

Sustainability and Environmental Studies

By

Abdullahi I.

Mohammed Habibu Abdulai

Melyne Amolloh Achieng'

Copyright © 2023 by CARI

All rights reserved.

This book or any portion thereof may not be reproduced or used in any manner whatsoever without the express written permission of the publisher and author except for the use of brief quotations in a book review.

Printed in USA

First edition published in 2023

CARI Journals and Books Publishers

journals@carijournals.org

<https://carijournals.org>

Journal of Environment

Vol 2 No 2 (2022), Vol 1 No 2 (2021) & Vol 1 No 1 (2021)

ISBN:

Table of Contents

Assessment of the Effectiveness of Healthcare Waste Management Practices in Major Town of Niger State, Nigeria.....	PG 4
Solid Waste Disposal in East Mamprusi Municipality: Assessment of Reasons for Disposal Methods.....	PG 17
The Potential Contribution of Public Primary Schools in Attaining Ten Percent Tree Cover in Kenya.....	PG 38

Assessment of the Effectiveness of Healthcare Waste Management Practices in Major Town of Niger State, Nigeria

¹*Abdullahi, I., ²Busari, A.O. and ³J. A. Tanko

¹Department of Civil Engineering, Faculty of Engineering, University of Abuja, Nigeria

²Department of Civil Engineering, Federal University of Technology, Minna, Nigeria

³Department of Civil Engineering, Federal University of Technology, Yola, Nigeria

*Corresponding Author's Email: babatumohd@gmail.com

Abstract

Purpose: The study was to examine the healthcare waste management practices in Niger State, Nigeria, with a view of promoting the quality of environment. The study has the following objectives: Determine the factors which influenced healthcare waste management practices in Niger State, assess the problems hindering the provision of adequate healthcare waste management practices, examine the physical planning implications on their sustainability, and examine the existing waste-management practices vis-a-vis of GHG emissions mitigation mechanism.

Methodology: A questionnaires survey was carried out on the one hundred and fifty (150) respondents who were workers in the health facilities selected for the study for proper assessment of healthcare waste management of the hospitals. There was an interview of the various heads of departments of the hospitals' administration to obtain accurate information on the management of the healthcare waste.

Findings: The study found that the health facilities do not have records of the volume of waste which they generate. The medical wastes generated range from 0.116 to 0.561 kg/bed/day, but there is no standard gauge for measuring waste collected in Niger state. Thus, the average generation rate is approximately 0.181 kg/bed/day. What the study classified as general waste was found to be common among the health facilities in the study area. About 66.4% of the respondents ascertained this type of waste which constituted of paper, food and plastic.

Unique Contribution to Theory, Practice and Policy: Policies and monitoring mechanisms should be generated and coordinated at the federal and State levels and including Local Governments Areas (LGA) and Health facilities levels.

Keywords: *Healthcare Waste Management Practices, Environmental Hazard, Physical Planning, Sustainability.*

INTRODUCTION

Global waste crises, among other environmental issues, confronting mankind in both developed and developing countries threatens both the assimilative and carrying capacity of the earth which supports life system. This modern world functions as a throw – way society and the price for that is a growing problem on how to handle the waste that is generated as precious spaces for its disposal is decreasing. It continues to be a major challenge, particularly, in most healthcare facilities of the developing countries where it is hampered by technological, economic, social difficulties and inadequate training of staff responsible for handling of the waste.

Poor conduct and inappropriate management and disposal methods exercised during handling and disposal of medical waste (MW) is increasing significant health hazards and environmental pollution/hazards due to the infectious nature and unpleasant smell of the waste.

Health-care activities generate significant amounts of hazardous waste such as mercury and expired pharmaceuticals, as well as large amounts of general waste. As a matter of fact, the management of health-care waste is an integral part of a national health-care system. A holistic approach to health-care waste management should include a clear delineation of responsibilities, occupational health and safety programs, waste minimization and segregation, development, adoption of safe and environmentally sound technologies, and capacity building.

Recognizing the urgency of this problem, a growing number of countries have taken initial steps to respond to this need. These include the establishment of regulatory frameworks, development of national plans and the demonstration of innovative approaches. However, funding of healthcare waste management remains very inadequate.



Figure 1: Medical Waste Dump at General Hospital Minna Waste Dump Site for Specialist Hospital Gwagwalada

The population of Niger State is on the increase and the amount of hospital waste generated is snowballing at alarming rates due to growth of population and healthcare facilities. However, there are some problems encountered with the management of MW and they are- improper storage, frequent dumping of infectious waste with municipal waste, no uniform definition and identification of hazardous waste and low level of awareness about the management of medical waste.

In order to maintain a clean Municipal environment, HCW must be effectively managed through appropriate reduction, reuse and/or recycled practices [8] Waste management generally involves the collection, transfer, treatment, recycling, resources recovery and disposal of waste in any location. The goals of waste management are therefore, to promote a quality environment, generate employment, and thus, support the efficiency and productivity of the economy. [10] Observed that, the quantity of waste generated in urban areas in industrialized countries is higher than in developing countries, still municipal solid waste management remains inadequate in the latter.

Also, waste in developing countries differs from developed countries. Most developing countries, example Nigeria, would therefore have waste management problems different from those found in developed countries in areas of composition, density, political and economic framework, and waste amount, access to waste for collection, awareness and attitude. [11] Also reported that, waste in developing countries is generally heavier, wetter and more corrosive.

Aims and Objectives of Study

The Aims of this study are therefore, to promote a quality environment, generate employment, and thus, support the efficiency and productivity of the economy. In order to achieve these goals, the following objectives set out for the study are to: -

- i Determine the factors that influence healthcare waste management practices in Niger State.
- ii Assess the problems hindering the provision of adequate healthcare waste management practices,
- iii Examine the existing waste-management practices and to provide effective disposal and mitigation of GHG emissions.
- iv Examine the physical planning implications on their sustainability

Statement of the Problem

Healthcare waste management involves the collection, transportation, storage, treatment and care of disposal sites. It is very alarming today, considering the nature and composition of waste generated, only little attention is given to proper treatment and care of the wastes. The volume of waste being generated continues to increase at a faster rate than the ability of the agencies to improve on the financial and technical resources needed to parallel this growth. Waste management in Nigeria is generally characterized by inefficient collection

methods, insufficient coverage of the collection system and improper disposal of waste materials [9]

Municipal solid wastes that do not contain valuables' and often re – usable materials (such as glass, paper, plastics and food remains) but also contain increasing amount of hazardous substances [12] Typical of the latter is mercury from batteries, cadmium from fluorescent tubes, pesticides and bleaches as well as wide range of toxic chemicals such as solvents, paints, disinfectants and wood preservations, chemicals.

The Study Area

Niger State lies between the latitude of 3°20' east and longitude 8 and 11.3' north. It is bordered to the North by Sokoto State, West by Kebbi State, South by Kogi and South-West by Kwara State. Kaduna and Federal Capital Territory border the State to both North-East and South-East respectively. The State has a common boundary with the Republic of Benin along New Bussa, Agwara and Wushishi Local Government Area. This has given rise to common inter border trade between the two countries. As at 26th August 1991 (before the merger of Borgu and Agwara LGAs), the State covered a land area of 74,244 square Kilometers, which is about 8% of the total land area of Nigeria.



Figure 2: Area of Study

Justification

The need to generate baseline data from this study in order to enhance proper healthcare waste management practice and environmental evaluation constitute one of the justifications for this study. Also, the need to contribute

to existing knowledge on medical healthcare waste management practices in other parts of the world also justifies the present study. Moreover, the dearth of data on medical waste management practice in the study area makes this research imperative. Finally, the outcome of the study could be beneficial to people thereby enhancing their economic status.

METHODOLOGY

This evaluation of the status of Health care waste management (HCWM) includes interview, observations, Sampling and Data collection of all available information on issues associated with waste management in Niger State.

Five Hundred (500) questionnaires survey was carried out of which only One Hundred and Fifty (150) respondents who were workers in the health facilities selected for the study responded for proper assessment on healthcare waste management of the hospitals, there was an interview of the various heads of Departments of the hospitals administration to obtain accurate information on the management of the healthcare waste.

FINDINGS

The respondents in the various facilities had adequate knowledge of waste categorization. About 76.67 % of the respondents rightly categorized paper, food, plastics and bottles as general waste. Soiled cotton wool, swab and Surgical gloves and cultures were also classified by 76.67 % of the respondents as infectious wastes. The majority of respondents also got it right by classifying Chemical (Medical and industrial) old drugs and sharps (Needles, scalpels, lancets etc.) as hazardous wastes. There was a significant association ($p < 0.05$) between the profession of the respondents and categorization of General wastes. However, there were no significant differences ($p > 0.05$) between socio-demographic variables and categorization of Hazardous waste.

The respondents in the various facilities had adequate knowledge of waste categorization as 83.33% perceived all of the above in table 28 above. 62 % indicated that segregation should be done at the source, as against 24.67 % who indicated otherwise. There was satisfactory knowledge of colour coding of wastes which is an essential factor for proper segregation of waste.

- i The study found that the health facilities do not have records of the volume of waste which they generate. The medical wastes generated range from 0.116 to 0.561 kg/bed/day, but there is no standard gauge for measuring waste collected in Niger state. Thus, the average generation rate is approximately 0.181 kg/bed/day.

- ii What the study classified as general waste was found to be common among the health facilities in the study area. About 66.4% of the respondents ascertained this type of waste which constituted of paper, food and plastic
- iii It was found from the study that it is always important to segregate medical waste in the hospital and other medical institution facilities. About 57.27% of the respondent agreed that medical waste should be segregated.
- iv It was observed that waste management in hospitals and other health care facilities had safety boxes and containers where all sharp objects and used syringes were deposited. About 66.4% of the respondents ascertain Needles, Scalpels, and Syringes as sharp waste in the study area.
- v It was found from the study to be common among the health facilities that people should be sensitized about the importance of recycling of sensitive hospital wastes. About 58(52.73%) of the respondent agreed to possible solutions to prevent land pollution by sensitizing people about Recycling of sensitive hospital wastes.
- vi It was also observed that people were aware of Government campaign about waste management practices in the study areas. About 65(59.09%) of the respondents Agreed that Government is campaigning about waste management practices in the study areas.
 - vii. It was found that facilities for the movement waste from health facilities to the dump site are available as the respondents in the study area all agreed to it. About 60(54.55%) of the respondents agreed that there are facilities available for the movement of waste from health facilities to the dump site.

CONCLUSION AND RECOMMENDATIONS

Conclusion

After evaluating the various researches relating to assessment of effective healthcare waste management practices by various authors, the following conclusions were drawn:

- i These problems have been compounded by many factors including in
 - appropriate planning for waste management particularly waste collection, waste storage, waste disposal, population growth and rapid technological development

- ii There is Poor conduct and inappropriate management and disposal methods exercised during handling and disposal of medical waste.
- iii Policies and regulations as stipulated by World Health Organization (W H O) are not strictly adhere to. These major components of inputs to healthcare waste management guide must be fully available and properly implemented for achievement of sustainability.
- iv Existing policies on healthcare waste management must be seen to be implemented fully and adoption of effective health practices that will ensure that those principles are observed.
- v Despite the fact that current medical waste management (MWM) practices vary from hospital to hospital, the problematic areas are similar for all healthcare units and at all stages of management.

Emerging Issues and Controversies

Inadequate Infrastructure and Resources: One potential issue could be the lack of proper infrastructure, equipment, and resources for effective healthcare waste management. This includes insufficient waste disposal facilities, waste segregation systems, and protective gear for healthcare workers. This can lead to improper handling and disposal of medical waste, risking environmental contamination and public health concerns.

Environmental Impact: Healthcare waste, if not managed properly, can have severe environmental consequences. This includes contamination of soil and water bodies due to improper disposal practices, which can lead to the spread of diseases and the pollution of local ecosystems.

Health Risks for Workers and Communities: Healthcare workers and the surrounding communities may be exposed to health risks due to inadequate waste management practices. Contaminated medical waste can carry infectious agents, hazardous chemicals, and other biohazards that can pose a risk to those who come into contact with them.

Regulatory Compliance: There might be controversies regarding compliance with healthcare waste management regulations and guidelines. Inconsistent enforcement of regulations and a lack of accountability can hinder effective waste management practices.

Public Awareness and Education: Lack of public awareness and education about the importance of proper healthcare waste management can contribute to the problem. People might not understand the potential risks associated with improper disposal practices, leading to a lack of community support for effective waste management initiatives.

Technological Solutions: The adoption of advanced technologies for healthcare waste management, such as waste treatment and disposal methods, might be a point of discussion. Emerging technologies could potentially offer more environmentally friendly and efficient solutions, but they may also come with implementation challenges and costs.

Data Collection and Monitoring: Effective assessment requires accurate data collection and monitoring. Issues may arise in gathering reliable data on the quantity and types of healthcare waste generated, as well as the disposal methods employed. Inaccurate data can lead to flawed assessments and ineffective waste management strategies.

Collaboration and Stakeholder Engagement: Involvement and collaboration among various stakeholders, including healthcare facilities, government agencies, waste management companies, and local communities, are crucial for effective waste management. Controversies might emerge around coordination and responsibilities among these stakeholders.

Financial Constraints: Implementing proper healthcare waste management practices can be costly. There might be debates about resource allocation and funding sources for waste management infrastructure, especially in areas with limited financial resources.

Socioeconomic Factors: Socioeconomic factors can influence waste management practices. Disparities in healthcare infrastructure, access to information, and economic conditions might lead to unequal healthcare waste management practices across different areas of Niger State.

REFERENCES

- 1) Smith et al 2007); Assessment of Medical Waste Management Practices Northern Jordan. Journal of Waste Management.
- 2) International Committee of the Red Cross 19, avenue de la Paix 1202 Geneva, Switzerland T +41 22 734 60 01 F +41 22 733 20 57 E-mail: shop@icrc.org www.icrc.org © ICRC, November 2011
- 3) Aniefiok (2007). Assessment of Waste Management Practices, Among Residents of Owerri Municipal. Imo State Nigeria. 6 Journal of Environmental Protection.
- 4) Habitat and UNEP, (1998). United Nations Environment Programme / SBC World Health Organization National Health-CareWaste Management Plan • https://www.who.int/water_sanitation_health/...
- 5) Scheu, (2001) Research Paper on Medical waste management practices among selected health-care facilities in Nigeria: A case study David O. Olukanni^{1*}, Dominic E. Azuh², Tunde O. Toogun³ and Uchechukwu E. Okorie² ¹Department of Civil Engineering, Covenant University, P. M. B. 1023, Ota, Ogun State, Nigeria. eprints.covenantuniversity.edu.ng/9088/1/Medical...
- 6) Magaji (2005) waste management systems of the study health facility for appropriate disposal of medical waste. American Journal of Obstetrics and Gynecology 2005; 193: 1270- 1273. Landes M, Newell ML, Barlow P, et al. Hepatitis B or hepatitis C .
- 7) Multi (1986) waste management practices as obtains in the urban developing nations. Journal of Environmental Protection. <https://www.researchgate.net/publication/283625266..>
- 8) (Dauda and Osita,2003) Enhancing Solid waste collection and transportation for sustainable development. Journal of Waste Management Resources 27 (3): 305–12
- 9) (Eja *et al* 2003.) Bacterial indications of faecal pollution of water supplier and public health Journal of medical science
- 10) Agunwamba, J.C, Egbuniwe,N and Ogwueleka,T.C (2003). Least cost management of Solid Waste Collection. Journal of Solid waste Technology and Management. Vol.29, No3, Pp154-167
- 11) Ogwueleka, T.C (2002). Characterization of Institutional waste. Journal of Environmental Studied, vol. 3, No 182 Pp156-159
- 12) Almufee, M, Memish, Z, (2003). Effective medical waste management: it can be done. American Journal of infection control 31, 188-192.

- 13) Archaeologist E.W. Haury.(2011)); Waste Management practices in hazardous waste. High use of resources (KPMG 2011).
- 14) Blenkham J.I (2006) Clinical Waste Management Module in Earth Systems and Environmental Science. *Journal of Hospital Infection* 62 (30 300-303 2006
- 15) Giegrich and Vogt, (2005) Guidelines for Environmental Infection control in Healthcare Facility; *Journal of Medical Waste Management in Ibadan, Nigeria: Obstacles and prospects* 29(2), 804–11.
- 16) (Abgede O.(1990), & Ajabge, (2004); *Management of Solid Waste in Nigeria and Other African Countries.*
- 17) Miller (1994) Health implication of Fungi in indoor Environments an over view of healthcare waste in Istanbul. *Journal of Waste Management* 28, 1227 - 35.
- 18) Guyana Environmental Protection Agency (2004)) *Medical waste management practices.*
- 19) (Bogner and Matthews, 2003). *Waste management and climate change. In developed countries seeking to reduce waste generation and Mitigation of Greenhouse gas Emissions from waste.*

Solid Waste Disposal in East Mamprusi Municipality: Assessment of Reasons for Disposal Methods

¹Mohammed Habibu Abdulai

Msc. Environmental Science, Kwame Nkrumah University of Science and
Technology University (KNUST)

*Corresponding Author's Email: habibabdulai41@gmail.com

²Kodwo Miezah (PhD)

Lecturer, University of Science and Technology (KNUST) Kumasi Campus

³Abdul-Basit Danajoe Munkaila (PhD Candidate)

Part Time Lecturer, University of Ghana, Legon and University of Education,
Winneba, Tamale Campuses

Abstract

Purpose: The study determined the methods of solid waste disposal in the municipality, in relation with awareness and compliance with dumping on approved locations.

Methodology: The study adopted simple and purposive sampling techniques to select households and respondents. The target respondents for the study were, planning and Environmental offices, chiefs and opinion leaders, and heads of households. Data were analyzed using a regression model to determine the influencing factors of the disposal options, while also evaluating compliance with the disposal on approved lands.

Findings: The research found out that; open dumping in the neighborhood, (83.33%), was the main disposal option of the municipality, also, there was a significant relationship between; awareness of approved dumping sites and compliance with dumping on approved sites, distance to the waste disposal sites affected the disposal on approved sites, and lack of knowledge on by-laws on waste management also affected the choice of disposal option. The research concluded that open dumping of waste is mainly driven by low awareness of approved disposal sites and the absence of recycling alternatives.

Unique Contribution to Theory, Practice and Policy: The study recommended the need for the provision of more communal containers and waste bins by government and sector players on waste management in the district; intensive education on bye-laws, emphasizing on the significance of dumping waste on approved sites is a welcoming intervention.

Keywords: *Waste, Waste Disposal Method, Open Dumping, Awareness, Compliance, Approved Sites, Purposive Sampling, Simple Random Sampling*

INTRODUCTION

Human consumption and activities lead to the generation of unwanted remains, and the management process determines whether it will produce waste or not. If proper handling is not made, it poses risk to the environment and human health (Zhu et al., 2008). Key sources of waste generation are usually after consumption (Li, 2019). Waste generation also stems from sources such as households, markets, commercial establishments and, recreational places (Sexena et al., 2010). The inability of several cities to source-separate their wastes leads to loss of valuables, hence difficulty in adding value to the wastes (Moh, 2014). Lack of value for waste has led to littering of solid waste in major parts of human settlements, creating health and environmental threats (Miezhah et al., 2015).

Similarly, technological issues are also major bottlenecks to waste management challenges (Ayotamuno & Gobo, 2004). Ayotamuno and Gobo (2004), added that, institutional capacities on waste management strategies are weak in technology, hence, degenerating into weak approaches to waste management. The increased generation of wastes marked by poor infrastructure development for its disposal has been identified as the cause of some of the unsafe disposal of wastes (Hoorweg & Bhad-Tata, 2012).

Waste disposal methods are the different approaches advanced to get rid of solid waste in the environment, be it approved or unapproved (Hamer, 2013). However, most common form of solid waste disposal is the open dumping (Narayana, 2009). Sam Jnr (2009), argued that engineering of open disposal sites is often less practicable in Ghana. These sites are often described as crude dumpsites. Disposal of solid waste in most parts of Ghana is either on approved locations or unapproved locations. The popular methods employed for solid waste dumping in Ghana include uncontrolled dumping of refuse, controlled dumping, sanitary landfills, composting and, incineration (Oteng-Ababio, 2011).

Solid waste assimilation has often been observed to be inversely related to its accumulation in the northern environment of Ghana (Oduro-Kwarteng, 2013). This inverse array of disposal and assimilation has led to the accumulation of solid waste in almost every part of the country. As a result, uncontrolled dumping in East Mamprusi Municipal is affected by this widespread practice.

In the light of this imbalance magnitude of accumulation and assimilation of waste, solid waste management has risen to be one of the most crucial health and environmental problems facing governments in developing countries

(Zurbrugg et al., 2012). It has been local government's responsibility to provide this service for decades. As opined by Verma and Antahal (2013), waste management service is non-exclusive; meaning that, upon the provision, it benefits the community as overall public welfare. The service is also non-rivalled, meaning that, any resident can enjoy the benefit of the service without diminishing the benefit to anyone else. They further argued that, waste management services by waste management administrators have often not met the demand of the general public, although the service is an important public affair. Research on waste management expenditure is often observed to be on the higher site.

As opined by Achankeng (2003), expenditure on waste management has often ranged twenty to twenty-five percent (20%-50%) of the income of most governments in developing nations. The major opposing challenges for this failure in managing solid waste are due to driving factors such as; rapid population growth, expansion of cities, diminishing resources regarding finance and poor urban planning (Achankeng, 2003). In effect, waste management budgets have often not met the demand of the population in developing countries even though the generation rate is high in developing nations compared to developed countries (Omar & Gavrilescu, 2008).

Solid waste collection accounts for most of the expenditure on solid waste management, and solid waste management is often the largest item of expenditure in municipal budgets (Fu, Li & Wang, 2015). The shortage of funds and the difficult procedures involved in accessing funds are often cited as the reasons why important steps cannot be taken (Shafuil & Sayed, 2006).

Added to that, one of the main causes of difficulties in the field of solid waste collection is the failure to take account of the important differences between geographical regions, between nations, between cities, and even within a city. International consultants, engineers who have studied overseas, and decision-makers who have been impressed by solid waste management systems in other countries, often recommend systems that they have seen work well in an industrialized country and assume the same systems will work equally well in a completely different context (Marshall and Farahbakhsh, 2013). This is a serious misconception. Decision-makers and engineers may believe that the only significant component in a waste collection system is the technology and ignore other vital aspects (Sharma, et al., 2019). International consultants may prefer systems with which they are familiar or which are manufactured in their own countries (Khana and Faisal, 2009). Too often, the result of these

influences is extravagant expenditure of foreign exchange, vehicles lying idle awaiting imported spare parts, and waste collection services that are unable to cope with the amounts of waste that are being generated (Aziale and Asafo-Adjei, 2013). The list of differences between one location and another can be quite long. These include social, economic, climate, spatial and urban development methods, and finally technical aspects (Chester and Allenby, 2019). All these differences account for the difficulty in adaptations of foreign methods of waste collection in developing countries.

Accordingly, solid waste management policy direction started taking shape within the 20th century in Ghana. The 2004 sanitation profile indicates that, solid waste management in Ghana is the responsibility of the Ministry of Local Government, and Rural Development, which supervises the decentralized Metropolitan, Municipal and District Assemblies (MMDAs). However, the regulatory authority is vested in the Environmental Protection Agency (EPA) under the auspices of the Ministry of Environment and Science. The Metropolitan, Municipal and District Assemblies are responsible for the collection of solid waste and its final disposal through their Waste Management Departments (WMDs) and their Environmental Health and Sanitation Departments (Sanitation report on Ghana, 2004).

However, research has observed a challenge in the waste management processes of these legit bodies (Guerrero, 2013). Also, studies on solid waste management reveal very interesting patterns. Most of these studies highlight on the health effects of uncontrolled dumping without emphasis on land appropriation, education, and awareness level (e.g. Norsa'adah, 2020).

Control on land use for waste management in the East Mamprusi Municipality has often hung so much on the balance. District Assembly is not able to enforce their sanitation related by-laws. Land designation for waste disposal has often not been included in the planning system of the District (Nnaji, 2015). Lack of education on the health implications is perceived as the cause of this act (Olli & Wollebaek, 2001) However, the cause may be beyond education and just knowledge on the health effects. It is important to note that, exploring the disposal methods, the use of land for waste management and evaluation of awareness and compliance with dumping waste on approve locations will to a great extent unfold the problem.

This paper is framed in to four major sections. Of these sections, the materials and methods being the section two; defining the rout to acquiring and analyzing information obtained from the field, follows the section one-the

introduction of the study, which also defines the general motivation for the study. The conclusion of the study being the final section highlighting the study findings and conclusions, follows the results of the study being the third section- unleashing the fundamental information obtained from the field.

METHODOLOGY

The study employed different approaches to collect data from the field for further analysis. The study is based on waste disposal options and reasons for adopting the various disposal options within the East Mamprusi Municipality. The keywords employed were waste, waste disposal method, open dumping, awareness, compliance, approved sites, purposive sampling, and simple random sampling. Some further studies were identified through the reference list of these articles and Google was used to find special reports or conference proceedings. Purposive sampling was employed in the selection of zonal council capital towns such as Langbinsi, Gambaga, Nalerigu, Sakogu, Nagbo, and Gbintiri. Random sampling was employed in selecting households from these selected sub-urban areas in the Municipality. The total number of household respondents was determined using the statistical formula:

$$Z * Z [P * P] / D * D Eqn 2.1$$

Where n= number of household respondents

Z=value at accepted confidence level, P= estimate of standard deviation in the population and D=margin of error.

A total of 340 respondents were selected for the study. The various components included households 300, chiefs and opinion leaders 33, and four (4) were administered to the Municipal Assembly and three (3) to a waste management service provider, Zoomlion Ghana Limited staff.

Information was collected from key informants with in-depth knowledge of waste accumulation and waste management as well as major party players on waste management challenges within the municipality using key informant interviews. These include four staff from the municipal assembly planning unit and the environmental unit. Private sector waste management bodies such as Zoomlion Ghana Limited had three staff contacted for information. Opinion leaders who are powered to talk, and influence the people on waste disposal as well as releasing land for dumping waste were also interacted with- through a semi-structured questionnaire.

Moreover, a questionnaire was administered to households to ascertain their methods of dumping waste and the reasons that result in the adoption of a particular method of choice. The primary data were collected from 300 households and 33 chiefs and opinion leaders of the municipality. Before data collection the questionnaire was pre-tested for content validity and easy understanding.

A group of stakeholders from the municipality were tasked to criticize the content of the questionnaire in relation to ambiguity, clarity, and appropriateness of the items used to operationalize each construct. They included; two from the municipal assembly, one from private sector waste management actors, two from the sampled households and one opinion leader, giving a total sum of six stakeholders. The respondents were also task to assess the extent to which the content sufficiently addressed the topic investigated. Based on the feedback received, the instrument was modified accordingly and used to collect information about the state of waste disposal practices in the municipal.

The results of the regression model (ordinance) were presented by using APA style tables, while categorical result such as the waste disposal options was presented by the use of a bar graph. The tools that were used for analyzing the data were Microsoft excel, and Statistical Package for Social Sciences (SPSS)

FINDINGS

Solid Waste Disposal Options in East Mamprusi Municipal

The study identified three main disposal options of solid waste in the Municipality. These included: Open dumping (250/300), dumping in communal containers (27/300), and collection by a waste service provider which is Zoomlion Ghana Limited (23/300). Open disposal practice is the crude dumping of solid waste in nearby compounds, close to residence. It includes dumping in created pits from gravel extracted for construction works. Open dumping also occurs along the roads in storm drains as well as any other form that is considered illegal and unacceptable.

Another method of solid waste disposal was dumping in communal containers. This method of solid waste disposal explains the act of dumping at located central points in the community where communal containers are placed close to the residence so that they can be carried away by the Municipal Assembly for final disposal. These communal container points serve as adopted transfer stations for solid waste collection. From observation and interviews conducted,

Communal container points are relatively scarce and seldom lifted for disposal by Municipal Assembly and service providers. This subsequently led to a complex process of handling. As a result, some communal containers have invariably turned to improvised open dumping sites aside from the known open dumping.

The third method involves waste management contractors who are charged by the Municipal Assembly per contract agreement to collect solid waste from individual residence, market centers, and offices and dispose them at approved locations. In the East Mamprusi Municipality, Zoomlion Ghana Limited is the sole service provider. The company provides waste collection services to households, market stores, and other clients. A service fee of two dollars (\$ 2) is charged per weekly lifting of the waste. This method agrees with the polluter pays principle; where individuals who generates waste pays for the environmental effect or the management of the waste generated.

Based on the volume of the waste bin, the individual has to meet the standard of payment for waste bins of either 120 liters or 240 liters. The survey revealed that Zoomlion Ghana has a total of 70 waste bins which they are contracted to manage in the Municipality. However, 40 out of the 70 are currently active for the service provider whilst the remaining 30 are dormant and are not used in any service due to the inability of the household to pay for the services.

East Mamprusi municipality constitutes five zonal councils which include: Gambaga, Nalerigu, Langbinsi, Sakogu, and Gbintiri Zonal Councils. From the survey, it was realized from the Municipal assembly that, the five zonal councils are served with 11 communal containers for waste collection. It is however important to note that, differences exist between what is said about what people do and what they do (Russell, 2006). Despite earlier accessions by the Municipal assembly that zonal councils were served with communal containers, further research on direct observation carried out in the zonal councils unpacked the evidence that, the new reality in the district is that; three of the zonal councils do not receive service from Zoomlion Ghana or the Municipal Assembly on communal containers provision.

An analysis of the various disposal options using an ordinal regression model to determine the significance of the three methods of disposals practices which include; open dumping, dumping in communal containers, and collection by service providers revealed that open dumping was significant at 0.00, the goodness of fit for the model revealed a significance of 0.001 and a chi- square

value of 70.195. This indicates that, of all the various disposal options assessed by the research coverage, open dumping is the predominant practice

Figure1 shows the various methods of solid waste disposal adopted by households from the communities selected for the survey. The survey revealed that open dumping is the most adopted waste disposal option in the District. Out of the 300 household respondents interviewed, 250 representing 83.3% households practiced open dumping, 27 households' respondents dumped in communal containers, representing 9.0% of the respondents and 23 representing 7.7% of the respondents said they subscribe to the services of Zoomlion Ghana Limited.

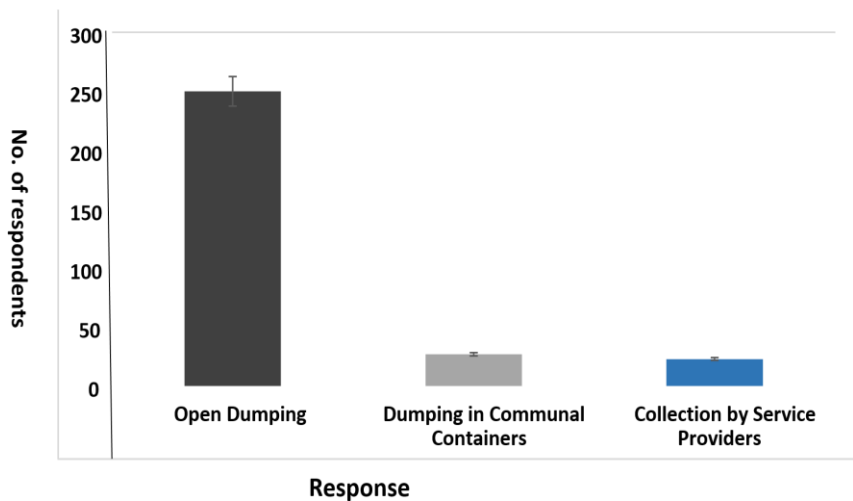


Figure 1: Waste Disposal Options of Households in East Mamprusi District

Source: Author's Construct

Factors That Affect Open Dumping in East Mamprusi District

The ordinal regression model was further employed to test the significant factors that influence open dumping in the district to obtain realities of the interconnectivity of open dumping for possible interventions. Several factors (independent variables) were tested for significance against the dependent variables, which is open dumping. From the list of factors tested, two factors significantly affect the act of open dumping in the district. These include; lack

of efforts of awareness of approved dumping sites, which was significant at 0.000, and poor effort to recycle waste, which was significant at 0.006.

Reasons for the Preferred Disposal Options

The survey further assessed the reasons for predominantly practicing open dumping. Interviews on Opinion leaders and some households cited reasons such as Lack of Communal Containers or Waste bins for disposal; long distances to dumping sites and individual ownership and control over land use. There was a challenge regarding the availability of communal containers and waste bins in the District. The number of the communal containers, as well as waste bins provided, were not enough to meet the individual household demand.

Also, many households were not able to afford the monthly payment charged by the service providers. Crude dumping being a predominant practice became the preference of most, even though they have the knowledge and were aware of the negative effects of the crude dumping of solid waste close to their residence. This is in line with the findings of Kirama and Mayo (2016), who cited reasons for poor patronage of private sector waste management bodies as; inferior and unavailable waste collection and transportation material, inefficient system of waste collection fees, inaccessible roads, and inefficient municipal policies and by-laws.

The study also revealed that 60% of the residents interviewed complained of a lack of communal containers in their neighborhood for disposal of waste. Another reason that was observed from the field survey was the distance to sites where the communal containers were positioned against individual homes was far-flung. This in reality prevented people from carrying solid waste over such a distance for disposal. Most (16%) of households explained the distance to be 1-2 km, thus believed this hindered them from disposing of waste in the few available communal containers.

Interviewing key informants from the district further revealed that land ownership by individuals has its effect, as land owners has control over its use. This has led to the abuse of land by individuals without any retribution, since the land belongs to them. Individuals decide on how to use their land without any hindrance. This is in line with the findings of Di Bella and Vaccari (2014) who stated issues of land ownership and availability as a constraint for solid waste management in Somalia.

Table 1: Disposal Options and Reasons for Indiscriminate Dumping

Response	No communal container or bins	Long distance to dumping site	Because I am the land owner	No applicable reason	Total
Open dumping	179	47	24	0	250
Dumping in communal containers	0	0	0	27	27
Collection by service providers	0	0	0	23	23
Total	179	47	24	50	300

Source: Author's Construct, 2021

Awareness of Approved Lands Demarcated For Solid Waste Disposal and Compliance

Awareness of Approved Lands Demarcated for Solid Waste Disposal

On the awareness of approved lands for solid waste disposal, the study revealed corresponding outcomes of the divergent views of respondents which was further analyzed statistically. The percentage of respondents affirming their awareness of approved lands demarcated for solid waste management were 82 in number, representing 27% of the total respondents. Those who responded in the negative were 218, representing 73% of the total households interviewed.

Table 2: Factors Influencing Awareness Of Approve Dump Site for Solid Waste

Variables	Estimate	Sig. (P)
Threshold awareness of approve dumping site		
Yes	-3.433	0.001
Location [awareness of negative effects of open dumping]		
Yes	-0.804	0.258
No	0 ^a	
Disposal option=1. open dumping	1.154	0.072
Dumping in communal containers	-2.645	0.009
3. Collection by service providers	0 ^a	
Awareness of land use bylaws		
Yes	-1.785	0.000 *
No	0 ^a	
Educational status= 1. No formal education	-0.604	0.277
Basic education	0.561	0.393
Secondary education	0.566	0.344
Tertiary	-0.162	0.825
Others	0 ^a	
Knowledge on bylaws for waste disposal=		
Yes	-2.645	0.000 *
No	0 ^a	

Ordinal regression model test, statistically significant (P) at < 0.05

Source: Author's Construct, 2021

Compliance with Dumping on Approved Lands Demarcated for Solid Waste Disposal

The research determined whether individual awareness will positively correlate their level of compliance on dumping waste on approves points or lands for waste disposal. The study revealed that 47.56% households agreed that they are complying with dumping waste on the approved venue, while 52.42% responded that they still dump waste openly without sending it to the approved site.

Table 3 shows the relationship between awareness of approved sites for dumping and compliance with dumping at the site. The results show that there was a significant relation between awareness and compliance. Thus, compliance level increases with awareness. The test which is a two-sided test

of both observed and expected are both significant with a chi square value of (3.0000E2a) and a likelihood ratio of 351.928.

Table 3: Ordinance Regression Model Pearson Chi-Square Relationship between Awareness and Compliance with Dumping Solid Waste on Approved Sites

	Value	Df	Asymp. Sig. (2sided)
Pearson Chi-Square	3.000E2 ^a	2	.000*
Likelihood Ratio	351.928	2	.000*
N of Valid Cases	300		

Ordinance regression model significant at $P < 0.05$

Source: Author's Construct, 2021

Factors Influencing Awareness of Approved Land Demarcated for Solid Waste Disposal

The awareness of approved dumping sites was statistically tested by factors such as the educational status (63.7% formal education), the awareness of the negative effects of open dumping (73% awareness), the knowledge on the land-use bylaws (30% awareness), the open disposal option (83%) and knowledge on approved lands demarcated (30%) for waste management to determine the significant influencing factors on awareness. A statistical analysis using the ordinance regression model revealed that knowledge on by-laws for waste disposal significantly ($P=0.00$) leads to awareness of approved lands for disposal. This means that once a person is aware of the by-laws, s/he would be aware of the approved site.

Thus, many people will practice open dumping if they do not know about the approved site for dumping. This had a positive correlation with the number of people who practice open dumping which was 250 as earlier illustrated in Figure 1.

Also, awareness of by-laws on waste management significantly ($P=0.00$) contributed to the awareness of individuals on approved lands for waste disposal. In simple, those who were conversant with the by-laws of the Assembly on waste management and waste disposal knew about demarcated areas for dumping and this also contributed to proper disposal practices in the District. Since the number remained very few, policies regarding enforcement of by-laws need to be put in place to ensure controlled dumping in the area.

On the contrary, educational status and awareness of the negative effects of open dumping did not significantly affect the awareness of approved dumping site. People might choose to dump openly or uncontrollably irrespective of the status of their education or their knowledge on the negative effects on the environment and their health. Thus, relaxed enforcement of by-laws could be the cause of open dumping in the area, though reasons such as distance to dumping sites and lack of disposal facilities were given.

CONCLUSIONS AND RECOMMENDATION

Waste disposal options in East Mamprusi District is a community menace and a challenge. Majority of the households in the District practice open dumping disposal. The practice is mainly driven by low awareness of approved disposal sites and the absence of recycling alternatives. This practice was influenced by factors such as lack of awareness of approved sites for disposal and no recycling efforts. These two major factors were lacking in the District per the outcome of the research. However, reasons such as lack of disposal facilities, long distances to dumping areas, individual control, and ownership of lands also influenced most people to dispose-off waste openly.

Awareness creation is about Education and this would bring about compliance with dumping on approved land and also strengthening the recycling efforts of households of the District. Since the awareness level was low, compliance was a challenge because people were not aware that lead to inability to comply. The factors that determined whether individuals were aware of approved dumping site were: the disposal options adopted, the knowledge of the by-laws on waste management, and by-laws on land ownership and usage.

The study recommended that; there should be strong government intervention that would deal with the challenge of open dumping. They include; a) District assembly in collaboration with central government should provide more waste bins and communal containers to serve the need of households so people can act positively towards dumping in approved locations. b) The number of officers in charge of education and ensuring compliance with environmental regulation concerning waste disposal should be increased with serious capacity building and working tools to allow them to operate effectively. By so doing, the government can recruit volunteers at the community level to identify waste management challenges so that it is reported for necessary address at the District level. Such officers shall be responsible for quality education and compliance on waste management strategies that are anthropogenic or tested and scientific.

By-laws on approved locations for waste disposal should be strengthened with the carrot approach employed as a motivational factor to ensure compliance by individuals in the District as far as issues of waste disposal on approved locations is concerned. Local stakeholders such as; chiefs, community elders, religious leaders, traditional leaders, assembly persons, as well as community members, should be charged with the responsibility of developing positive sub-cultural practices that can enhance proper waste management in the District. The District Assembly should correlate effectively with local NGO's who are into the area of Health and Sanitation so that the message can be carried across all communities to ensure that higher compliance level is achieved on by-laws for waste management

Further research should be conducted on the health risk of open dumping in the District to acquire realities on the disease prevalence rate from the available hospitals in the District. Further research on land use by-laws, stakeholders, or sector players' coordination in ensuring safe disposal of waste is a potential area of investigation.

Acknowledgement

Greater appreciation goes to parents and families of the authors for the support giving them throughout their education. The field team who supported the collection of data for this study are very much appreciated. Opinion leaders of the research communities are also appreciated for their patients during our visit for the data collection.

Emerging Issues and Controversies

Inadequate Waste Collection Services: The availability and adequacy of waste collection services might be a major concern. If the municipality lacks proper waste collection infrastructure, residents might resort to informal and unsustainable disposal methods.

Open Dumping and Health Concerns: Open dumping of solid waste can lead to environmental pollution, disease transmission, and health hazards for both residents and waste handlers. Controversies could arise around the potential health impacts on the community due to improper waste disposal.

Limited Recycling and Resource Recovery: The lack of recycling facilities and resource recovery initiatives could contribute to controversies surrounding the wasteful use of valuable materials. Encouraging recycling and waste reduction measures could be a point of contention.

Informal Sector Involvement: In many places, informal waste pickers play a crucial role in waste management. However, conflicts might arise around their involvement in waste collection and recycling, including issues related to fair wages, health, and safety.

Land Use Conflicts: Identifying suitable land for waste disposal can be challenging. Controversies might emerge if waste disposal sites encroach upon residential areas, agricultural lands, or ecologically sensitive zones.

Community Engagement and Participation: The involvement of local communities in waste management decisions could be a source of contention. Some residents might resist changes in disposal practices or not be adequately informed about the potential impacts.

Lack of Awareness and Education: Inadequate public awareness and education about the consequences of improper waste disposal could lead to disputes over the adoption of more sustainable waste management practices.

Government Policy and Regulation: Controversies might arise regarding the enforcement of waste management regulations and the effectiveness of policies related to waste disposal. This could involve debates over accountability, penalties, and regulatory gaps.

Waste-to-Energy and Incineration: Discussions about waste-to-energy technologies and incineration could be controversial due to concerns about air pollution, health effects, and environmental impacts associated with these methods.

Integration of Circular Economy Principles: The adoption of circular economy principles, which aim to minimize waste and maximize resource use, might be met with resistance or challenges due to existing economic systems and practices.

Funding and Infrastructure: Disagreements might occur over the allocation of funds for waste management infrastructure, including waste collection trucks, disposal sites, and recycling facilities.

Traditional Practices and Modern Waste Management: In areas with strong traditional practices, introducing modern waste management methods could be met with skepticism or resistance. Balancing cultural sensitivities with the need for effective waste management could be a topic of debate.

REFERENCES

- Achankeng, E., (2003). Globalization. Urbanization and municipal solid waste management in Africa. Proceedings of the African Studies Association of Australia and the Pacific 26th annual conference. Pp 1-22.
- Ayotamuno, J., M., and Gobo, A., E., (2004). Municipal solid waste management in Port Harcourt, Nigeria: Obstacles and Prospects. *Management of Environmental Quality: an international journal*, vol. 15, issue 4, pp389-398.
- Aziale, L. K., Asofo-Adjei, E. (2013): Waste management in Ghana, a case of Tema metropolitan Assembly. *European Journal of Business and Management*, vol. 5, issue 32, pp 116-128.
- Chester, M. V. and Allenby, B. (2019): Towards adaptive infrastructure: flexibility and agility in a non-stationarity age. *Sustainable and Resilient Infrastructure*, vol. 4, issue 4, pp173-191.
- Di Bella, V., Vaccari, M. (2014): Constraints for solid waste management in Somaliland. *Proceedings of the Institute of Civil Engineering-Waste and Resource Management*, vol. 167, issue 2, pp 62-71.
- Fu, H. Z., Li, Z., S., and Wang, R., (2015). Estimating municipal solid waste generation by different activities and various resident groups in five province of China. *Waste Management*, vol. 41, pp 3-11
- Guerrero, L., A., Maas, G., and Hogland, W., (2013). Solid waste management challenges for cities in developing countries. *Waste management*, vol. 33, pp 220-232.
- Hamer, G., (2003). Solid waste treatment and disposal: effect on public health and environmental safety. *Biotechnology Advances*, vol. 22, issue (1-2), pp 71-79.
- Hornweg, D., and Bhad-Tata, P., (2012). What a waste. A global review of solid waste management. *Urban Development Series Knowledge Paper*.
- Khan, S. and Faisal, M. N. (2008): An analytic network process model for municipal solid waste disposal options. *Waste management*, vol. 28, Issue 9 pp 1500-1508

- Kirama, A. and Mayo, A. W. (2016): Challenges and prospects of private sector participation in solid waste management in Dar' es Salaam City, Tanzania habitat international Habitat International Volume 53, Pp 195-205.
- Li, Y., Jin, Y., Borrión, A., and Li, H. (2019), current status of food waste generation and management in China. *Bio-resource Technology*, vol. 273, pp 654-665.
- Marshall, R. E., Farahbakhsh, K. (2013): Systems approach to integrated solid waste management in developing countries. *Waste management*, vol. 33, issue 4, pp988-1003
- Miezah, K., Obiri-Danso, K., Kadar, Z., Fei-Baffoe, B., and Mensah, M., Y., (2015). Municipal solid waste characterization as a measure towards effective waste management in Ghana, *Waste Management*, vol. 46, pp 15-27.
- Moh, Y., (2017). Solid waste management transformation and future challenges of source separation and recycling practice in Malaysia. *Resource Conservation and Recycling*, vol.116, pp 1-14.
- Narayana, T., (2009). Municipal solid waste management in India: From waste disposal to recovery of resources? *Waste Management*, vol. 29, issue 3, pp 1163-1166
- Nnaji, C. (2015) "Status of municipal solid waste generation and disposal in Nigeria", *Management of Environmental Quality: An International Journal*. Vol.26, issue 1, pp.53-71.
- Norsa'adah, B., Salinah, O., Naing, N., and Sarimah, A. (2020): Community Health Survey of Residents Living Near a Solid Waste Open Dumpsite in Sabak, Kelantan, Malaysia. *International Journal of Environmental Research and Public Health*, vol. 17, issue 311 pp 114
- Oduro-Kwarteng, S., and Van Dijk, M., P., (2013). The effect of increased private sector involvement in solid waste collection in five cities in Ghana. *Waste Management & Research*, vol. 31, issue 10, pp 81-92.
- Olli, E., Grendstad, G., & Wollebaek, D. (2001) Correlates of Environmental Behaviors: Bringing Back Social Context. *Environment and Behavior*, 33(2), 181-208.

- Omar, A., and Gavrilescu, M., (2008). Municipal solid waste management in developing countries: A perspective on Vietnam. *Environmental Engineering and Management (EEM)*, vol. 7, Issue. 4, pp 469-478.
- Oteng-Ababio, M., (2011). Missing links in solid waste management in the Greater Accra Metropolitan Area in Ghana. *GeoJournal*, vol. 76, issue 5, pp 551-560.
- Sexena, S. Srivastava, R., K., Samaddar, A., B., (2010). "Towards sustainable municipal solid waste management in Allahabad City", *Management of Environmental Quality: An International Journal*, 21 (3), pp.308-323.
- Sharma, N., Litoriya, R., Sharma, D., Singh, H. P. (2019): Designing a decision support framework for municipal solid waste management. *Int. J. Emerg. Technol.*, vol. 10, issue 4, pp 3794379.
- Zhu, D., Asnani, P., U., Zurbrugg, C., Anapolsky, S., and Mani, S., (2008). *Improving Solid Waste Management in India: A Sourcebook for Policy Makers and Practitioners*, the World Bank, Washington, DC.

The Potential Contribution of Public Primary Schools in Attaining Ten Percent Tree Cover in Kenya

¹*Melyne Amolloh Achieng'

Postgraduate Student, School of Environment and Earth Sciences, Maseno University

²R. Kapiyo

Lecturer, School of Environment and Earth Sciences, Maseno University

³B. Akala

Lecturer, School of Environment and Earth Sciences, Maseno University

³A. Fredrick Otieno

Graduate School, Faculty of Business and Social Sciences, University of Southern Denmark (Syddansk Universitet)

*Corresponding Author's Email: directorpr@maseno.ac.ke

Abstract

Purpose: This paper demonstrates the influence of school land-use practices on tree population in public primary schools in Kisumu County.

Methodology: A descriptive cross-sectional research design was employed and systematic random sampling used to select 124 schools (20% of 615). Primary data came from self-administered questionnaires to school heads and harmonized using focus group discussions with teachers and pupils. Further, key informant interviews, observation, photography and desk studies were also used.

Findings: From the study, the average land size of a public primary school is 3.26Ha with approximately 23.7% unused spaces. 32.26% of the schools do not have a documented land use plan hence rely on sheer instincts and ad hoc decisions of the administration or Board of Management (BoM) for space allocation to any land cover. There is a significantly positive correlation between school land-use practices ($r^2=0.843$) and tree population. Out of the common land use practices identified; forestry ($p=2e-16$), tree nursery ($p=2e-16$) and kitchen gardening ($p=0.017$) had a significant positive influence on the total tree population in schools. The findings show that land use practices positively influence tree population in public primary schools.

Unique Contribution to Theory, Practice and Policy: The study demonstrates that school administration should take advantage of the unused

spaces to provide adequate room for establishment of woodlots and gardens to facilitate the achievement of the 10% forest cover.

Keywords: *Land Cover, Land Use Practices, Public Primary Schools, School Land Size, Tree Population*

INTRODUCTION

Forests remain critical national, regional and global assets especially in the current age where global temperature continues to rise towards a tipping point due to the high concentration of anthropogenic carbon dioxide (Ambus, D’Arcy, & Tyler, 2007). Unfortunately, forest cover is constantly shrinking in response to natural patterns and human activities (Food and Agriculture of the United Nation, 2007); (Laura, Alain, & Anne-Marie, 2010) leaving only an approximate 31% forest cover globally (93% being naturally occurring and 7% planted) as of 2010 based on a World Bank report.

Kenya shares with other African countries the problem of having small, fragmented areas of forests which are also under pressure from encroachment and overexploitation (Food and Agriculture of the United Nation, 2007). In 2018, Kenya was classified among countries with the lowest forest cover as closed-canopies stood at about 2% compared to the African average of 9.3% and a world average of 21.4% (FAO, 2015).

General forest cover was at 4%, against the recommended national minimum of 10% (Government of Kenya, 2018). Similarly, with greater potential of increasing tree cover based on its ecological conditions, Kisumu County had 0.44% forest cover by 2018 (County Government of Kisumu, 2018). Therefore, woodlots and other trees out of the forest are increasingly important sources of woody biomass. The trees also serve a critical role of soil and water conservation and correct the imbalance in various land uses (Emmanuel & Davison, 2010; Blaes, et al., 2013; Deakin, Kshatriya, & Sunderland, 2016). Hence the need for studies aimed at identifying new lands outside forests for tree cover or woodlots establishment.

Emmanuel & Dickson (2010) established that any sustainable plantation or woodlot establishment plans and activities would need to begin with a clear understanding of land resource use practices. AAR group, 2014 sustainable report revealed that substantial land resources existing under local government institutions like schools and if sustainably managed, can support a wide range of forest ecosystems. In the 1970s and 80s, countries built huge schools with the expectation of providing a more comprehensive curriculum (Sanoff & Walden, 2016).

According to Kenya’s Education Act (2012), it is a requirement that any primary, secondary or college should have at least 0.202 Ha. For this reason, Sustainability – COP Report (2014) recommended growing trees on school grounds for aesthetic values, to increase tree cover and enhance better

understanding of tree growth. Furthermore, greening of school grounds requires relatively little financial investment and school administrator(s) have more control over school lands, as they can make decisions about school ground greening or work with the surrounding communities to implement other greening initiatives (Browning & Rigolon, 2019).

However, Ailin & Nirmala (2017), in a study, established that evaluation of school learning environments traditionally focused on the technical and infrastructural performance of the facilities and wished to go further. Therefore, this study adventured not only on identifying various school land uses as per the school designs but also their influence on the population of trees within the school compound.

LITERATURE REVIEW

The outdoor environment provides a suitable setting for reinforcing curriculum, entrenching practical learning and socialization among learners across abilities and ages (Merike, Emer, & Cliona, 2010). Chawla et al., (2014) found out that contemporary school activities involve more than simply listening or writing and that schools with green, attractive exterior in which children take on an active role outside of the classroom encourage experiential learning with lasting effects on the learners.

However, Sanoff & Walden (2016) established that educational reform, has largely focused on what is taught and how it is taught with the consequence of strengthening curricula, improving instructional strategies, and learning materials. However, the role of the physical environment which present an opportunity for experiential learning has been given little attention.

According to Evergreen (2002), public primary schools have different ways of making or contributing to environmental greening. Presently, the need to plant trees on farms is increasing yet it is difficult for smallholders to access the trees that they want to plant (Food and Agriculture of the United Nation, 2007).

Mbora, Lillesø, & Ramni (2008) provides that to meet present and future demand for planting material, it is necessary to promote on-farm and community tree nurseries that can be owned and managed by schools or a range of other local institutions. This approach would provide income-generating opportunities, act as models for further nursery development, provide seedlings more cheaply to planters, and raise the particular species of interest to the local people.

Tree planting is also a practical way of introducing and integrating Environmental Education in schools (Temu, Chamshama, Kung'u, Kaboggoza, Chikamai, & R., 2008). As established by Miriam, Ochieng, & Agnes (2015), setting up tree nurseries within the school compound and transplanting the seedlings will equip learners with appropriate knowledge, skills and techniques they can apply to promote agroforestry even out of school. Furthermore, according to Bekel et al. (2015), making the school compounds green and clean, which involved regular site selection, land preparation, digging holes, planting the seedlings, mulching, weeding, and watering, can take place without interrupting the class schedule.

However, Darmody, Smyth, Doherty (2010), affirmed that current school design guidelines make provision for ball courts and play areas but are generally much less specific on aspects of outdoor space than on indoor space. The study shows that school designs in many countries, including Kenya (as evident from primary school design guidelines), seem to only concentrate on the structural development and design of these facilities.

One of the major recommendations given in Merike et al., (2010) is the need for guidelines to incorporate school garden and other green habitats as many respondents strongly complained about the absence of mature trees in the school compounds, among other things. Therefore, this research sought to understand how school land use practices and priorities influences number and distribution tree in primary schools.

This study was based on the possibility of forest cover dynamics being captured in a time dimension, theorized as the forest transition theory (FT), and introduced by Mather in 1992. The U-shaped curve model consists of two trends or periods: forest decline due to conversion of forested lands to agriculture, settlement and other land uses (Wolfers et. al. (2015). The other is forest recovery resulting from reforestation and afforestation. Mather explains that after soil fertility decline, people will relocate to new areas and the left areas used for reforestation.

However, this study assumed that the population pressure in Kenya allows for insignificant chances for relocation, and new lands identification for tree cover establishment is most appropriate. Therefore, the use of public primary school land for tree cover establishment comes in at stage two. Their contribution is aimed at lifting the country to stage three, where there is a recovery in forest cover using tree cover as supplement.

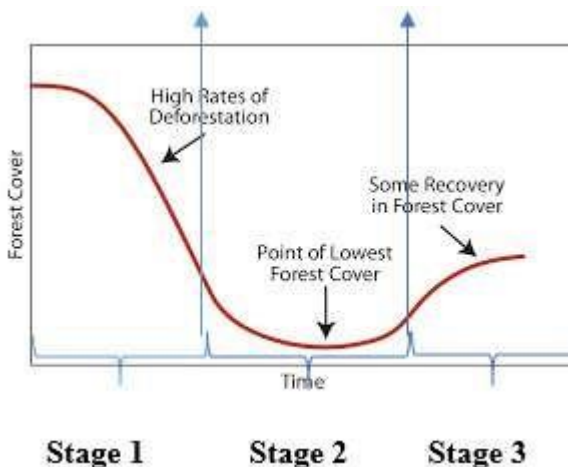


Fig 1: Forest Transition Theory

METHODOLOGY

This paper documents the results of a study carried out in Kisumu County in the Nyanza region, Kenya. The County (208,600Ha) has two gazetted forests; Karateng' (25Ha) and Koguta (400Ha) forests (County Government of Kisumu, 2018) and is lying between longitudes 330 20'E and 350 20'E and latitude 00 20' S and 00 50' S. As at 2018, there were 615 public primary schools and 153 private ones, 222 public secondary schools and 19 Vocational Training Institutes (VTI) in the County.

Descriptive survey research design was used for this study. Using Mugenda and Mugenda (2003), 20% (124 schools) of the 615 were randomly selected in a systematic manner (every 5th school) for the study. Land use practices and tree population in the selected public primary schools were observed in situ, without manipulation. The process's observation was also guided by knowledge from experience and theoretical review

All participants in the study consented to the process of interviewing and questionnaire administration. Responses obtained through administered questionnaires were harmonized using focus group discussions (FGDs) with teachers, upper primary pupils and lower primary pupils from 10% of the sampled schools per sub-county selected using simple random sampling technique. Further, key informant interviews were used to get professional

points of view from education, forestry, administrative (area chiefs) sectors and PTA (Parents Teacher Association) representatives.

Content validity and item analysis reliability tests were used to validate the data collected before analysis. Qualitative data on land use practices and tree population was organized into themes and categories using manual codes, then the trends and relationships established. Simple descriptive statistics was used to analyse the trends of the quantitative data collected on; size of school land covered by various land covers and number of trees from the identified land use practices. In addition, product-moment correlation and linear regression analysis were used to determine the relationship and make predictions on land use practices and tree population in schools. The results and findings on land use practices and tree population were presented in text for qualitative data and tables, graphs and charts for quantitative data.

FINDINGS

Public Primary School Land Sizes and Land Covers

Public primary schools in Kisumu County cover between 0.03 Ha and 8.2 Ha. The mean size of land occupied by the sampled public primary schools was 3.26 Ha. The majority (50.81%) of schools land size ranged between 2.00Ha and 3.99Ha. Cumulatively, all the 615 public primary schools in Kisumu County cover a total area of 2004.9 Ha. This observation confirms Sustainability – COP (2014) and AAR (2015) Sustainability reports, which revealed that substantial land resources exist under public institutions including schools.

It was discovered that 32.26% (40) of the schools did not have a school layout plan but instead used instinct or BoM decisions to allocate space for their land covers. The common land cover across the public primary schools include buildings, playgrounds, assembly, gardens and woodlots. Though few (4.84%), other schools had teachers' quarters and water points (boreholes and wells). All the identified land covers are deliberately managed and modified to achieve a purposive land use outcome. The common land use practices in public primary schools were identified as summarized as in figure 1 below.

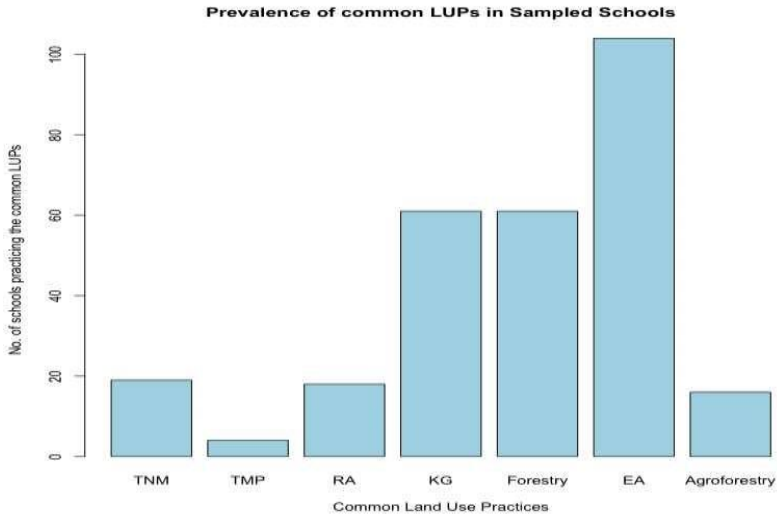


Figure 2: Prevalence of Common Land Use Practices in Sampled Public Primary Schools in Kisumu County

The study shows that land use practices are done on specific land covers for certain purposes with specific aims or objectives. Whereby, forestry is done in woodlots; educational activities (EA) is directly associated with the structurally built areas; agroforestry and kitchen gardening (KG) in gardens; recreational activities (RA) in the playgrounds and tree nursery management (TNM) in the tree nurseries. Even though tree management practice (TMP) came prominently in 4.96% of the sampled schools, it is a general practice which could be done to either clustered, scattered or linearly arranged trees within the school compound hence could not be attached to a single land cover.

Space occupied by land covers and contribution of Land use practices to tree count in schools. Apart from water points and tree nurseries whose spaces are extremely negligible, the amount of space occupied by each land cover was assessed to identify areas within the schools where various land use practices were done as summarized in Table 1 below.

Table 1: Percentage Space Occupied by Various Land Covers in Public Primary School

Range of school land sizes	Built area & assembly	Garden	Playground	Woodlot	Total used%
0.00-1.99	23.97	12.745	26.545	16	71.3
2.00-3.99	34.16	3.3	34.675	9.82	83.5
4.00-5.99	37.805	2.05	31.75	10.855	82.6
6.00-7.99	43.585	1.05	23.415	9.2	72.65
8.00 and above	33.3	0.25	30	10	73.6
Average	31.7	3.12	28.2	10.14	76.3

The above table shows that schools with land sizes below 1.99Ha and those with above 6.00Ha had almost similar measures of used spaces as they had less than 80% of their land occupied by various land covers. Schools with between 2.00Ha and 3.99Ha have the highest percentage of space occupied. The average used spaces for all the schools in Kisumu County is 76.3% while 23.7% is unused.

Further, it was observed that quantifiable space within the schools which could have trees were the gardens and woodlots, given that trees could not be planted on structurally developed spaces nor grown in a playground. However, in some occasions trees are scattered within the open spaces in the built areas or grown along the boundaries but they were difficult to quantify and in most cases negligible. Therefore, it could be said that 63.04% of school land is occupied by structures and playgrounds, while 13.26% have different forms of greening from trees to crops. It was also established that schools with less than 1Ha preferred to have buildings and assembly than any other land use including playgrounds.

However, it was also not obvious that schools which had more than 6Ha would have a higher percentage of space occupied by green land covers. Therefore as Ailin & Nirmala (2017) established, school greening activities begin with prioritization of land uses.

Apart from the above mentioned land covers, public primary schools had a total of 25354 trees scattered within the compounds, others arranged in a linear pattern or clustered in woodlots and gardens. 99.19% schools had mature or young trees in the ratio of 3:1 while the rest had seedlings. The small number in schools with seedlings was attributed by the period within which the study

was conducted which was just after a long holiday break. Therefore, school activities had not been running for some time and the majority of schools had not yet started their ground greening initiative for the year. Across all the sub-counties and the category of land sizes, there are a significantly higher number of exotic trees as compared to indigenous trees. Trees present in the designated spaces for various land covers were physically counted and to represent trees resulting from the land use practices done in these spaces. Table 2, below gives a summary of the resultant trees from these land use practices.

Table 2: Resultant Trees from Land Use Practices in Public Primary Schools in Kisumu County

Land Use Practice	Land Size (Ha)					Total	Contribution (%)	Mean
	0.00-1.99	2.00-3.99	4.00-5.99	6.00-7.99	8.00 and above			
Forestry	609	2473	4455	513	509	8559	33.76	140
Educational activities	0	1030	86	4	0	1120	4.42	11
Tree nursery	0	550	0	0	0	550	2.17	29
Kitchen gardening	28	253	103	75	17	476	1.88	8
Agroforestry	0	73	80	0	0	153	0.6	10
Recreational activities	0	34	31	0	0	65	0.26	4
Total	637	4413	4755	592	526	10923	43.08	

Although 100% of the schools had educational activities, these activities could not result in tree planting and management in all of these schools, a fact which is consistent with Gibb, (2016) and Mitchell & Fisette, (2018) findings, hence the mean (11 trees). Similarly, recreational activities, found in 96.77% schools contributed to the least number of trees compared to all the practices. This could be explained by the nature of the two land use practices which allowed for minimal space for trees.

However, woodlots which were present in 43.55% and covered an average of 10.14% contributed the highest number of trees. Agroforestry and kitchen gardening in school gardens covering an average of 3.12% contributed to 8 and 10 trees respectively. The two and tree nursery practice which contributed to the second largest number of trees despite occupying legible spaces, were the only ground greening land use practices identified. The greater means obtained by the three was because of the nature of the land covers which lent more to tree planting and management. This was a confirmation of findings recorded by Oduol, et al,(2006); Mirriam et. al. (2015) & Gibb (2016)

Generally, land use practices in public primary schools contribute to 43.08% (10923 trees) of the total tree count. Apart from agroforestry and forestry, the number of trees from land use practices peaked in schools with 2 to 4 hectares of land then gradually reduced as the sizes of land increased. With respect to school land sizes, the number of trees from land use practices increase from schools with less than 2Ha of land up to those with 4Ha to 6Ha then reduce as the land sizes increased.

Further, with respect to the mean number of trees per land use practice; educational activities, forestry, tree nursery and agroforestry contribute to at least 10 trees per school. Therefore, apart from recreational activities, land use practices contribute greatly to the population of trees in public primary schools and hence can help in solving various physical, social, economic and environmental problems (Zinck, et. al. (2013), Kyule, et.al. (2015) and Sivarajah, et al. (2018)). Relationship between resultant trees from land use practices and tree population in schools

To effectively understand the influence of land use practices on tree population in public primary schools, preliminary analysis on school land sizes and total tree count was conducted. The analysis shows that there was a significantly weak positive correlation between the land size of public primary schools and tree population ($r=0.192$). At intercept of 36.916, simple linear regression showed that for every increase in 1ha of school land size, an increase of 85 trees would be expected. The analysis revealed that land size ($p=0.03<0.05$) significantly influence tree cover in public primary schools as trees require space to grow, hence can only exist where there is one.

Therefore, given the land sizes of schools visited (mean=3.26Ha); as established by Evergreen (2002); public primary schools have great opportunities to contribute significantly to overall community sustainability by making or contributing to environmental greening.

Further analysis to establish the relationship between land use practices identified and tree population in public primary schools was carried out as in Table 3 below.

Table 3: Relationship between Trees from Land Use Practices and Total Tree Population and That between Spaces Occupied by Land Covers and Tree Count: Regression on Resultant Trees from Land Use Practices and Total Tree Population

Variable	Estimates	SE	t-value	Pr(>/t)	
Intercept	151.387	24.5859	6.157	1.07e-08***	
Educational activities	-0.279	0.453	-0.616	0.539	
Kitchen gardening	7.992	3.311	2.413	0.017*	
Agroforestry	7.739	5.812	1.332	0.186	
Recreational activities	0.364	5.012	0.073	0.942	
Forestry	1.946	0.169	11.492	<2e-16***	
Tree nursery	8.897	0.761	11.695	<2e-16***	
Regression on space occupied by land covers and tree count					
Variable	Unstandardized coefficient	SE	Standardized coefficient	t-value	p- value
Buildings	1.315	1.671	0.064	.787	0.433
Field	22.123	34.928	0.052	.633	0.528
Garden	377.967	178.997	0.174	2.112	0.037*
Woodlot	432.688	86.141	0.4240	5.023	4.53e-05***

Notes: Significance codes- 0 '***' 0.01 '*'

From the analysis, trees from land use practices have a highly significant positive correlation with the total tree count in public primary schools ($r^2=0.843$ & $p=1.07e-08$). The value of r^2 showed that 84.3% of the total trees present in public primary schools could be explained by the trees from various land use practices in these schools. This means that apart from the school land size, the modifications and management practices done is a major factor in determining the number of trees in the sampled schools as earlier alluded. Further, forestry ($p=2e-16$), tree nursery ($p=2e-16$) and kitchen gardening ($p=0.017$) have a significant correlation with tree population in the sampled schools.

For every 1Ha increase in space for garden and woodlot, there would be a statistically significant increase in the total number of trees in public primary school ($P<0.05$) by 378 and 433, respectively. The high significance level of correlation for forestry and tree nursery could be explained by the fact that these land use practices purely deal with tree planting and management and that their major output is trees. Therefore schools which had woodlots and tree nurseries would do various management practices to ensure success, which is

pegged on the resultant number of trees. Besides, kitchen gardening ($p=0.017$) and sizes of these gardens ($p=.037$) also have significant positive correlation with tree count. Generally, forestry, tree nursery and kitchen gardening were the major ground greening practices hence the significance.

As Evergreen (2002), Mborra, et.al (2008) & Kyule, et. al. (2015) put it, setting up woodlots, tree nursery and kitchen gardening are the major ways schools contribute to environmental greening; meet present and future demand for planting material and equip learners with appropriate knowledge, skills and techniques they can apply to promote agroforestry even out of school

On the other hand, educational activities and recreational activities done in built areas and fields have insignificant correlation with the number of trees ($p>0.05$). Subsequently, space in hectares for buildings and fields were found not significantly correlated with the total number of trees. This is because of the nature of their land covers-buildings and playgrounds- which allows for minimal consideration of trees as output. Even though agroforestry is a ground greening land use practice, it had insignificant relationship with the total number of trees. This could have been because of its frequency, priority and difficulty to access right trees (Food and Agriculture of the United Nation, 2007).

As previously stated schools have an average of 76.3% of their land occupied by various land covers and 23.7% is unused. Assuming that part (10%) of the total school land size is to be used for tree cover establishment while the rest (13.7%) left for other school developments, the following increase in number of trees would be achieved respectively.

When the 10% is added to garden:

When the 10% is added to garden:

Additional trees from garden = 0. 1 of SLS * 0. 174 ...Equation 1

When the 10% is added to woodlots:

Additional trees from woodlot = 0. 1 of SLS * 0. 42Equation 2

Where SLS is the school land size

Since the size of the school garden and woodlots were distinct and positively significant in determining the number of trees in public primary schools. They were the only land covers which could be manipulated to increase tree population in schools. As much as tree nursery management also had a

significant relationship with tree count, the sizes of tree nurseries encountered were negligible with respect to the total school land size.

CONCLUSION AND RECOMMENDATION

The study showed that there is a significant correlation between the land size of public primary school and tree population. This means that, however not strongly, total school land size is a determinant factor while making decisions on school ground greening. Therefore, given the recorded land sizes and availability of unused spaces, public primary schools have great opportunities to contribute significantly to overall community sustainability by making or contributing to environmental ground greening.

Further, a positive correlation between school land use practices and tree population shows that the choice of land cover and management practices done in schools significantly influence tree population in these institutions, to be specific, forestry and gardening among the other land use practices. Therefore, with reference to availability of unused spaces and significant relationship between size of land occupied by woodlots and gardens and number of trees, there is a possibility of increasing tree cover. It can then be said that increasing space under trees-woodlots and gardens- have a potential increasing the total number of trees in public primary schools.

Therefore, with proper record keeping, public primary schools should set aside part of their unused spaces to establish active woodlots and gardens to purposely increase tree cover in these institutions.

Areas for Further Research

The researcher recommends a similar study which goes beyond determining influence of land use practices on tree population to influence of these practices on actual tree cover. That is, application of actual measurement of individual tree canopy with respect to land covered and then obtaining its relationship with the land use practices.

Emerging Issues and Controversies

Land Use and Infrastructure: One potential issue is the availability of land within public primary schools for planting trees. Schools may have limited space due to existing infrastructure, playgrounds, and buildings. Balancing the need for tree planting with other educational and functional requirements can be a challenge.

Competing Priorities: Schools have multiple priorities, including academic curriculum delivery, extracurricular activities, and student well-being. Incorporating tree planting and management into an already busy schedule might lead to debates about how to effectively allocate resources and time.

Maintenance and Care: Planting trees is one aspect; ensuring their long-term survival requires consistent care and maintenance. There might be controversies surrounding who is responsible for ongoing tree care, including watering, pruning, and protection from pests.

Local Ecological Considerations: Tree species selection needs to consider local ecological conditions to ensure the planted trees thrive and contribute positively to the environment. Disagreements might arise regarding which tree species are appropriate for the specific region and school environment.

Community Engagement: Involving local communities in tree planting initiatives can be essential for success. However, controversies might arise if there's a lack of community support, interest, or understanding of the benefits of tree cover.

Funding and Resources: Implementing tree planting initiatives requires financial resources for purchasing saplings, tools, and other necessary materials. Disputes might occur over funding allocation, especially when schools already face financial constraints.

Curriculum Integration: Integrating tree planting and environmental education into the curriculum can be contentious, especially if educators and administrators perceive it as an additional burden on an already packed curriculum.

Long-Term Sustainability: Achieving a ten percent tree cover goal involves not just planting trees but also ensuring their survival and growth over time. Sustainability planning and ensuring continuity beyond short-term initiatives could be points of discussion.

Measurement and Accountability: Accurately measuring the percentage of tree cover and tracking progress towards the goal might be challenging. Defining methods for measurement and establishing accountability mechanisms could be debated.

Climate Change and Adaptation: Discussions might arise regarding how tree planting in schools contributes to climate change adaptation and mitigation. The role of trees in enhancing resilience and sequestering carbon could be points of contention.

Biodiversity and Invasive Species: Controversies might emerge concerning the potential impact of introduced tree species on local biodiversity, including the risk of invasive species outcompeting native vegetation.

Equity and Access: Ensuring that all public primary schools, including those in marginalized areas, have equal opportunities to contribute to tree cover goals might be a challenge. Debates could arise about how to address disparities in access to resources and opportunities.

REFERENCES

- AAR group. (2014). *Sustainability Report Communication of Progress*. UN Global Compact.
- Ailin, I., & Nirmala, R. (2017). The Green School Concept: Perspectives of Stakeholders from Award-Winning Green Preschools in Bali, Berkeley, and Hong. *Journal of Sustainability Education Vol. 16*, 18-32.
- Ambus, L., D'Arcy, D.-C., & Tyler, S. (2007). Big expectations for small forest tenures in British Columbia. *BC Journal of Ecosystems and Management Volume 8, Number 2*, 46–57.
- Basic Education Act. (2013). *CAP 211*. Nairobi: Government press.
- Bekele, M., Tesfaye, Z. Y., Zewdi, S. M., Y., T., Brockhaus, M., & Kassa, H. (2015). The context of REDD+ in Ethiopia: Drivers, agents and institutions. *CGIAR*, 43-60.
- Blaes, A., Ridgers, N. D., Aucouturier, J., Praagh, E. V., Berthoin, S., & Baquet, G. (2013). Effects of a playground marking intervention on school recess physical activity in French children. *Elsevier Inc*, 581-583.
- Browning, M. H., & Rigolon, A. (2019). School Green Space and Its Impact on Academic Performance: A Systematic Literature Review. *Int. J. Environ. Res. Public Health*, 74.
- Chawla, L., Keena, K., Pevec, I., & Stanley, E. (2014). Green schoolyards as havens from stress and resources for resilience in childhood and adolescence. *Health Place*, 1–13.28.
- County Government of Kisumu. (2018). *Kisumu County Annual Development Plan (FY 2018/2019)*. Kisumu.
- County Governmnet of Kisumu. (2018). *Kisumu County Intergrated Development Plan II, 20182022*. Kisumu, Kenya.
- Darmody, M., Smyth, E., & Doherty, C. (2010). Designing Primary Schools for the Future. *ESRI Research Series*;16, 37-47. Deakin, E., Kshatriya, M., & Sunderland, T. (2016). *Agrarian Change in Tropical Landscapes*. Indonesia: Center for International Forestry Research.

- Emmanuel, N. C., & Davison, J. G. (2010). *The Dry Forests and Woodlands of Africa; Managing for Products and Services*. London: Earthscan.
- Evergreen. (2002). *School Ground Greening -A Policy and Planning Guidebook*. Evergreen: (pgs. 4-49).
- FAO. (2015). *Kenya Forest Assessment Report*. Rome: Country Report Kenya.
- Food and Agriculture of the United Nation. (2007). *The State of the World's Forest*. Rome: Electronic Publishing Policy and Support Branch.
- Food and Agriculture Organization. (2009). *The state of the World's Forest*. Rome: FAO-UN.
- Gibb, N. (2016). *Sustainable and Climate-Friendly Schools A Teacher's Guide to Taking Action*.
- Government of Kenya . (2018). *National Climate Change Action Plan (Kenya) 2018-2022 Volume 3: Mitigation Technical Analysis Report*. Nairobi: Ministry of Environment and Forestry.
- Laura, A. G., Alain, K., & Anne-Marie, T. (2010). *Governing African forest in a globalized World*. United Kingdom: Earthscan.
- Mbora, A., Lillesø, J.-P. B., & Ramni, J. (2008). Good Nursery Practices: A Simple Guide. *World Agroforestry Centre 36pp, 2-8*.
- Merike, D., Emer, S., & Cliona, D. (2010). Designing Primary Schools for the future. The Economic and Social Research Institute, Research Series Number 16, 42-49,107-111.
- Miriam, K. N., Ochieng', K. J., & Agnes, N. O. (2015). Promoting Evergreen Agriculture Among Secondary Schools in Arid and Semi-Arid Lands of Kenya. *International Journal of Scientific Research and Innovative Technology Vol. 2 No. 3, 1-8*.
- Mitchell, S., & Fisette, J. (2018). *The Essentials of Teaching Physical Education: Curriculum, Instruction, And Assessment SHAPE America Set the Standard*. Reston: Human Kinetics.
- Mugenda, O. M., & Mugenda, G. A. (2003). *Research methods: Quantitative and qualitative approaches*. Nairobi: African Centre for Technology Studies.

- Oduol, P. A., Nyadzi, G., Mbwambo, L., R Swai, B. G., Mwangeni, W., & D. Mbaruk, T. p. (2006). Scaling Up Agroforestry Technologies Through Schools: Lessons from Western Tanzania. *Workshop* (pp. 63-69). Mbeya: National Agroforestry and Environment.
- Sanoff, H., & Walden, R. (2016, march 10). School Environments. Retrieved from <https://www.researchgate.net/publication/234625948>,
- Temu, A., Chamshama, S., Kung'u, J., Kaboggoza, J., Chikamai, B., & R., K. (2008). New Perspectives in Forestry Education-Forestry Schools and Education Peer reviewed papers presented. Nairobi: ICRAF.
- Wolfers, B. J., Delacote, P., & Serge, G. (2015). An empirical analysis of forest transition and land-use change in developing countries. *LEF – AgroParisTech/INRA – 14*, 1-36.
- Zinck, E., & Carola, E. (2013). *Environmental Education to Promote Peace and Cooperation: A Case Study of Tree Nurseries in Nakuru, Kenya*. Retrieved from *Children, Youth and Environments* 23(1): 198-210: <http://www.jstor.org/action/showPublication?journalCode=chilyoute nvi>.