presented at the 8th Annual Conference Proceedings Waste Management Institute, New Zealand.
- Hunt, S. S., & Lo, C. W. H. (2011). Evaluating Sustainability in Waste Management: A Case of Construction and Demolition, Chemical and *Hong Kong Resources conservation and Recycling, 37*, 119-145.
- Jung, C. H., Matsuto, T., & Tanaka, N. (2005). Behavior of metals in ash melting and gasification-melting of municipal solid waste (MSW). *Waste Management*, *25*(3), 301-310.
- Jung, C. H., Matsuto, T., & Tanaka, N. (2005). Behavior of metals in ash melting and gasification-melting of municipal solid waste (MSW). *Waste Management*, *25*(3), 301-310.
- Kontos, T. D., Komilis, D. P., & Halvadakis, C. P. (2003). Siting MSW landfills on Lesvos island with a GIS-based methodology. *Waste management & research*, *21*(3), 262-277.
- Kostova, A. (2006). *The Role of GIS in the Privatization of Malaysia Solid Waste Management*, Paper presented at the 6th Ersi South Asia Users Conference, Penang, Malaysia.
- Leitner, K. (2017). *Health and Environment, a view from the perspective of World Health Organisation. Environment Matters, Lema.*
- Leton, T. G., & Nweke, V. N. (2003). Health risk of domestic solid waste scavenging. *Journal of Environmental and Behavior*, *1*, 35-38.
- Leton, T., & Nweke, V. (2010). Health Risk of Domestic Solid Waste Scavenging. *Journal of Environmental and Behaviour*, *1*, 35-38.
- Martuzzi, J. T. (2010). *Environmental Pollution and Domestic Waste Management in Kano.* Paper presented at the GAF/FEPA Workshop.
- Mato, R. R. A. M. (1999). Environmental implications involving the establishment of sanitary landfills in five municipalities in Tanzania: the case of Tanga municipality. *Resources, conservation and recycling*, *25*(1), 1-16.
- Mato, R. R. A. M. (1999). Environmental implications involving the establishment of sanitary landfills in five municipalities in Tanzania: the case of Tanga municipality. *Resources, conservation and recycling*, *25*(1), 1-16.
- Noah, F., Zongzhi, L., Mari, R., Rob, K., Matthew, H., & Mark, T. H. (2008). *Short-term temporal variability in air-borne bacterial and fungal populations.* Applied and environmental Microbiology, 74, (1), 200-207.
- Noah, F., Zongzhi, L., Mari, R., Rob, K., Matthew, H., & Mark, T. H. (2008). *Short-term temporal variability in air-borne bacterial and fungal populations.* Applied and environmental Microbiology, 74, (1), 200-207.
- Nwankwo, A. P. (2011). Stakeholders' Perception of Physical Environmental Hazards and Risks of Waste Dumpsites in Lagos. *Dept. Of Urban* and *regional planning Obafemi Awolowo University, lle-life, Osun*.
- Nwankwo, A. P. (2011). Stakeholders' Perception of Physical Environmental Hazards and Risks of Waste Dumpsites in Lagos. *Dept. Of Urban and regional planning Obafemi Awolowo University, lle-life, Osun*.
- Obire, O., & Aguda, M. (2002). Bacterial community of leachate from a waste-dump and an adjacent stream. *Journal of applied sciences and environmental management*, *6*(2), 71-75.
- Obire, O., & Aguda, M. (2002). Bacterial community of leachate from a waste-dump and an adjacent stream. *Journal of applied sciences and environmental management*, *6*(2), 71-75.
- Odeyemi, A. T., Faweya, E. B., Agunbiade, O. R., & Ayeni, S. K. (2011). Bacteriological, mineral and radioactive contents of leachate samples from dumpsite of Ekiti State Government Destitute Centre in Ado-Ekiti. *Archives of Applied Science Research*, *3*(4), 92-108.
- Odeyemi, A. T., Faweya, E. B., Agunbiade, O. R., & Ayeni, S. K. (2011). Bacteriological, mineral and radioactive contents of leachate samples from dumpsite of Ekiti State Government Destitute Centre in Ado-Ekiti. *Archives of Applied Science Research*, *3*(4), 92-108.
- Olanrewaju, A. O. (2002). Dangers of indiscriminate refuse dumps in metropolis countries. *Environment opinions*, *35*, 567-571.

- Olanrewaju, A. O. (2002). Dangers of indiscriminate refuse dumps in metropolis countries. *Environment opinions*, *35*, 567-571.
- Onyido, A. E., Okolo, P. O., Obiukwu, M. O., & Amadi, E. S. (2009). A survey of vectors of public health diseases in un-disposed refuse dumps in Awka town, Anambra State, Southeasthern Nigeria. *Research Journal of Parasitology*, *4*(1), 22-27.
- Onyido, A. E., Okolo, P. O., Obiukwu, M. O., & Amadi, E. S. (2009). A survey of vectors of public health diseases in un-disposed refuse dumps in Awka town, Anambra State, Southeasthern Nigeria. *Research Journal of Parasitology*, *4*(1), 22-27.
- Porta, A. (2009). *The potential for Climate Change Mitigation in the Nigerian Solid Waste Disposal Sector: A Case Study from Lagos.* (MSc), Lund University, Sweden.
- Siboe, (2006). Antibiogram Status of Bacterial Isolates from Air around Dumpsite. *Ekiti State Destitute Centre at llokun*, Add-Ekiti, Nigeria.
- Siboe, N. T. (2006). Antibiogram Status of Bacterial Isolates from Air around Dumpsite. *Ekiti State Destitute Centre at llokun*, Add-Ekiti, Nigeria.
- Tchobanoglous, O. L. (2012). *Landfill Site and Improvement in Design for Sanitary Landfill in Malaysia.* In Tong S.L (ed). Paper presented at the Hazardous Waste Regulation and Management, 175-199, Kuala Lumpur.
- Vineis, O. C., & Wixun, J. I. (AIT). (2009). *Municipal Solid Waste Management in Asia*. Thailand: Asian Regional Research Program on Environmental Technology (ARRPET), AIT.