UNIVERSITY OF CAPE COAST

ENVIRONMENTAL HEALTH IMPACT OF WASTE MANAGEMENT PRACTICES OF THE UNIVERSITY OF CAPE COAST AND ITS SURROUNDING COMMUNITIES: PERCEPTIONS OF UNDERGRADUATE STUDENTS.

VIDA ADJELEY AKAI-TETTEH

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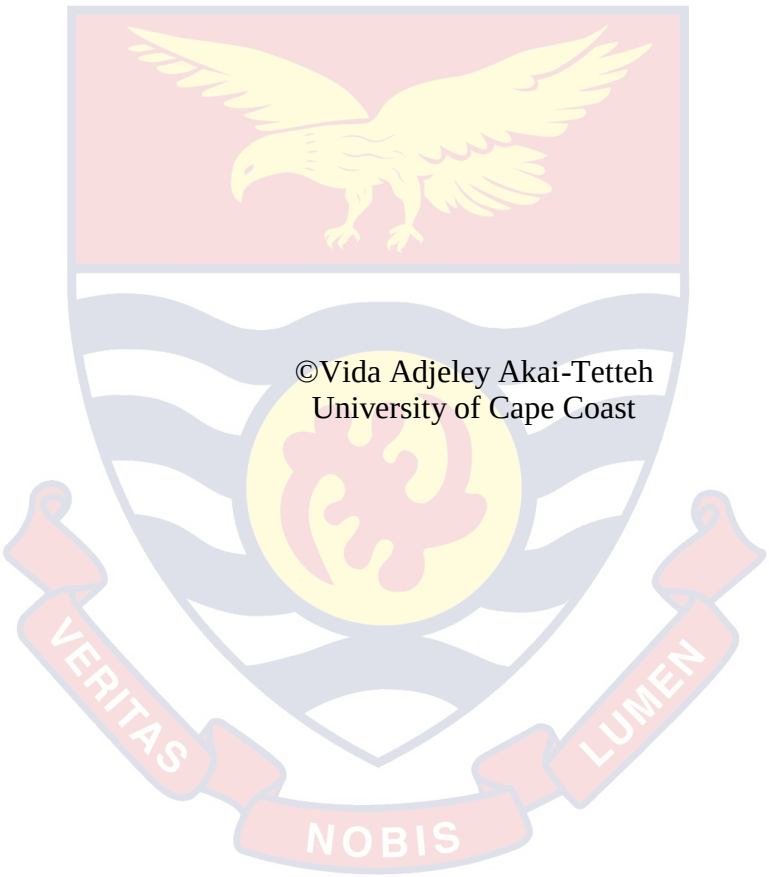

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ENVIRONMENTAL HEALTH IMPACT OF WASTE MANAGEMENT PRACTICES OF THE UNIVERSITY OF CAPE COAST AND ITS SURROUNDING COMMUNITIES: PERCEPTION OF UNDERGRADUATE STUDENTS.

BY

VIDA ADJELEY AKAI-TETTEH

Thesis submitted to the Department of Health, Physical Education and Recreation of the Faculty of Science and Technology Education, College of Education Studies, University of Cape Coast, in partial fulfilment of the requirements for the award of Doctor of Philosophy Degree in Health Promotion (Environmental and Occupational Health)

OCTOBER 2021

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: …… Date: …….

Name: Vida Adjeley Akai-Tetteh

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature: …… Date: ……

Prof. Joseph K. Mintah

Co-supervisor's Signature: …….. Date:.....

Name: Dr. Edward Wilson Ansah

ABSTRACT

Quality health status is paramount for a smooth academic work of students. However, poor waste management practices could expose students to adverse health impacts that could negatively affect their performance. The study assessed the environmental health impact of waste management practices of the University of Cape Coast and its surrounding communities. In this descriptive study, a stratified proportional sampling technique was used to select 4,400 students for the quantitative analysis. Three key informants were purposively sampled for face to face interview. Structured questionnaire, interview guide and observational checklist were used for the data collection. The inferential analysis on the quantitative data was done using Wilcoxon rank sum test, logistic regression analysis, and structural equation model (SEM). The qualitative responses were analysed through data reduction and thematic content analysis. The waste management practices of the students were generally good though evidence of poor waste management were observed in the communities. Again, it was observed that, poor waste management influences the health status of the students negatively. The university also follows the National Sanitation Policy to guide waste management practices. The main conclusion was that waste management practices have direct and indirect adverse impact on the health status of the students. The study recommends that the Environmental Health Section of UCC and the Environmental Unit of CCMA need to increase the frequency of waste collection. The Environmental Health Section of UCC and the Environmental Health Unit of CCMA need to sensitise students on the need to control the environmental health impact before its extent to affect their health.

KEYWORDS

Environmental health

Food Waste,

Gender

Health Impacts

Residential Status

Waste Generation

Waste Management challenges

Waste management Policies

Waste Management Practices,

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DEDICATION

To the memory of the late Professor Joseph Kwesi Ogah, of the Department of Health, Physical Education and Recreation- University of Cape Coast

TABLE OF CONTENTS

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
ANOVA	Analysis of Variance
BSU	Benguet State University
CCMA	Cape Coast Metropolitan Assembly
CED	Cumulative Energy Demand Indicator
CIRT	Centre for Innovation and Research Teaching
DRIC	Directorate of Research, Innovation and Consultancy
DWMP	District Waste Management Plan
ECOTEC	Emission Control Optimization Technology
EHI	Environmental Health Impact
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
ERB	Environmentally Responsible Behaviour
ESMF	Environmental and Social Management Framework
FAs	Field Assistants
GDHS	Ghana Demographic and Health Survey
GESAMP	Group of Expert on the Scientific Aspect of Marine Environmental Protection
GNA	Ghana News Agency
HCF	Healthcare Facility
HCW	Healthcare Waste
HI	Health Impact
HPER	Department of Health, Physical Education and Recreation

HRM	Halifax Regional Municipality
IPCC	Intergovernmental Panel on Climate Change
IRB	Institutional Review Board
ISWM	Integrated Solid Waste Management
IVs	Independent Variables
IWM	Integrated waste management
KMA	Kumasi Metropolitan Assembly
MLGRD	Ministry of Local Government and Rural Development
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NESSAP	National Environmental Sanitation Strategy and Action Plan
OECD	Organisation for Economic Co-operation and Development
PCB	Perceived Behavioural Control
PWM	Poor Waste Management
PWMP	Poor Waste Management Practices
SDG	Sustainable Development Goals
SEM	Structural Equation Model
SN	Subjective Norm
SPSS	Statistical Package for Social Science
SRC	Students Representative Council
SRS	Students Records Section
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action

TTM	The trans-theoretical model of change
UCC	University of Cape Coast
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United National Development Programme
UNEP	United Nations Environmental Programme
UNEPA	United Nations Environmental Protection Agency
UN-HABITAT	United Nations HABITAT
UNHCHR	UN High Commissioner for Human Right
UNICEF	United Nations International Children's Emergency Fund
USEPA	United States Environmental Protection Agency
USPS	Urban Sector Programme Support
W M	Waste Management
WHO	World Health Organization
WMP	Waste Management Practices
WRAP	Waste and Resources Action Programme

CHAPTER ONE

INTRODUCTION

Background to the Study

Global garbage production is estimated to exceed population growth by twofold by 2050(World Bank Group, 2018a). The quantity of waste generation rate is projected to increase rapidly with increasing population and economic development (World Bank, 2018b). According to Liyala (2011), one of the most visible urban services whose sustainability and effectiveness serve as an indicator for sound municipal management, successful urban reforms and good local management is the swiftness of the waste management process.

At least thirty-three percent of the world's estimated generation of 2.01 billion tonnes of municipal garbage is conventionally not controlled in an environmentally sound manner (Kaza, Yao, Bhada-Tata, & Van Der Woerden, 2018). Plastic waste is considered the greatest challenge in municipal solid waste stream. There was a global generation of 242 million tonnes of plastic waste in 2016 alone. On the volume of waste generated, it is estimated that 1.6 billion tonnes of carbon dioxide (CO_2) equivalent, greenhouse gas emissions were generated from solid waste treatment and disposal in 2016 (Kaza et al., 2018). That same year recorded an estimation of 1.6 billion tonnes of carbon dioxide (CO_2) equivalent greenhouse gas emissions generated from solid waste disposal and management. Moreover, by 2050, solid waste related emissions are predicted to upsurge to 2.6 billion tonnes. According to World Bank (2018b), waste has become a threat to the environment and human health. Though there are ways to keep the environment free from the negative effects of waste, the indiscriminate disposal and exposure of waste pose severe

danger to the environment and human health (Hoornweg, & Bhada-Tata, 2012). This is due to the fact that waste degrades the natural phenomena and thereby creating health risk which may be carried through different vehicles including flies, dogs, and rodents (Lomate, 2013).

As countries advance from low-income to middle-and-high-income levels, their waste management situations also evolve. Movement to urban centres and growth in prosperity are linked to increases in per capita generations of waste (World Bank, 2012a). Larger population centres are furthermore, created from rapid urbanization and population growth, making the collection of various types of waste and the acquisition of land for disposal and management very difficult (Kumar et al., 2017). The World Bank (2012b) observed that increasing urbanization and its associated lifestyle changes among urban dwellers have led to the production of huge volumes of garbage. According to Gallo et al., (2018) and Fernández, Leslie and Ferreira (2015), Waste, which is not controlled effectively pollutes the world's oceans, clogs sewers, causes flooding, and spreads diseases by breeding vectors. In addition, poorly managed garbage causes respiratory difficulties due to airborne particles from garbage burning, affects animals that unintentionally consume waste, and has a negative impact on economic development due to reduced tourism.

In a few years to come therefore, global governments will be expected to meet an increased annual waste management cost from $205 billion to about $376 billion (World Bank, 2018a). Inefficient collection methods, insufficient coverage of the collection system, and inappropriate disposal of municipal garbage are all issues with waste management techniques in most

developing countries (Ferronato & Torretta, 2019). Also, waste management funding is always insufficient, and real budgets are never completely recovered (Uma, Nwaka, & Enwere, 2013). The World Bank has invested more than $4.7 billion in over 340 solid waste management programs in countries worldwide since 2000 (World Bank, 2018a).

Municipal waste has gained much attention in low-and-middle-income countries due to the relationship waste has with health care, education, and transportation (World Bank, 2012). Improperly managed waste is among the top five global challenging problems for city managers (Guerrero, Maas, & Hogland, 2013; UN HABITAT, 2013). World Bank has documented that even though developing countries spend 20-50% of their regular budget on solid waste management, the situation still remains that 30-60% of urban solid waste is not collected, serving only less than half of the population (World Bank, 2018b). In the same vein, the United Nations Conference on Human Settlement in 1996 established that over a third of waste generated in developing economies is not collected and indiscriminately disposed of at prohibited landfills, on roads, open spaces and waste lands (UN High Commission for Human Right [UNHCHR], 2011).

With over 3.6 billion tons of garbage production annually as by-products of food, yard and wood wastes as well as paper, plastic, glass and metal. Ghana like many other low-income countries has challenges with waste collection and disposal due to infrastructural and technical inefficiencies (Loboka, Shihua, Celestino, Hassan, & Wani, 2013). This can negatively affect the country's effort of ensuring good health and well-being as well as clean water and sanitation for all its citizenry as enshrined in the Sustainable

Development Goal 3 and 6 (Tandoh & Adoboe, 2018). Goal 3 focuses on achieving universal health coverage that seeks equitable access of healthcare services to all men and women. It also proposes to end the preventable death of new-borns, infants and children under-5 (child mortality) and end epidemics. Goal 6 also focuses on reducing toxic waste, eliminating dumping and minimizing release of dangerous substances and materials, and increasing recycling, and safe reuse (United Nations Department of Economic and Social Affairs [UNDESA], 2015). Studies have shown that the storage, collection, transportation, and final treatment/disposal of wastes constitute a major problem in several urban centres in Africa (Okot-Okumu & Nyenje, 2011; Wilcox, Echaubard, de Garine-Wichatitsky, & Ramirez, 2019). The composition of garbage produced in many African urban centres is mainly decomposable organic materials consisting mostly of kitchen wastes, compound wastes, and floor sweepings (Scheinberg, Spies, Simpson, & Mol, 2011). For positive health, aesthetics, and environmental impacts, a well-organized and effective waste collection system must be established.

Poor waste management practices have major health impacts such as skin conditions, breathing abnormalities, duodenal and intestinal complications, dental disorders, ear and eye infections not only on the waste collector but also on the general public (Addo, Adei, & Acheampong, 2015). Perhaps, such wastes have serious health problems to the extent that inappropriate handling of these wastes may cause serious environmental health consequences as well as significant negative impact on human health. Hettiarachchi, Meegoda, and Ryu (2018) reiterated that, such problems are much higher in under developed and developing nations due to either the non-existence of proper garbage

segregation method or other disposal methods are not being practised. Therefore, it is incumbent on health professionals to take steps to ensure waste segregation, safe waste disposal and management without causing any unfavourable effect to human health and the environment (Biomedical Waste Rules, 2016).

In Ghana, recycling of hazardous waste has also been a talking point in the media with Agbogbloshie in Accra taking the spot light (Daum, Stoler, Richard, & Grant, 2017). Most Ghanaians dispose of their broken televisions, computers, microwaves, and refrigerators in municipal waste bins, which are further disposed at landfill sites. Waste collectors incinerate these gadgets in order to recuperate such metals as copper, aluminium, and iron. The unwanted parts are burned into ashes. Such waste management practice poses severe danger or infections to the scavengers and the inhabitants who stay nearby (Kishore, Goel, Sagar, & Joshi, 2000). The fumes released from the burning of the plastics and metals produce highly toxic chemicals and carcinogens (Verma, Vinoda, Papireddy, & Gowda, 2016) which can affect the health of the inhabitants. Therefore, there is the need to effectively manage all the various kinds of waste found in the communities.

Moreover, developing countries such as Ghana normally disposed of waste into wetlands, watercourses, drains, and burrow pits. These practices have sometimes resulted in serious human and environmental health hazards (Ihuoma, 2012). Universities like many other institutions face these waste management issues although attempts are made to mitigate the effects (Ebrahimi & North, 2017). Appiah, Amponsah, Asibey, and Ayambire (2019) emphasized that plans to dispose of these wastes have become a major

challenge for both the universities and their surrounding local authorities because of increasing university education in Ghana, coupled with rapid increases in the student population and the in-out-out-out residency policy, which have led to increase in wastes generation both within and outside the universities.

This implies that the waste management practices of the university may have environmental health impact on the surrounding communities as well as the sanitary conditions within the university. Despite the fact that waste generation of the university spills over to the surrounding communities, the waste management policies of the university do not directly apply to these communities. That notwithstanding, the final effects of any such waste management issue, especially the health impact, end up at the university's door step since these communities share a common health facility with the university.

Waste management remains a challenge to both universities and its surrounding communities as student lives continuously expand beyond the borders of the universities (Assumang, 2000). The need for policy action is more than due but that could not be done effectively without proper insight into the dynamics of waste management both within and outside the university community. Hence the need for an empirical enquiry into waste management practices of university students within the halls of residence, in the hostels and apartments in the neighbouring communities.

Statement of the Problem

Waste management is one of the most prominent metropolis services, and its effectiveness and sustainability serve as indicators of good municipal

management, good local governance, and successful urban reforms. For many centuries, those wastes comprised completely of substance which biodegraded easily (such as vegetables and human waste), or were inert (such as bones and wood ash). Given the relatively small inhabitants then, the quantities were minor and could be readily absorbed by the environment. Certainly, they had value in fertilizing the soil. Today, the population has increased with its associated upsurge in waste generation and possible threat to human health and the environment if inappropriately treated, stored, conveyed, disposed of or managed.

The quantum of wastes generated worldwide poses threat to the environment and the measures to effective solid waste management in Africa (Okot-Okumu, 2012). The direct relationship between increasing university population and waste generation is well established in the literature; hence thoughtfulness has been shifted to the consequences of not managing the waste in an environmentally responsible manner. Although several studies have focused on garbage disposal and controlling approaches in Ghana, the debate on the issues of health and environmental health impact is still ongoing and requires further understanding (Addo, Adei, & Acheampong, 2015; Amoah & Kosoe, 2014; Daum et al., 2017; Yoada, Chirawurah, & Adongo, 2014). The tendency for the waste management practices of an academic institution such as the University of Cape Coast to differ from that of the neighbouring community also demands empirical attention in the literature.

The need to juxtapose the garbage controlling approaches of resident and non-resident students is worsened by the fact that the university's garbage controlling approaches do not directly extend to the neighbouring

communities, though a greater part of the student population resides in such communities. Earlier Studies that looked at the universities focused mainly on resident students and dealt mainly with the various types of waste generated and their management practices among university students (Akai-Tetteh, 2014; Dery, 2018). In addition, such studies did not assess the impact of these garbage-controlling approaches in the university on the university environment and the immediate communities. Considering the special role good health plays in the success of academic work and the fact that both resident and non-resident students depend on the University for their health care, it is imperative to devote much time to research into issues that could contribute to the escalation of any health condition. The study also assessed the nature and forms of existing policies of the university in terms of their coverage and future directions for the university communities and the neighbouring communities.

Purpose of the Study

The purpose of the study was to assess the environmental health impact of garbage-controlling approaches in the University of Cape Coast and its immediate communities. It evaluated the type of waste generated by students, their garbage-controlling approaches, the challenges of garbage-controlling, environmental health and health impact of reduced garbage-controlling approaches, and the existing policies and strategies used to mitigate the environmental health impacts of reduced garbage-controlling approaches.

Research Questions

This study seeks to answer the following questions:

1. What types of waste are generated in the University of Cape Coast campus and its surrounding communities?
2. What are the existing waste management practices in the University of Cape Coast and its surrounding communities?
3. What are the challenges associated with managing waste in the University of Cape Coast and its surrounding communities?
4. What are the environmental health impact of waste management practices in the University of Cape Coast and its surrounding communities?
5. What are the health impact of waste management practices in the University of Cape Coast and its surrounding communities?
6. What existing policies and strategies are there to mitigate the environmental health impact?

Hypotheses

As part of evaluating the research questions, the following alternate hypotheses were stated:

1. Poor waste management practices do influence the health status of the students of UCC.
2. Poor waste management practices do influence the quality of the environment in UCC and the surrounding communities.
3. Environmental health does mediate the effects of reduced garbage controlling and health status of the students of UCC.

Significance of the Study

The study would provide information on the proper ways of managing waste in the University of Cape Coast. The outcome is of great importance to the university management in reviewing policies and regulations on the controlling of garbage in and around the university community. It also provides alternative means of knowledge to other tertiary institutions and to all stakeholders in addressing waste management issues. It again provides avenue to the effective understanding of the different challenges that resident and non-resident students encounter in their waste management process. The results also add to the call for specialised waste management policies for higher institutions in Ghana, especially in the case of the University of Cape Coast.

Delimitations

Issues concerning waste generation and poor waste management are so numerous that it is not feasible for any single study to capture all. The study was delimited to University of Cape Coast and its surrounding communities. Specifically, the data collection included the eight traditional halls of residence and the hostels in the five immediate communities that provide accommodation to non-resident students. Also, the study was delimited to solid, liquid and biomedical wastes and how they are disposed of in the university and its immediate environment.

Furthermore, the study population was delimited to undergraduate regular students of 2018/2019 academic year in the eight traditional halls of residence as well as those affiliated but staying outside the halls. Other three key individuals including the officer of the Environmental Health Section of the University of Cape Coast, the officer of the Environmental Health and

Sanitation Unit of the Cape Coast Metropolitan Assembly (CCMA) and the Director, Directorate of Health Services-UCC. The study was again delimited to observation of bin sites in the halls of residence and the dumpsites in the communities that surround the university.

Limitations

The major limitation of the study was its theoretical scope which was limited to waste generation, practices, and impact (environment health and health), but failed to consider waste segregation and recycling. The scope did not also cover waste management practices of staffs of the university as well as non-students in the neighbouring communities, which are equally important. Another limitation could be traced from the sampling procedure and the representativeness of the sample for the non-residential students. That is though the probability sampling technique was used for the selection of the residential students, that of the non-residential students followed a non-probability sampling procedure due to lack of data on the distribution of non-residential students in the neighbouring communities. Also, the study was unable to estimate the actual impact of waste management practices due mainly to unavailability of health data on respondents that could be matched to their waste management practices. Again, certain impacts of reduced garbage-controlling such as cholera are not predictable and difficult to assess in a non-experimental study like the current study.

Definition of Terms

Environmental Health – protection of human health and the environment from the negative effect of waste and promoting well-being (WHO, 2017).

Waste – discarded material which has no consumer value to the one who disposed of it. However, if another person picks it (waste material) up and puts it to use, it becomes a resource (Environmental Protection Agency [EPA], 2019).

Solid Waste – refers to the range of garbage arising from animal and human activities that are discarded as unwanted and useless. Solid waste is generated from industrial, residential and commercial activities which include fine dust, cinder, metal, glass, paper and cardboard, textiles, putrescible vegetable materials and plastic characterize waste (LeBlanc, 2019).

Biomedical wastes – garbage that are generated during the diagnosis, testing, treatment, research or production of biological products for humans or animals. They may be solid or liquid such as discarded blood, unwanted microbiological cultures and stocks, identifiable body parts, used bandages and dressings, discarded gloves (Rao, Dhakshaini, Kurthukoti, & Doddawad, 2018).

Liquid waste – liquid waste can be defined as such liquids as wastewater, fats, oils or grease (FOG), used oil, liquids, solids, gases, or sludges and hazardous household liquids (Abercrombie, 2017).

Waste management – relates to materials produced by human activity, and the processes generally undertaken to reduce the effect of waste on health and the environment or aesthetics (LeBlanc, 2019).

Organization of the Study

The study is presented in five chapters. Chapter one entails introduction and background to the study, statement of the problem, purpose of the study, research questions, significance of the study delimitations,

limitations, and definitions of terms. Chapter two explored related empirical and theoretical literature on concept of waste, waste management practices, challenges and problems associated with waste management, health implications of waste, waste regulations and policies, waste management theories, educational institutions and waste, conceptual framework and summary. The methodology of the study is found in chapter three. It consists of the study design, population, sampling procedure, instrument for data collection, data collection procedure, and data processing and analysis. Chapter four presents the findings and discussion while for chapter five, summary, conclusions, and recommendations of the study are presented.

CHAPTER TWO

LITERATURE REVIEW

The purpose of this study was to assess the environmental health impact of garbage-controlling approaches in the University of Cape Coast. It covered areas such as type of garbage produced by students, garbage-controlling approaches of students, challenges of garbage-controlling approaches, environmental health and health impacts of reduced garbage controlling approaches as well as policies and strategies of reduced garbage controlling approaches. The problem regarding the controlling of garbage is an important developmental issue and of global concern given its far-reaching consequences. In view of this, the chapter reviewed related literature on the garbage controlling approaches. Sources for the review of related literature included relevant books, journal articles, magazines and newspaper publication on garbage controlling. The literature review therefore was on the following concepts and theories: The Concept of Waste, Waste Management Practices, Challenges Associated with Waste Management, Health Implications of Waste, Waste Regulations and Policies, Waste Management Theories, Educational Institutions and Waste, Conceptual Framework and Summary.

The Concept and Definition of Waste

Waste is generally described as any unwanted material that emanates from industrial, agricultural, business, and household sources. Waste may come in the form of liquid, solid or gaseous in nature and may be dangerous or harmless depending on the location and the absorption (Davies, 2008). According to the U.S. Environmental Protection Agency [EPA] (2015), waste

is any garbage or refuse slush emanating from a waste water management plant, water resource management plant, or air contamination regulator facility. Waste can be produced by the use of unwanted materials together with solid, liquid, semi-solid, contained gaseous substances and elements resulting from industrial, commercial, mining, agricultural operations, and from community activities.

Many ecosystems have been achieved stability by means of the co-existence of different species. It is possible that it is a type of waste that has grown to be the cause of another, in order to create an equilibrium in the system. For example, carbon dioxide may be waste for humans but beneficial to plants. Waste, according to the EPA (2019), is a discarded item with no consumer value to the loser. However, if someone picks it up (waste) and uses it, it becomes a source. Waste can be recognized without much difficulty than defined. Material or substances no matter their sources can become waste if they are no longer valuable to the owners or they are used and fail to fulfil their purposes (Freduah, 2007).

Solid Waste

Several different organisations and authors have defined solid waste in various forms. Solid waste management, according to Zerbock (2003), includes harmless, industrial, commercial and domestic materials, together with organic waste, appliances, scavenger work, development and safe and secure, and the construction of the waste. According to LeBlanc (2019), solid waste refers to the variety of refuse or gar bagewaste materials arising from visceral and human undertakings that are rejected as undesirable and useless. Furthermore, solid waste is produced from industrial, residential and

commercial activities in a particular area, and may be controlled in a variety of ways. A large combination of materials comprising fine dust, metal, glass, paper and cardboard, textiles, perishable vegetable materials and garbage discarding plastic (Freduah, 2007).

Classifications of Solid Waste

According to Oyelola and Babatunde (2008), solid waste is used for the description of non-liquid waste from farms, commercial, corporate, and public service. The World Health Organisation [WHO] generally classifies solid waste based on their origin or source of generation which include suburban, industrialised, marketable, institutional, building and destruction, metropolitan services, process, and agricultural. Residential or suburban garbage are produced from single and multifamily apartments (LeBlanc, 2019). These wastes generally include foods and foodstuffs wastes, papers and cardboards, plastics, textiles, all types of leather, yard wastes, wood, glass, metals, ashes, special wastes e.g. bulky items, consumer microelectronics, batteries, oil, tires, and domestic harmful wastes. Industrialised garbage, on the other hand, are garbage generated from light and heavy manufacturing, fabrication, construction sites, power and chemical plants (Trozzi, 2009). This includes housekeeping garbage, packaging, garbage associated with food, building and destruction materials, harmful wastes, ashes, special garbage (Pai, Rodrigues, Mathews, & Hebbar, 2014).

Wastes generated from marketable activities as well as firms such as stores, hotels, cafeterias, markets, and office buildings constitute commercial garbage. These include paper, cardboard, plastics, wood, food and foodstuffs garbage, glass, metals, special garbage, and harmful garbage. Institutional

garbage is the by-product of organisations such as educational institutions, health care facilities, reformatories, and administration centres (Troschinetz, 2005).

Municipal solid waste (MSW) comprises regular stuffs, which are unwanted and discarded by members of the community (Kumar et al., 2017). These waste materials consist of items gathered together and picked up by or on behalf of municipal authorities, or directly by the private sector (profitable or private non-profitable establishments). They contain, as a rule, outdoor soles, landscape and tree decorations, all-purpose garbage, parks, seashores and other entertainment areas (Otchere, Anan, & Bio, 2015). Agricultural garbage is generated because of various agricultural procedures. It comprises animal droppings used as fertilizer and other garbage from farm houses, poultry houses and slaughter houses, harvest garbage, fertilizer run-off from fields, pesticides that enter into water, air or soils, salt, and silt drained from grounds (Organisation for Economic Co-operation and Development [OECD], 2004). The scope of this study covers almost all the types of solid wastes identified but focused more on the domestic waste from the residence of the students, institutional waste from offices, and biomedical waste from the University hospital as well as metropolitan waste from the communities.

Biomedical Waste

Biomedical wastes are infectious waste or medical wastes (Rao et al., 2018). They are the wastes generated in the course of the diagnosis, testing, treatment, investigation or manufacturing of biological products for humans or animals. Biomedical or biochemical garbage may be solid or liquid which are communicable garbage such as unwanted blood, discarded microbiological

cultures and stocks, recognisable body parts (including those as a result of amputation). They can also be attributed to human or visceral tissues, used bandages and dressings, gloves, recycled equipment, other therapeutic and medical supplies that may be exposed to blood and body fluids, contaminated needles, blades, lancets, and other devices capable of piercing through the skin (Hinge, Divate, & Nibe, 2015**)**. Rao et al. (2018) emphasized that these wastes are extremely transmittable and can pose severe danger to human health and well-being if not controlled or handled in scientific and safe method. It has been roughly projected that, of every 4 kg of garbage produced in a health care facility, at least 1 kg could be contagious (Radha, 2012). Improper practice of hospital medical wastes disposal affects the para-medical staffs, rag pickers, and the citizens in general besides the medical people who directly come in contact with these wastes.

Biomedical wastes are classified as non-clinical waste and clinical waste special or regulated waste (Pépin, Abou, Pépin, Nault, & Valiquette, 2010). Non-clinical wastes are such wastes that are not posing any threat to human well-being and or the surroundings (Ali, Wang, Chaudhry, & Geng, 2017). These wastes include packaging or wrapping materials such as cardboard, office paper, excess food, and cans. WHO (2017), defines clinical wastes to comprise various kinds of wastes, communicable or infectious waste, radioactive waste, chemical waste, pathological waste, pharmacological waste, and sharps. Clinical wastes, according to Controlled Waste Regulations (1992), are garbage, which comprise exclusively or partially of human and visceral tissue, blood and other body fluids, excretions, medications or other pharmacological products, swabs, bandages, syringes, needles and other

piercing devices, being waste which except considered safe may prove hazardous to persons coming into contact with them. According to Hossain, Santhanam, Nik Norulaini and Omar (2011), any additional waste emanating from therapeutic, treatment dental, veterinary, pharmacological or analogous practice, research, repair, maintenance, teaching, examination or the gathering of body fluid and blood from transfusion, being garbage, which may cause contamination to any individual who comes in connection with it, may be classified as biomedical.

Liquid Waste

Liquid waste is generated from all segments of the society. They consist of sewage as well as wastewater from industrialised procedures including foodstuff, farming processing and industrial (EPA, 2019). The composition of liquid waste, wastewater or sewage is exceedingly different and principally determined by their sources. Residential, commercial, and industrial areas are the three main sources of liquid waste in municipalities and cities. They come from point source and non-point source discharges, which comprises storm water and wastewater respectively.

One of the most serious infrastructure and service deficiencies confronting city authorities is the management of the rapidly growing quantities and complex flows of liquid waste. Liquid waste management services are grossly inadequate, unreliable, and unevenly provided. In many countries, waste removal services are still organized and regulated along a public health orientation espousing the expeditious removal and disposal of waste from residential and other dwelling areas in order to safeguard public health (Karanja, 2005). With the expansion of communities and population

growths, the situation will worsen and the need for harmless, maintainable and reasonable sanitation mechanism or system will even be of a very great importance. According to Faris, Alemayehu, Wubshet, and Hailu (2002), the liquid waste or the sanitation methods, which are encouraged in the developing nations fall under one or two general forms: "Flush-and-Discharge" and "Drop-and-Store". On behalf of residents who do not have or will not have the access to flush toilets, the conservative or traditional substitute is the "Drop-and-Store" means, usually a ditch or pit latrine. Pit latrines are intended for the suppression and indefinite storing of human excreta. The Drop-and-store device is often considered as a sub-standard and short-term solution compared with flush system. Even though this machinery can control infection in some places, it is not regularly feasible in urban congested communities because of inadequate space (Aydiko, 2015).

The important purpose of any garbage controlling agenda is to make sure that there is a reduction in the contamination of the environment as well as using the garbage as a resource. These objectives should be attained in a financially sustainable manner by employing approaches, which can be affordable by the community members over a long period of time and within a minimum risk level to the individuals concerned (Ambat, 2003). Procedures of managing liquid waste vary greatly among communities with respect to local circumstances. Liquid waste can be sub-grouped into other waste types depending on the nature of the waste and the risks it poses. For instance, wastewater may hold biological materials and nutrients that are very useful to agriculture, but may be very dangerous because of the substances or pathogens found in it (Helmecke, Fries, & Schulte, 2020).

Waste Management Practices

Waste management is more comprehensive compared to just the disposal of waste. Management of waste comprises the generation, assortment, processing, and conveyance of waste. It again includes minimization of the generation of garbage and the reconceptualization of garbage as a resource (Jacobs & Sadler, 1990; WHO, 2006). The general garbage controlling approach embraced locally, regionally and nationally have much influence on public health. In the view of Kittle, McGraw and Garbutt (1995), the concept waste management generally refers to resources generated by human activity, and the procedures usually carried out to decrease their influence on health and well-being as well as the environment or aesthetics. Waste management methods can vary for industrialised and unindustrialised nations, for metropolitan and countryside areas, and for indigenous and manufacturing producers. These practices or methods are major challenges confronting most developing countries (Guerrero, Maas, & Hogland, 2013). Guerrero et al. also supported the argument and added that the recent increase in waste disposal problems is because of peoples' attitudes and perceptions towards waste and the inability of metropolitan authorities to include waste management schemes in official development plans.

Solid Waste Management Practices

The management of compacted garbage is an important feature of maintainable growth for any country and its prioritization is greatly reinforced by worldwide initiatives (UNDESA, 2015). Prominent among these initiatives are the Rio Declaration on Environment and Development and the SDGs for the 2012 Sustainable Development Conference (UNDESA, 2015). All these

initiatives explicitly affirmed that environmentally sound controlling of wastes is essential in the preservation of the quality of Earth's surroundings (UNDESA, 2015). Although not emphatically stated as in Agenda 2030, workable solid waste control is indirectly encouraged in the goal 6, which guarantees accessibility and sustainable controlling of water and public health for all and wishes to incorporate the values of sustainable development into national guidelines and programmes, and reverse the damage of environmental resources. Irrespective of the important determinations created by several administrations and additional individuals in handling challenges associated to the generation of garbage, there are still key problems to be solved with regards to the issue of waste (United Nations Environmental Programme [UNEP], 2009). UNEP maintains that, metropolises in unindustrialised nations employ 20-50% of their accessible budget on compacted garbage controlling, despite the fact that 30-60% of all the metropolitan compacted garbage stay uncollected and below 50% of the population have their garbage collected.

The development of civilization and globalization have occurred with their drastic changes in lifestyle and in each action undertaken by human such as schooling, recreation, vacation, feeding, clothing and housing, thereby producing heaps of wastes (Liyala, 2011). The current "culture of consumerism" has worsened the waste problem. This is due to the fact that, a greater percentage of goods produced in the society are for one time use and then disposed off as waste thereafter, creating serious waste management challenges for metropolitan managers. The most generally familiar approaches for the ultimate discarding of compacted garbage were throwing away on land, valleys and mining pits, discarding in water, cultivating into the soil, provide

for hogs, reducing and burning (Addaney & Oppong, 2015). Some of these unwholesome methods of compacted garbage accepted during the initial discarding practice, are still present in cities, towns and villages now. Haphazardly disposing of refuse on open lands and in gutters especially are evident in municipalities and cities, while discarding of refuse in waterways is common with people living along the beaches. Burning of garbage dump is also common in peri-urban and rural communities in Ghana as well as other industrialised nations (Mariwah, 2012).

Implications of Poor Waste Management Practices

Orthodox waste management emphasises greatly on garbage gathering, management (composting and burning) and disposal (landfills). Only inadequate efforts are made to employ integrated or combine garbage-controlling methods that comprise garbage reduction at the source, resource recovery and reprocessing or recycling (UNDESA, 2015). The resource value of garbage becomes difficult achieve until separation of garbage is efficiently and effectively practised at the source (Gunn, 2009). Gunn emphasised that, in several metropolises in unindustrialised nations, rates of gathering of refuse continue to lessen and the value of gathering services are very reduced. He reiterated that whereas there are some successful instances where the private sectors and communities are involved in waste management services in many cities of developing countries, involvement of these segments of society is still very inadequate. In poorer neighbourhoods such as slums, waste gathering services are generally absent (UNDESA, 2015).

The gathered refuse normally ends up in open dumps, where burning may occur, and in some instances deposited in an unauthorised dumping

places (UN-HABITAT, 2010). Due to conventional waste control methods, many municipalities in unindustrialised nations encounter various environmental and health threats as well as be unable to find commercial prospects in terms of the resource value of the garbage. There are several health threats for garbage gatherers and the publics due to conventional garbage controlling methods. Casual garbage collectors, who most frequently work without any protective measures, may be affected by to a variety of health risks including HIV (management of healthcare garbage), tetanus (management of jagged metals), breathing challenges (exposure to smoke), brain damage (contact with lead), injuries, skin and gastrointestinal difficulties (Gunn, 2009).

According to Songsore (2004), majority of the people found in metropolitan and municipal areas reside in insufficient congested housings, suffer the effects of infections and injuries arising from closeness to poisonous and dangerous wastes and poor sanitary conditions. They are mostly susceptible towards typhoid, diahorreal diseases, cholera and intestinal worms from polluted water and food, as well as diseases in connection with poor drainage and refuse gathering comparable to malaria (Yedla, 2005). Furthermore, people living downwind of a burning dumpsite have the possibility of suffering from breathing infections (Tsiboe & Marbell, 2004).

Integrated Solid Waste Management Practices and their Implications

A turn over from the conservative waste controlling methods to the Integrated Solid Waste Management (ISWM) is very crucial for the municipalities to efficiently and successfully control the garbage stream. ISWM is a all-inclusive waste prevention, recycling, composting, and disposal

programme (Kinantan, Matondang, & Hidayati, 2017). An effective ISWM system reflects on how to check, recycle, and control compacted garbage in manner that most efficiently safeguard human health and well-being as well as the environment. ISWM comprises the necessities and circumstances of the local communal members, and then selecting and linking the most suitable garbage controlling methods suitable for those conditions (Reddy, 2016). There are several chances of implementing ISWM as against the conservative or the orthodox method.

Integrated waste management (IWM) has developed as a combined method to deal with waste and merging and applying with various techniques, machineries and organise programs to attain specific goals and objectives of the initiative (Bowan, Anzagira, & Anzagira, 2014). The idea of IWM emerged from the recognition that waste controlling schemes came up through several interrelated structures and functions. It has been established as "a structure of reference for designing and employing new waste management systems and for analysing and optimising existing systems" (UNEP, 2009, p.10). Since IWM system cannot be perfectly achieved (McDougall, White, Franke, & Hindle, 2001), and also no particular approach to waste management, individuals IWM systems would be different across regions and organisations. However, some key elements characterize IWM:

1. engaging an all-inclusive methodology which measures the general environmental problems and monetary value of the system, allowing for planned arrangement.

2. employing a series of gathering and management approaches that dwell on generating fewer waste and efficiently handling waste that is produced at all cost.
3. management of all resources in the solid waste stream as compared to concentrating merely on exact resources or sources of materials. For instance, harmful resources are supposed to be managed effectively in a separate stream within the system.
4. becoming ecologically operational through the reduction of environmental burdens such as discharges to air, land, and water.
5. becoming financially reasonable by drastically reducing cost and embracing a market-oriented method to build customer-supplier relationships with garbage produces that have end uses and can produce revenue.
6. Communal tolerability by integrating community involvement and making certain that people recognise and appreciate their responsibilities in the garbage controlling system (McDougall et al., 2001).

According to UNEP, (2009), once a greater proportion of the garbage stream could be changed for material and resource recovery, a drastic decrease in final volumes of garbage can then be realised. Moreover, improved materials and resources could be recycled to create returns to fund the controlling of garbage. This activity established the principle for the ISWM system grounded on 3Rs (reduce, reuse and recycle) principle. A study by Appiah (2015), revealed that few countries (Wuxi, PR China; Pune, India; Maseru, Lesotho) have pilot tested the ISWM system and has been

acknowledged or approved by indigenous governments. UNEP specified that with suitable separation and reprocessing system, a greater amount of waste can be turned from landfills and changed into resource (UNEP, 2009). Similarly, United States Environmental Protection Agency [USEPA] (2010), revealed that for countries or indigenous authorities to strategize and implement ISWM system, it is important for them to bear in mind an order of methods, which include reduce, recycle, and incinerate/landfill. These methods (source reduction, waste diversion and minimization, reuse, sanitary landfills, open dumping, composting, recycling, and incineration) among others are the approaches of handling solid waste in this modern age (Denison & Ruston, 1990).

Source Reduction

Tchobanog and Kreith, 2002 indicate that any action that enables the decrease in the size or the harmfulness of compacted garbage preceding its processing and disposal in incinerators or landfills is referred to as source reduction or pollution prevention. Nemerow (2009) supports their view and adds that source reduction mainly concentrates on the decrease in the size and/or harmfulness of waste generated. Source reduction comprises the shift to reusable products and packaging, the most conversant is the returnable bottles. According to Urban Sector Programme Support [USPS] (2000), a reduction in waste generation was very essential to the reduction in future waste problems. Repetition in the usage of containers (bags, cups and bowls), better purchasing practises, and reduction in the usage of disposable (one time use) products and packaging among others are possible examples in reduction at the consumption level. The three R's (reduce, reuse, and recycle) are terms mostly

used in garbage controlling process. Available landfill space decreased as rates of waste generation have risen which in turn increased processing costs. Therefore, the three R`s have become a vital view in the efforts to sustainable garbage controlling (Suttibak & Nitivattananon, 2008; Tudor, Robinson, Riley, Guibert, & Barr, 2011).

Concepts of waste reduction or waste management, which means products in the development or modification of public consumption patterns, use and management of waste. These methods of waste reduction: (purchasing reusable products instead of one time use, engaging in a reusable product packaging system. Again, purchasing eco-friendly products, which can be repaired and replace, prevent the production of garbage and reduce the harmfulness of the subsequent garbage (Jouhara et al., 2017). The methods can also be attained, in various ways by decreasing the intake of goods and services.

Waste Management: Reuse

Sometimes, it is likely to put a product to use many a time in the same form, for the same reason. This act represents a repeated use of the product (USEPA, 2010). This may include the use of one-sided paper for writing and repeating the usage of disposable items, which consist of shopping bags, storage boxes, and containers (Davis, 2008). Replaceable products consider the importance for obtaining some other products, thus preventing the production of garbage. Minimizing garbage from increased reuse, offers a number of benefits, including conservation, utilisation of the natural resources, minimizing the creation of new products and waste during the manufacturing process formed, decrease in the volume of garbage generated in the device,

and decrease of costs in connection with wastewater (USEPA, 2010). It is assumed that garbage will be generated as a consequence of everyday life (Kim, 2002). However, in several instances, this waste can be redirected and reused in any other form. Glass, plastic, and metal products tend to accumulate and turn into new materials or objects. By reusing the product, it offers many advantages of garbage degeneration efforts (transfer of fresh material, use of garbage, reduction of costs incurred in connection with the sale).

Waste Management: Sanitary landfill

Sanitary land filling comprises restricting the waste, compressing it and topping it with soil. Not only does it prevents burning of refuse but also helps in retrieval of land for valuable use (Centre for Environment and Development, 2003). The ancient and absolutely the utmost dominant practice of final waste disposal is the situation of compacted garbage in landfills (Zerbock, 2003). Zerbock, was of the view that landfills are just undeveloped and occasionally organised rubbish dump. He emphasized that, level of engineering, planning, and administration involved marks the difference between landfills and dumps. Exposed dumps are consequence of inadequate engineering measures, inadequate leachate controlling, and lack of consideration of landfill gas controlling. The method also lacks working procedures comprising record keeping of consumers and monitoring the amount of "tipping fronts" or compaction of garbage (Puopiel, 2010).

Landfills remains a unique method of garbage controlling measures, which not even one person wants it, yet needed by everyone (Nemerow, 2009. Mostly, combinations of garbage controlling methods need landfilling to enable them function efficiently. Among the key controlling choices of

compacted garbage, landfills become the single controlling method that is equally essential and adequate. Siegle (2006) indicates that there are certain types of garbage, which are very difficult to recycle. Various biodegradable wastes ultimately get to a stage where their inherent benefits entirely degenerate whereby can no longer get better, and recycling itself generates residuals. He further emphasised that knowledge and process of modern landfill can guarantee the protection of human health and wellbeing as well as the environment.

In view of the different opinions of several writers concerning sanitary landfill as an option for waste management, they did not recognize that landfill goes with lots of disadvantages such as costly in its construction and maintenance, pollution of underground water as a result of leaching, and location is difficult with regards to accessibility of land mainly in the metropolises. The authors again did not clearly spell out other critical causes such as gas recovery, composting, garbage to energy recovery, storm water control, distance to any settlement and water body

Waste Management: Recycling

Efforts to take action to decrease garbage generation before the actual generation takes place can be termed as pre-cycling (Halifax Regional Municipality [HRM], 2010). Recycling is regarded as an absolute means of reducing the volume of domestic solid wastes that are the dumped (Momoh & Oladebeye, 2010). Raw materials needed by industries are again produced through recycling. However, this may not be worthwhile in unindustrialized nations including Ghana. USEPA (2010) has suggested retrieval for recycling as one of the most applicable garbage controlling methods. United States

Environmental Protection Agency (2010) argues that, recycling converts resources, which would otherwise become discarded, into worthwhile reserves. The practice produces ecological, economic, and community incomes into natural resource management, energy conservation, toxic waste avoidance, and financial growth and competitiveness. Most seriously, large volumes of discarded materials contain worthwhile resources which comprises metals, glass, paper, wood, and plastic that can be reprocessed and utilized again as raw materials.

Recycling is the most apparent and attainable method compared to all the other waste controlling decisions (Hung, Shammas & Wang, 2014). Hence, recycling sends unprocessed products back to market by distinguishing products, which can be used again, from the rest of the metropolitan garbage stream, with other full advantages. Recycling protects valuable limited resources, lowers the need for mining of virgin materials and reduces the environmental impact for mining and processing (Nemerow, 2009). For instance, according to the Institute of Waste Management as cited by Tsiboe and Marbell (2004), UK recycles only 11% of its household garbage, Italy and Spain only 3%, Netherlands 43%, Denmark 29%, and Austria 50%. However, one of the vital elements to the effective implementation of any recycling project is cost. The original capital projections are so huge that even developed countries are sometimes unable to fully implement the project (Hopewell, Dvorak, & Kosior, 2009). Nevertheless, it possibly will be the finest conclusion for effective solid waste controlling in Ghana, principally for institutions of higher learning that are expected to lead in best practices as the head of all educational institutions.

Waste Management: Composting

Composting approach engage the use of bacteria to decrease the biological content of the garbage. Aerobic composting ensues at a greater frequency and changes the varied organic garbage resources into similar and stable humus (Jara-Samaniego et al., 2017). Composting is a organic breakdown of decomposable compacted garbage beneath management mainly aerobic environments to a state, which is adequately steady or problem-free storage and management and is practically matured for safe use in agriculture (UNEP, 2009). UNEP reveals that, in unindustrialized nations, with few exceptions, composting is the choice that excellently falls within the inadequate resources obtainable. A feature that renders composting particularly suitable is its flexibility to a broad range of circumstances. According to Zerbock (2003), composting is a reduced industrial methodology to garbage reduction. He further established that in unindustrialized nations, the average city's community garbage stream is above 50% biological material, thereby making considering composting as the most viable and sustainable waste management choice for local authorities in unindustrialized countries.

Waste Management: Incineration

The practise of destroying waste substances by burning is referred to as incineration (Greentumble, 2015). It is a management skill, which consist of the burning of waste for energy recovery. Alternatively, incineration is often called, "Energy-from-waste" or "waste-to-energy". Allsopp, Costner, and Johnston, 2001, argue that incineration is a chemical reaction in which carbon, hydrogen and other substances in the garbage combine with oxygen in the

burning zone to generate heat. Normally, the incinerator receives excess air to ensure the complete mixing and combustion.

Countries like Japan where there is scarcity of land mostly engage in incineration or thermal treatment of waste and that has become a popular practice. The energy produced by incineration is extremely required by nations like Denmark and Sweden. In 2005, an estimation of 4.8 percent of the electricity expensed by the Danish populace was generated through incineration (Waste Resources Foundation, 2009). However, Africa and most unindustrialised nations including Ghana are yet to exploit the energy produced through incineration. Volumes of garbage are reduced by nearly 90 percent through the assistance of incinerators or thermal treatment plants (Pour, Webley, & Cook, 2017) and decrease the compacted amount of the original garbage by 80 to 96 percent (Greentumble, 2015). Therefore, while thermal treatment does not entirely eliminate the need for dumping ground, it surely reduces the amount of land needed. This is significant for unindustrialised nations such as Ghana, as large amounts of space that could be used more productively, is taken up by landfills.

Carbon dioxide, carbon monoxide, heavy metals, oxides of nitrogen, particulates, and dioxin, which is a carcinogen are principal gas products of incineration (Farmer & Hjerp, 2001; Greentumble, 2015). Even though incineration pollution control technology is changing to lessen these chemicals, it is evident that with the existence of controls, some left over dioxin still penetrates into the atmosphere. In spite of these challenges, incineration or thermal treatment remains the highest substitute to landfills (Zhang, Xu, Feng, & Chen, 2019). Kafando, Segda, Nzihou, and Koulidiati

(2013) observed that poor garbage controlling measures have numerous negatives influences including the increase of mosquitoes and flies as well as bad odours and visual pollution. Kafando et al. further demonstrated that the negative effects of poor garbage controlling measures on the environment in turn affect the health and well-being of the inhabitants.

Zero Waste

Zero waste refers to garbage controlling and planning methods, which emphasize garbage avoidance as different from end of pipe garbage controlling (Snow & Dickinson, 2001; Spiegelman, 2006). Zero waste incorporates farther than removing garbage through recycling and reuse. It focuses on reorganising manufacture and distribution systems to decrease garbage generation (Young, Ni, & Fan, 2010). A significant consideration of the "zero waste" view point is that it is more of an aim or ideal rather than a hard target (Snow, & Dickinson, 2001). Snow and Dickinson argue that, although it is very difficult to remove waste entirely due to physical restrictions or cost bans, zero waste, provides guidelines for ongoing work on waste disposal. As a result, many communities have become successful due to the application of the "zero waste" philosophy around the world. (Townend, 2010). Zero waste or no waste as viewpoint has been accepted as a supervisory standard by governmental organisations and industries (Snow, & Dickinson, 2001; Townend, 2010).

With the introduction of the "zero waste" concept into an already established integrated garbage controlling system of two communities in Durban-South Africa (Matete & Trois 2008), garbage production and discarding was reduced by 50% and 25% respectively. Since the emphasis of

the "zero waste" concept is on the elimination of garbage waste from the unset, it entails full participation primarily from industries, and authorities, as they are offer many benefits over individual countries. In fact, the concept of "zero waste" would not be realised if industries and governments fail to include their major efforts and actions (Connett & Sheehan, 2001). Spiegelman (2006) posits that by adopting the "zero waste" concept, industries would have the potential to remove 75 percent of their waste stream. This is because; industrial companies have influence over merchandise and packaging designs, industrial procedures, and substance collection (Townend, 2010).

In the interim, the authorities possess the power to develop and support, show production, design, and sales. They also possess the capability to create and adopt comprehensive garbage collection strategies, which intend to remove the waste rather than its management (Snow & Dickinson, 2001). External producers responsibilities have become essential part of the "zero waste" strategy since the serious participation of industries in the garbage collection process (Spiegelman, 2006), which aims to lower the state of garbage collection and increase efficiency.

Challenges to Solid Waste Management

In Africa, thousands of tons of compacted garbage are produced regularly (Aweso, 2013). Large quantities of these wastes are poured into open dumps and wetlands, infecting surface and ground water and causing major health risks. The United Nations have accepted that universally poor garbage controlling is one of the top five thought-provoking difficulties for city administrators (Guerrero et al., 2013; UN-HABITAT, 2010). Considering the rates of generation from approximately 0.5 kilograms per person per day to 0.8

kilograms per person per day for most industrialised municipalities and regions across the world, waste management has indeed become a global headache for city managers (Van den Berg & Heuer, 2015).

Despite the fact that this generation of waste may seem modest compared to the 1–2 kg per person per day produced in industrialised nations (UN-HABITAT, 2010), large quantities of garbage generated in Africa, are left uncollected by the metropolitan collection systems. This is likely to be the result of poor administration, fiscal irresponsibility or malfeasance, equipment failure, or insufficient garbage collection finances (USAID, 2009). For instance, documentation by the World Bank Study showed that, even though unindustrialised nations employ 20-50% of their regular finances on garbage collection, 30-60% of urban garbage remains uncollected, with only less than 50% of the population having the opportunity to enjoy the services (World Bank, 2012).

Due to environmental costs in rapidly growing economies, urbanization and enhancement in living standards in municipalities, there is an increase in the quantity and complexity of garbage generated (United Nation Development Programme [UNDP], 2004). In the industrialised nations, very well regulated programmes for garbage collection, have been established. However, unindustrialized nations have generally continued to use ingenuous methods such as open dumps (Mohee & Simelane, 2015).

Various researchers have identified a number of factors that influence garbage collection efforts in poor nations. Linden, Gomez, and Ngoilie (1997) recognised ten common challenges that influence garbage collection efforts in Asian nations. These challenges include inappropriate technologies,

inadequate finance, inadequate training and lack of political support. Others include inadequate human resource, inadequate enforcement of regulations and by-laws, policy conflict among levels of government, overlapping responsibilities. Lastly, rapid growth in garbage production, and inadequate data on waste, inadequate awareness creation among community members, limited land areas and land tenure issues.

Kironde (1999) studied problems associated with garbage collection in Tanzania. Kironde emphasized that, the garbage collection sector had performed poorly due to resource constraints including the inadequacy of economic, physical, human, and technical resources for the organization of garbage controlling activities. Studying the garbage collection challenges confronting the city of Kampala, Shuaib (2006) recognised several causes. These causes included inadequate dumping sites, unawareness of the community members about best management practices, ineffective collection approaches, poor governmental attitude towards garbage controlling, corruption among public officials and inadequate human resource for garbage collection processes. Several researchers, (Mohee & Thokozani, 2015; Neizer, 2014; Otchere, Anan, & Bio, 2015) have explained how these factors interact to exacerbate the garbage collection challenges in poor nations.

Another challenge that confronts the effective and efficient management of waste is finance. According to UN-HABITAT (2015), the lack of economic independence among metropolitan administrators and extreme central government power on productive sources of revenue leaves local authorities with few revenue generation options for garbage collection. Armah (1993) argues that the financial struggle of metropolitan authorities is because

of over dependence on central government grants for the provision of metropolitan services. He reiterated that, any establishment that depends solely on central government's support to manage any garbage collection provision is likely to be unsuccessful because those grants are frequently inadequate and undependable.

Furthermore, most unindustrialised nations engaged the use of unsuitable and insufficient technologies in garbage collection process. Zurbrugg (2002) has noted that the approval of the conservative garbage collection trucks used in luxuriant nations puts huge economic burden on local governments in unindustrialised nations. Unindustrialized nations, aside their high procurement and upkeep costs involved, also, possess inadequate engineering capacity to provide funding for the operation and maintenance of such sophisticated equipment like compactors and skip lifts.

Moreover, the scarcity of appropriate equipment, the insignificant spatial organization of many unindustrialised nation, characterized by unplanned housing developments, poor road quality and poor access within settlements do not support the use of huge and heavyweight western type of trucks for collecting garbage. (Baabereyir, 2009). Due to poor road networks, usually, the bulky garbage collection trucks find it difficult to gain access to many unplanned residential areas. The general inadequate qualified personnel in the garbage collection sector has also contributed to the poor waste disposal situation in deprived nations and municipalities (Aweso, 2013). Neizer (2014) argues that, most city managers are unable to appeal to appropriately experienced workforces for the various aspects of garbage collection process such as planning, operations and monitoring. According to Ogawa (2002),

unindustrialised nations usually lack the mechanical knowledge required for garbage collection planning and operation and this lack has affected both state and indigenous levels. Ogawa was of the view that, several generals responsible for garbage collection possess minimum or no technical knowledge or training in engineering or management. He reiterated that, solid waste management projects would not be operational and sustainable without adequately qualified staffs.

According to Sujauddin, Huda and Hoque (2008), family size, their educational level and the regular revenue manipulate waste production. Families attitudes related to segregation of garbage are affected by the active support and investment of a real estate company, community residential committees' involvement for public contribution (Zhu, Asnani, Zurbrügg, Anapolsky, & Mani, 2008) and fee for collection service based on the garbage volume or weight (Scheinberg, Spies, Simpson, & Mol, 2011).

Domestic garbage collection procedure and segregation behaviour (Ekere, Mugisha, & Drake, 2009) are explained by sexual characteristics, peer influence, land size, location of household and membership of environmental organization. A report on waste management revealed that improper bin collection systems, poor route planning, lack of information about collection schedule (Tumpa -Hazra & Goel, 2008), insufficient infrastructure (Moghadam, Mokhtarani, & Mokhtarani, 2009), poor roads and number of vehicles for waste collection (Henry, Yongsheng, & Jun, 2006) are as a result of gathering, transfer and transportation practices.

According to Chung and Lo, 2008, one factor affecting the treatment of garbage is the inadequate knowledge of management systems by experts.

Analysis done by Tadesse, Ruijs and Hagos (2008) on the factors that affect household garbage discarding decision making revealed that, garbage disposal choices are considerably affected by the provision of garbage collection facilities. Insufficient quantity of garbage containers as well as proximity to these containers upsurge the likelihood of garbage discarding in open areas and road sides relative to public containers usage. Pokhrel and Viraraghavan (2005) also outlined inadequate economic resources preventing the safe disposal of garbage in well-resourced and engineered landfills and the nonexistence of policies and regulations.

Examining the statistics from ‘‘Solid Waste Management in the World’s Cities’’ and relative to the estimating for dumping, Scheinberg et al. (2011), report that there are indications of high rates of recovery associated with tipping fees at the disposal site. They emphasized that high disposal pricing has the effect of more recovery of garbage produced, that goes to the value chains or beneficial reuse of garbage. A study on reprocessing by Gonzalez-Torre and Adenso-Diaz (2005) reported that, some communities cultivate resilient reprocessing practises for the reason of social influences, philanthropic, and supervisory factors. People who often visit the bins sites to dispose off general wastes probably reprocess some products at home, and in most cases, as the proximity to the recovering bins reduces, the fraction that citizens separate and gather at family rises (Díaz, Beleña, & Zueco, 2020). Minghua et al. (2009) argued that, for recycling rates to rise the authorities need to enact guidelines and regulations that support the market for recycled materials.

Studies by other scholars mentioned other factors including economic support for recovering projects and infrastructures (Nissim, Shohat, & Inbar, 2005), reprocessing enterprises in the nation (Henry, Yongsheng, & Jun, 2006), drop-off and buy back centers (Matete & Trois, 2008) and organization of the informal sector (Sharholy, Ahmad, Mahmood, & Trivedi, 2008). Enabling factors that facilitate the system performance include practical, conservational, commercial, socio-cultural, institutional and legal, also influence garbage controlling. Technical factors influencing the system are related to inadequate technical skills among staffs within metropolises and management (Tumpa-Hazra & Goel, 2009), poor infrastructure (Moghadam et al., 2009), poor roads and vehicles (Henry et al., 2006), inadequate machineries and unreliable data (Mrayyan & Hamdi, 2006). Matete and Trois (2008) and Asase, Yanful, Mensah, Stanford and Amponsah (2009), respectively, recommended that, the factors affecting the environmental aspect of garbage collection in unindustrialised nations include the adequate environmental control systems and evaluation of the real impacts. A study by Ekere et al. (2009), proposed that the contributions of the inhabitants in active environmental groupings is essential to have improved systems.

Metropolises have been unsuccessful in controlling garbage due to economic reasons. The huge expenses required to offer the service (Sharholy et al., 2008), the lack of economic provision, inadequate resources, the reluctance of the users to offer payment for the service (Sujauddin et al., 2008) and inadequate use of economic instruments have hindered the delivery of proper garbage controlling services. Sharholy et al. (2008) indicated that an important factor that could advance the effectiveness of the system is the

participation of the private sector. Generally, garbage controlling is seen as the sole responsibility of local authorities, and that the community is not expected to participate (Vidanaarachchi, Yuen, & Pilapitiya, 2006). The effectiveness or productivity of the garbage controlling process depends on the active involvement of both the metropolitan agency and the residents; therefore, socio cultural aspects outlined by some scholars include peoples' participation in decision making (Sharholy et al., 2008), as well as communal consciousness and societal indifference for contributing in solutions (Villanueva, 2013).

Organisational weaknesses that are often seen by the community members. A group of researchers who studied the institutional factors that affect systems concluded that we, the local authorities responsible for waste management, lack organisational capacity (management) and specialised expertise. Furthermore, they concluded that the accessible data are too limited by public wealth (Chung & Lo, 2008). Very limited information is either incomplete, or they are fed by different institutions, and therefore it will be extremely difficult to get an idea of the difficulty of the problem and the controlling of community solid waste (Seng, Kaneko, Hirayama, & Katayama-Hirayama, 2010). Workers in connection with waste are looked down upon and are not given the needed respect (Vidanaarachchi et al., 2006), a condition that contribute to low motivation among the solid waste personnel. Other metropolitan activities are given higher priority by politicians as compared to solid waste management (Moghadam et al., 2009) which gives rise to inadequate trained and skilled personnel in the municipalities.

Usually, metropolises in charge of garbage collection activities in the cities have the challenge of delivering an effective and efficient system to the

residents. The metropolitan administrators more often than not, encounter challenges beyond their ability (Sujauddin et al., 2008) mostly as a result of inadequate organizational processes, economic resources, complexity and system multi dimensionality (Burntley, Ellis, Flowerdew, Poll, & Prosser, 2006). Less than 50% of all the garbage generated in municipal centres all over African regions is gathered, and 95 percent of that amount is either haphazardly discarded at several dumping sites on the borders of municipal centres or at a number of so-called temporary sites, typically empty lots scattered throughout the city (Mohammed et al., 2016). The social garbage gathering service is substandard, and scenes of spread out garbage are common in most part of the city. This is evident that the service cannot meet changing demands (UNDP, 2004).

In Ghana particularly, expansion in metropolises including Accra, Kumasi, Cape Coast, Sekondi -Takoradi, Tamale, and Tema has necessitated the collection of garbage in the area of public health and environment. This is because these metropolitan assemblies serve as the doorways to the nation for foreign financiers and holidaymakers. Underprivileged or deprived assemblies or cities can discourage foreign investor of their intention. Nevertheless, garbage if poorly collected; turn out to be a threat to human health, an irritation and perhaps a key public challenge (Abagale, Mensah, & Osei, 2012). Abagale et al. emphasized that Ghanaians engage in open dumping system of garbage removal, which is more or less an unrestrained method. The system faces several challenges to health and well-being as well as the environment once it does not have highly engineered personnel.

A study by Otchere, Owusu-Sarpong and Okyere (2013) on the challenges affecting garbage collection system in the Kumasi Metropolitan Assembly, revealed that, Kumasi, which is estimated to produce about 500,000kg of garbage daily based on the 2006 projected population of 1,610,867, is faced with funding as a major challenge for compacted garbage administrators of KMA. Secondly, KMA faces staff management challenges including working condition, training and logistics as well as transportation.

Liquid Waste Management

In Ghana currently, people reside and nurture their youngsters in extremely unhygienic suburbs found cities, towns and villages. It is generally believed that town and peri-urban areas are among the worst polluted and disease ridden environments. The development and upkeep of urban infrastructure and services has become a major challenge in the urban areas of many unindustrialised nations especially in low-income countries. In most of the cities in many of these countries, management of water, sanitation, waste removal services, roads, systems for public transportation, and other essential public services have drastically deteriorated (Karanja, 2005).

One of the most serious infrastructure and service deficiencies confronting city authorities in these cities is the management of the rapidly growing quantities and complex flows of faecal waste. Faecal waste management services are grossly inadequate, unreliable and unevenly provided. In many of the countries, waste removal services are still organized and regulated along a public health orientation espousing the expeditious removal and disposal of waste from residential and other dwelling areas in order to safeguard public health (Karanja, 2005).

With community expansion and population growths, the waste situation will escalate and the need for non-toxic, maintainable and reasonable sanitation machinery or system will be even more desirable. According to Faris, Alemayehu, Wubshet and Hailu (2002), the sanitation methods promoted in unindustrialised nations fall under one of these two types: "Flush-and-Discharge" and "drop-and store". For those who have no access to flush toilets, the conservative alternative is a drop-and-store device; usually a pit latrine. Pit latrines are designed to contain and indefinite store human excreta. Drop-and-store is usually considered as sub-standard and short-term solution compared with flush system. Even though this machinery can check pollution in some places, it is not often possible in urban crowded communities due to lack of space.

The basic reason of any garbage collection package is to reduce the toxic waste of the surroundings as well as using the garbage as a resource. This objective must be realised in an economically maintainable manner, by using methods that can meet the expense of the residents over a long term and with minimum risk to the people involved (Ambat, 2003). Approaches of faecal waste controlling are different among communities due to local conditions. The best systems are designed by fixing together the fundamental goals, a clear analysis of local conditions and factors, and understanding of the full variety of technology choices that are available and a cognizance of the traditional wisdom and systems that the indigenous inhabitants have established.

According to Ambat (2003), it is a mutual understanding that garbage is seen as valuable material found at an improper location. Ambat emphasized that, all waste materials are very useful in one-way or the other, and that no material is useless. Johannessen and Boyer (1999) perceived that, the design and optimization of garbage collection technologies and practices are aimed at making the most out of the yield of valuable stuffs of the garbage, as well as reducing the environmental consequences in the Africa Region.

Health Implications of Solid Waste

The consequences of unproductive waste management and reduced garbage controlling is uncountable. Inadequate gathering and reduced discarding practices produce severe health and wellness related challenges to human life and well-being including the environment (Loboka, Shihua, Celestino, Hassan, & Wani, 2013). According to USEPA (2010), solid wastes are categorised by parameters such as sources, kinds of wastes generated, production rates and structure. Sources may include domestic, manufacturing, institutional, building and pulling down, commercial street sweeping and agricultural (Moeller, 2005). Moeller emphasized that solid waste can be harsh or corrosive, ignitable, sensitive and poisonous in nature. Corrosive garbage or waste materials are that which include acids or bases that are able to rust metal containers, e.g. tanks, saucepans and coins. Ignitability solid wastes, on the other hand, are that which can produce fires under certain condition, such waste include, solvents and waste oils. Responsive solid wastes are insecure in nature, which can outburst or cause poisonous fumes when heated. Lastly, toxic wastes are ones that remain destructive or deadly when swallowed, inhaled or absorbed into the body.

Living organisms can be exposed to solid waste through various methods. These methods include absorption, storage and biodegrading, plant uptake, ventilation, leaching, insects, birds, rats, flies and animals, direct dumping of unprocessed garbage found in seas, rivers and lakes. Improper handling of solid wastes may pose possible hazards to human health and well-being as well as the environment. Direct health threats affect mostly the personnel in the field of health, who require maximum protection at all course, from being connected to garbage. Abandoned dangerous garbage from manufacturing homes mixing up with community garbage creates possible threats to human health and well-being. Other forms of challenges include chemical poisoning through chemical inhalation, uncollected garbage can hinder the storm water runoff creating flooding, low birth weight and cancer. Moreover, genetic deformities, neural infection, nausea and vomiting, mercury harmfulness from consuming fish with high levels of mercury, birds consuming plastic found in oceans, give rise to high algal population in rivers and sea, and dreadful conditions of water and soil quality.

All forms of pollution (air, soil, and water) are caused by inappropriate garbage discarding and controlling. Unselective discarding of garbage pollutes surface and under-ground water supplies. Drains in municipal assemblies become chocked with MSW, producing standing water for fly breeding as well as outpourings throughout raining periods. Wild burning of MSW and inappropriate incineration contribute greatly to metropolitan air contamination. Greenhouse gases are produced from the decay of organic garbage in landfills, and unprocessed leachate pollutes surrounding soil and water bodies. Health and safety issues also arise from inappropriate MSWM. Cholera and dengue

fever among other diseases can again spread as insect, rodent and vectors get involved with the garbage. Findings from studies by Zhu, Asnani, Zurbrügg, Anapolsky, and Mani (2008) and Sharholy, Ahmad, Mahmood and Trivedi (2008) argue that reduced garbage waste gathering methods and inappropriate garbage discarding contribute to several occurrences of infection, regional water source contamination and global greenhouse gases. Manfredi, Scharff, Tonini and Christensen (2009) observed that the direct release of greenhouse gases is the major contribution to the global greenhouse gases generation. Boadi and Markku (2005) also indicated that the high occurrence of diarrhoea in children six years and below is linked to food infestation by flies, which had fed on the garbage.

Domfeh (2009), maintains that, diarrhoea that is associated with sanitation alone, is believed to have caused 30,300 deaths within a year and that is commonly seen as an example of the communal casualties in the Greater Accra Region of Ghana. Disposal of waste into water bodies is another unpleasant garbage collection method shown. This practice pollutes the environment (Aibor & Olorunda, 2006), adds to cases of flooding and serves as potential means to intensifying transmission of infectious illness, which comprises malaria, dengue and haemorrhagic fever, blood borne viruses such as hepatitis B and C, tuberculosis, yellow fever and West Nile Fever. The World Health Organization (WHO, 2000) and United Nations Environmental Programme (UNEP, 2009) argued that inhabitants who stay nearer to unprotected and uncontrolled garbage dumps are prone to further attacks of cholera, acute intestinal infection, skin infections, blood and eyes cancer and breathing diseases. United Nations Children Fund (UNICEF and Siaw, 2011),

indicated in a joint monitoring programme conducted for Water and Sanitation that, Ghana has an impressive water supply (75%) and poorer public health challenge (18%), with less expectation of development. These unwanted issues heighten fitness threat on persons through solid waste.

Impacts of Solid Waste on Environment

The breakdown of garbage into component chemicals is a usual source of local environmental effluence. Unindustrialised countries in particular, face this serious challenge. Very few existing landfills in the world's poorest countries would meet environmentally acceptable quality in industrialised citizens, and with inadequate revenue, there are likely to be few sites thoroughly assessed prior to future use. The issues associated with rapid urbanization again make the challenge of local environmental pollution complex (Goorah, Esmyot, & Boojhawon, 2009). Goorah et al. emphasized that a key ecological challenge is gas released by decaying waste. Methane is a by-product of the anaerobic inhalation of bacteria, and these bacteria increase in landfills with high amounts of moisture. Methane absorptions can rise up to half (50%) of the composition of landfill gas at highest anaerobic decay (Cointreau-Levine, 1997).

Various research works have focused on the role of methane in greenhouse trapping of the ultra violet energy discharged by the Earth and its atmosphere. Studies by Etminan, Myhre, Highwood and Shine (2016) showed that methane influence to global warming and climate change is 25% greater than previous approximations. Methane exceeds the warming power of carbon dioxide by 80 times, making it a main driver of climate interference (Intergovernmental Panel on Climate Change [IPCC], 2018). The change in

climate contribute to environmental health hazards, which include upsurges in vector-borne diseases, more regular droughts and other risks to water security, and further regular dangerous climatic events, including further recurrent and hash temperature influences (Arbuthnott & Hajat, 2017; Wilcox, Echaubard, de Garine-Wichatisky, & Ramirez, 2019).

Another challenge associated with these gasses is their involvement in the enhancement of the greenhouse gas effect and environment adjustment. The management of liquid leachate varies throughout the landfills in the unindustrialised countries. Local surface and ground water systems are exposed to the threat of liquid leachate (Srivastava & Singhvi, 2013). Srivastava and Singhvi argued that, the use of dense clay deposits at the end of the waste pits, combined with plastic sheeting-type liners to check penetration into the surrounding soil, is the best possible strategy to contain excess liquid. In this manner, garbage evaporation is encouraged instead of infiltration (Royal Commission on Environmental Pollution, 1984).

One sort of solid waste demonstrating surprising environmental threat is the pollution from plastic bags. Despite being a visual pollution, the plastic bag effluence is associated to numerous environmental challenges. Nyavor-Akporyo et al. (2013) found among students of the University of Ghana that the students used enough sachet waste such that enough waste are created to be recycled in bags, dresses, shopping bags, and umbrella. The issue of increase in generation of plastic waste was also stressed by Oppong-Ansah (2020) who also stress the role of lack of storage facility for the continuous use of plastic through outsourcing of food. Utama, Ambariyanto, Syafrudin and Samudro (2018) and Taghizadeh, Ghassemzadeh, Vahed and Fellegari

(2012) underscored the fact that food waste and plastic waste are the two most generated waste among individual.

Health Implications of Biomedical Waste

The generation of biomedical or hospital waste throughout the passage of health care provision is known to carry higher threats to human health and the atmosphere owing to their transmittable, dangerous, and poisonous compositions. Diaz and Savage (2003) argued that health care waste is generated in all orthodox medical units where management of (human or animal) patients is delivered. A significant amount of medical waste produced through materials used for patient diagnosis, management and or immunization, may pose significant hazards to human health and the atmosphere if not properly disposed off and or managed (UNHCHR, 2011).

Squire (2013) asserts that certain grades of health-care contaminants are bioactive in water ecosystems even at low concentrations. These contaminations negatively affect aquatic life in terms of reproduction and growth. According to Chudasama et al. (2013), biomedical or health care waste contribute to disease or injury. This is because the garbage mostly contains infectious agents which are genotoxic or radioactive. Central Pollution Control Board (2000) posits that, garbage produced in the hospital has serious health effect on the biomedical staffs as well as the public. Moreover, the inappropriate management of garbage poses major threat or pollution to residents due to pathogens such as HIV, Hepatitis B and C virus. It also plays a major role in water, air and soil contamination, thereby poorly affecting the surroundings and the population as a whole.

Hepatitis C is spreading speedily among young garbage pickers and scavengers, as they pick up used needles and other clinical garbage from different public and private health care centres for recycling (United Nations High Commission for Human Right, 2011). The fast spread is due to the fact that, the hepatitis C virus is extremely stubborn in dry air and can survive for several weeks on a surface. It is also resistant to brief exposure to boiling water. Garbage in general, poses several hazards to human health and the environment and must be controlled appropriately to avoid such hazards. Inadequate garbage collection will contribute to environmental contamination, unpleasant odour, growth and multiplication of vectors such as insects, rodents and worms and may lead to the transmission of illnesses like typhoid, cholera, hepatitis and AIDS through injuries from syringes and needles contaminated with human (Lomate, 2013).

Lomate (2013) emphasized that, health care waste pollution spreads through air movement, surface and ground water flow and poses severe health threats to human and animals having access to these sites. Even though there are inadequate comprehensive documented studies on health threats associated with poor hospital garbage collection, some determinants like progressive increase in hospital infection rate and increasing resistance to wide variety of antibiotics are the pointers to how poor health care garbage controlling, contribute to the health effect of the health care facilities.

Health Implications of Liquid Waste

Liquid waste comprises mostly liquid discharges from domestic, commercial, industrial and/or agricultural establishments. These liquid discharges contain a wide variety of possible pollutants and absorptions. One

major challenge faced by humanity in the twenty-first century, is water quality issues (Schwarzenbach, Egli, Hofstetter, von Gunten, & Wehrli, 2010). According to Group of Expert on the Scientific Aspect of Marine Environment Protection [GESAMP] (2001), pollution of the coastal environment by sewage points to significant amounts of communicable infections associated with washing and swimming in our seas as well as other water bodies and to the eating of seafood.

The exposures of human to contaminants connected to algae blooms also enforce major threats. Most abdominal (enteric) diseases are contagious and spread through liquid waste. Pathogens such as virus, bacteria, protozoa, and parasitic worms are disease-producing agents found in the faeces of infected persons. These infections are more predominant in communities with reduced liquid waste disposal mechanisms or channels. These pathogens travel through water sources and inter-fuses directly with persons' management of food and water. In tropical regions, infections such as hepatitis, cholera, dysentery, and typhoid are the common illnesses that upset large populations as a result exposure to liquid waste (Ball & Taleb, 2011).

A greater number of infections are initiated by pathogens (organic and or infectious agents) that cause infections or illnesses. They contribute to a wide variety of severe infections such as diarrhoea, cholera, dysentery, typhoid, and hepatitis A. Pathogenic bacteria can endure in liquid waste from a few days to several weeks. For example, viruses can endure in water, fish or shellfish for several months while the hepatitis virus can remain sustainable in the sea for over a year (GESAMP, 2001). Dependant on the source and collection approaches, liquid waste comprise a range of chemicals and specialized wastes

including industrial chemicals, nutrients such as nitrates and phosphates, heavy metals, pharmaceuticals, medical garbage, oils and greases. These chemicals and specialized wastes contribute to further dangers to human health and the environment. Nutrients are essential chemical elements that organisms need to stay alive and reproduce (Smith & Smith, 1998). Most domestic and industrial liquid waste contains nutrients from biological or chemical sources. Most liquid wastes especially those from domestic sources end up in our water bodies, which cause the destruction of these nutrients. Release of liquid wastes to the coast and estuarine has been the practice for several years by most of the neighbouring countries along the sea (Newell, Cleggb & Maughanb, 1991).

According to Ball and Taleb (2011) and Grimvall, Sundblad and Sonesten (2017), additional nutrients are cleared into the marine environment through sewage, fertilizers from agriculture and nitrogen oxides from burning fossil fuels. Group of Expert on the Scientific Aspect of Marine Environment Protection (GESAMP) (2001) posit that sewage remains the key source of nutrients near cities. Increment in nutrients is a leading factor of eutrophication, which is an extreme development of marine plant life and decay. Plants such as algae often experience a population increase (called an algal bloom) which limits the sunlight obtainable and cause inadequate oxygen in water. When oxygen levels decline, marine animals, coral reefs, sea grass beds and other vital habitats might suffer and may die. Studies by Al-Musharafi, Mahmoud and Al-Bahry (2014) on liquid waste in Oman showed the presence of considerable amounts of major ions, heavy metals and organic pollutants. They concluded that these pollutants eventually seep into

underground water and cause soil corrosion, which will lead to serious health challenges.

Sanusi and Sarfo (2016) confirmed that poor waste management can harm the aesthetic beauty of an ecosystem. Health and Pollution Action Plan of Ghana reports also identified poor waste management practices has adverse impact on the environment (Republic of Ghana, 2019). Ferronato and Torretta (2019) reviewed several studies on waste management and concluded that environmental impacts are pervasive worldwide in areas such as marine litter, air, soil, and water contamination. Addy (2013) revealed that poor garbage collection can lead to flooding, pollution of water bodies, and devaluation of the town due to the odour, which can result in outbreak of diseases.

Educational Institutions, Waste Generation and Waste Management Practices

Waste (solid, biomedical and liquid) is a necessary by-product of human activities. Universities like many academic institutions generate waste as a direct consequence of the research activities of faculty and students. In addition, as a human establishment, waste is created because of human engagements including as cookery, laundry and washing. Each academic institution creates garbage ranging from everyday activities including class work, sweeping, portion of food, and bush cutting. However, studies by Waste and Resources Action Programme [WRAP] (2013) identified the cafeteria as the major source of food waste generation. Similarly, Ana et al. (2011) found various sources of solid waste in all the educational institutions surveyed for the study. The usual solid wastes found in several schools in less industrialised societies included paper, grass, plastics (in the manufacture of sachet water bags and biscuits, lollypops, ice cream, and sweet or candy wrappers), sugar

cane residue, maize or corn cobs, and groundnut shells (Wahab, 2003). Other kinds of wastes may be found on school premises, and these may not have even been generated directly by students and staff. Most tertiary institutions have health facilities attached to it, which produce health care wastes.

The ultimate aspiration of any university is to reduce the quantity of garbage produced as well as to ensure its effective and economical disposal. Most universities in the developed countries have well drafted guidelines for ensuring safe disposal of their waste. Most of these universities embark on programmes or initiatives aimed at generating limited waste or no waste and where waste is inevitable, they ensure the sustainable treatment (Dery, Kuusaana, & Owusu-Sekyere, 2018; McMullen, 2016).

At Arizona State University, the roll out of the Ditch, the Dumpter project has averted approximately 942,100 pounds of garbage from landfill since 2009. In addition, the University of Virginia in Charlottesville has a new Sustainability Plan that includes specific long- and short-term goals to increase sustainability consciousness on and off campus, stewardship and decreasing the environmental impact of university functions (McMullen, 2016). These plans incorporate social, environmental and economic sustainability considerations into the university's purchasing practices, therefore ensuring the efficient use of structures and parks in order to decrease the desire for newer construction, and increasing the number of sustainable buildings. Nevertheless, the case in Africa is different.

A research work done by Dery et al. (2018) in analysing the garbage collection practices of two Ghanaian universities, revealed that both universities spend a total of GH¢336,216 annually to throw away paper waste

valued at GH¢30,930. He further reiterated that the major challenges that confront the operative and effectual controlling of institutional waste include inadequate facts and cognizance of the best management practices, governmental obligation and insufficiency of policies and regulations and the application of bylaws and legislations. Inadequate modern technology and well laid down process for the collection of garbage in most tertiary institutions in Africa has worsened the problem of waste management in most tertiary institutions (Kaloki, 2015). According to Longe, Longe and Ukpebor (2009), several administrations in unindustrialised nations have gradually concentrated on recognising precise income sources for garbage collection, partly due to austerity and organisational adjustment guidelines and pressures from multilateral economic institutions and partly due to pressures to control taxes. Educational institutions are therefore forced to put in place structures that would enable them manage the waste they generate.

In most educational institutions in Ghana, two approaches of garbage dumping are vital; open burning and dumping into nearby bushes. A study conducted by Rotowa and Enisan (2012) observed that, open burning technique of solid garbage disposal is a common practice of solid waste disposal in all the sampled schools except St. Dominic High School which still has a considerable percentage (40.8%) of solid waste dispose in nearby bushes and 59.2% on dump site. Generally, the rampant and indiscriminate dumping of waste in educational institutions can be attributed to the erratic collection of waste by institutional and city authorities (Jerie, 2006). In most universities in Ghana, garbage collection is the sole concern of the environmental sanitation unit in collaboration with the estate unit (Dery, 2017; Gbogbo & Awotwe-

Pratt, 2008). However, due to the lack of funding and technical expertise, these units are not able to fully tackle their waste burden. A study by Gbogbo and Awotwe-Pratt (2008) revealed that only 40% of the total garbage produced in the University of Ghana is managed whereas the leftovers or residue are deposited in unauthorized refuse dumps or left unattended to. A similar study conducted by Dery et al., (2018) in both the University of Ghana and the Central University College revealed that 35% of garbge generated in the University of Ghana remains uncollected. A study by Akai-Tetteh (2014) showed that 21% of waste generated in the University of Cape Coast are deposited on unauthorized areas. This attracts rodents and vultures which are mostly vectors or host to a lot of communicable diseases (Okpan, Nwankwo, & Okafor, 2017; Taghizadeh, Ghassemzadeh, Vahed, & Fellegari, 2012).

According to Campbell (2009), vultures and other predators are regularly located in regions connected to markets with exposed foodstuffs, large refuse discarding regions and in some cases reduced public health. According to Zohur-uz-Zaman and Riyad (2014), 83% of wastes generated in most universities in Bangladesh are bio-degradable. Similarly, a study by Akai-Tetteh (2014) revealed that food waste constitutes 92% of the entire garbage produced in the University of Cape Coast. She also emphasized that, the putrescible nature of food and biodegradable waste, contribute to the breeding of flies and the generation of bad odour, (Ferronato & Torretta, 2019; Taghizadeh et al., 2012) which pose serious environmental and health hazards.

Starovoytova (2018) studied solid waste management on university campus and found the following composition of waste: food waste (37%), paper (32%), glass (13%), plastic and metals (8%), electronic waste (1%) and

other-non-combustibles (1%). Ishak, Mahayuddin and Mohamed (2015), also observed that students in the university, produce food waste above any other waste with food waste accounting for 48.30% of all garbage produced. Yoada, Chirawurah and Adongo (2014) studied the household garbage practices, garbage discarding, and notion concerning garbage as well as health in an metropolitan assembly in which a sample of 364 household heads and six (6) key informants were interviewed. The finding indicated that, 93.1% of family discarded food remains as garbage and 77.8% discarded plastic materials as garbage. The study again showed that 61.0% of the households disposed of their garbage at public bins or had garbage picked up at their residences by private contractors. The rest of the households 39.0% discarded their garbage into channels, paths, dumps and immediate bushes.

Dolipas, Ramos, Alimondo and Madinno (2018), evaluated the garbage collection processes of students in Benguet State University (BSU) in Philippines and found out that the students usually produce vegetable garbage, papers, tissues and plastic wrappers in their families and frequently practice garbage segregation by organising their garbage and discarding them in the suitable garbage containers in their houses. The study also showed that, BSU students have same everyday garbage collection methods irrespective of their gender and family origin. Ozcicek-Dolekoglu and Var (2019) examined garbage associated with food at the Çukurova University's dining halls in Adana in Turkey, and found out that, about 10.7% of the served food goes waste. The study also found that students produced more plate waste than academic staff and have the lowest sensitivity to wasting of food.

A common sight in educational institutions where waste is poorly managed is an exposed garbage from overflowing bins and illegal dumpsites (Dery,et al., 2018). This exposed rubbish can definitely be blown away by wind, causing littering and thereby polluting the environment. Spilling over garbage containers are an ultimate breeding habitation for bacteria, insects and vermin. Ecube and Labs, (2016), argue that, air pollution is one of the consequences of overflowing garbage, which causes various breathing infections and other adverse health effects as pollutants are absorbed from lungs into other parts of the body. Educational institutions generate pathogenic or infectious wastes in the laboratories or hospitals. A study conducted by Okyere-Hayford (2016) revealed that 44% of waste generated at the Kwame Nkrumah University Hospital is pathogenic or hazardous in nature. The disposal of these wastes poses serious threats to human health and wellbeing as well as the environment when it is not properly managed (Jerie, 2006).

The placement of dustbins has been identified severally (Adejobi & Olorunnimbe, 2012; Khan & Samadder, 2016; Dery, 2017) as one of the main features to indiscriminate garbage disposal in most educational institutions. A study by Khan and Samadder (2016) showed a positive correlation between the location of garbage gathering bins and the rate of gathering. Akai-Tetteh (2014) posited that one of the causes for the indiscriminate discarding of garbage in the University of Cape Coast (Halls of residence) was that dustbins were too far away. Rotowa and Enisan (2012) revealed that in schools where the dump sites were located at the extreme end, maintaining a distance of more than 150 metres to some of the classrooms, students could not embark on such journey before disposing the solid waste, thus finding alternative means of

disposing the refuse into nearby bushes. However, Vijay, Gupta, Kalamdhad, and Devotta (2005) argued that, for effective and efficient waste collection, spacing between dustbins should not be more than 50metres.

For most educational institutions, the discarding of garbage from the dumpsites in the institutions to the final disposal sites is vehicular dependent (Dery et al., 2018; Jerie, 2006). However, for most institutions, these collection trucks are very old and incapable of collecting all the garbage produced within a day. Studies conducted by Dery (2017) revealed that the University of Ghana has only two waste collection truck (18 years old) which makes it very challenging to collect all the garbage produced. Also, inadequate personnel and operational logistics (Vijay et al., 2005) are major challenges to the reliable and efficient disposal of waste to final disposal sites. This clearly calls for a deliberate initiative by university governing authorities and government to put in place measures that would ensure sustainable management of waste.

Desa, Kadir and Yusooff (2011) examined the information, manners, awareness status and conduct regarding garbage collection among 589 university year one students by means of survey. Results indicated that, students' information, manners, consciousness status and conduct regarding garbage collection were reasonable. The students also showed that the introduction and the duty of resolving their campus's compacted garbage challenges rest with the university's management and its staff. The fact that students see the authorities and members as partners in waste management has been confirmed by Owusu-Sekyere, Osumanu and Yaro (2013) and Oteng-Ababio, Melara and Gabbay (2013) in Ghana.

Paghasian (2017) also observed among Philippine university students that waste management practices were generally very good. Daniel and Ibok (2013) explained the relatively good waste management practices of students indicating that such habits can be associated with values, culture and indigenous knowledge inculcated in them at the family level. Coker, Achi, Sridhar and Donnett (2016) also made a similar observation and concluded that waste made on the university campuses, are managed regularly using the appropriate technology.

Some studies, however, found universities and university students to have engaged in poor waste management practices. Ifegbesan, Ogunyemi and Rampedi (2017) found in public universities in Nigeria that littering and burning of waste are common daily occurrences among the students. Dangi and Agarwal (2017) also pointed to the possibility for even an organised university system to have poor waste management practices.

Policies and Regulations on Solid Waste Management

Usually, guidelines as well as strategies on garbage collection in Ghana emanate from the Ministry of Local Government and Rural Development, the Ministry of Environment, and the Environmental Protection Agency (EPA). The Environmental Protection Act, 1994 outlines the responsibilities, roles, organisation and finance of the EPA. The obligation of the EPA comprises drafting environmental guiding principles and constructing approvals for the protection of the environment. The EPA is required to ensure agreement with Environmental Impact Assessment (EIA) procedures in the organisation and implementation of developments projects, including agreement with respect to existing projects (EPA, 1994). This implies that any project likely to have

possibly adverse consequences on the environment, is exposed to an EIA. The EPA is mandated under section 2(f) of EPA Act 1994 for the issuance of environmental permits and pollution abatement notices for regulating waste discharges, emissions, deposits or other sources of contaminants.

In 1999, the Ministry of Local Government and Rural Development drafted the National Environmental Sanitation Plan that pursues to improve and conserve a clean, safe and pleasant physical environment for human settlements. However, the plan was reviewed in September 2010. The inclusive aim of this innovative programme is to create a clear as well as nationwide recognised concept of ecological cleanliness as a critical communal service and a key element for improving healthiness and excellence living in Ghana (Environmental and Social Management Framework [ESMF], 2019). This became necessary, as there was the need to organise and shape all attempts in handling the devastating challenges of reduced cleanliness in Ghana. The National Environmental Sanitation policy summarises the functions and duties ascribed to the public, organisations, subdivisions and agencies and the private sector impact on the environmental controlling and security, regulation and law implementation and the conditions for insisting on facilities and programmes, funding, equipment and provisions and a lot more. Alongside this policy, indigenous administrations have been instructed to expound Strategic Environmental Plans to execute the programmes projected in the policy (Institute of Green Growth Solutions, 2016).

The policy outline regulating the controlling of dangerous, compacted and radioactive waste includes the Local Government Act (1994), Act 462, the Environmental Protection Agency Act (1994), Act 490. Otherthe Pesticides

Control and Management Act (1996), Act 528, Others include Environmental Assessment Regulations 1999, (LI 1652), the Environmental Sanitation Policy of Ghana (1999), the Guidelines for the Development and Management of Landfills in Ghana, and the Guidelines for Bio-medical Waste (Sanitation Country Profile Ghana, 2004). The frameworks and the policy guidelines, are all geared towards addressing the challenges and constraints that inhibit the safe and prompt disposal of waste in the country. Aside the above-mentioned legislations, several important regulations intended to manage garbage, have also been approved (Puopiel, 2010). These include the following: Local Government Act, 1990 (Act 462), Environmental Assessment Regulations, 1999 (LI 1652), Criminal Code, 1960 (Act 29), Water Resources Commission Act, 1996 (Act 522), Pesticides Control and Management Act, 1996 (Act 528) and the National Building Regulations, 1996 (LI 1630).

The afore-mentioned Acts and Guidelines emanated from the National Environmental Action Plan (Sanitation Country Profile Ghana, 2004). The Environmental Protection Agency planned the compacted garbage controlling guiding principle for metropolises, and in the same way created standards for the planning, building and controlling of garbage discarding structure to safeguard human health and wellbeing as well as aesthetics. The reason for the guidelines is to support the district assemblies and other relevant stakeholders in the planning and controlling of garbage. The EPA ensures that the District Waste Management Plan (DWMP) sees to it that all facets of garbage collection processes in the district is fully taken care of (Ampofo & Banye, 2018).

Theoretical Framework

A theory is a deep-rooted belief, established to describe some aspects of the environment. Theories result from observations and assessments that are repeatedly, carried out. These theories include facts, estimates, regulations, and tested guesses that are generally recognised (Swanson & Chermack, 2013). A theory presents a thought or knowledge that is testable. It is a fact-based framework for describing an occurrence (Cherry, 2012). By their nature, theories are intellectual and not subject-or topic-specific. Even though different researchers have used various theoretical models of garbage collection, the same general ideas may be reproduced. Each theory engages an exceptional terminology to pronounce the actual factors well thought-out to be essential (Glanz, Rimer, & Lewis, 2002). The theoretical framework considers theories used to explain waste behaviour and practices. For the reason of the research work understudy, the models and theories reviewed included Behavioural Change Model, Environmentally Responsible Behaviour Model and Reasoned Action Theory, the Trans-Theoretical Model of Change, Planned Behaviour Theory and Health Belief Model. These theories jointly interact among themselves to provide further understandings and probable explanations to the increasing garbage collection challenges. In other words, a single theory cannot solely explain the human-environment collaboration

Behavioural Change Model

According to Hungerford and Volk, (1990), individuals will become fully aware of environmental challenges if they are well educated and better equipped with information, and as a result be encouraged to put up an environmentally responsible behaviour. Their consciousness will link

information to attitudes and attitudes to behaviours. When awareness intensifies, naturally constructive thoughts, which lead to reliable conservational conducts are, established (Boudreau, 2010).

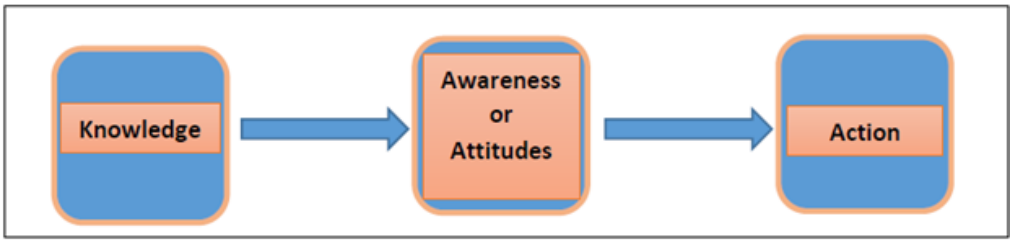

***Figure 1*: Behavioural Change Model**

Source**:** Hungerford and Volk, (1990)

The model provides an insight to the thought of the potential connection that exists among conservational facts, conservational consciousness as well as the approach, and the manner these elements convert into achievements and or delays. Information of conservational variables, which are well grounded, might not automatically suggest decent and maintainable conservational conduct. Inadequate conservational information or consciousness might also not automatically suggest a reduced ecological practice. Hence, additional interfering features such as the locus of control, intention to act and personal responsibility are expected to initiate best environmental practices. Whereas a probable association can be differentiated all the way through the model, reality is far more complex therefore; a well-advanced model is needed to incorporate this relationship in other to recommend a concise description of the interrelating variables of person's behaviour in ecological protection.

Theory of Environmentally Responsible Behaviour (ERB)

Hines, Hungerford and Tomera proposed the Theory of Environmentally Responsible Behaviour (ERB), in 1989. The model contends that, a key factor influencing ERB is the possession of an intention to act. It again indicates that, variables such as intention to act, locus of control (an assumed sense of individuals control over the events in their own lives), attitudes, sense of personal responsibility, and knowledge suggested if a behaviour will be adopted or not. This model considers the major variables that play a part in the individual process of ERB adoption. The model indicated that, the internal control centre significantly impacts on the intention of acting, which establishes a person's ERB considerably.

The relationship, which exists among the control centre, attitudes of individuals and their intentions to act is also emphasised by the model. Hines et al. (1989) reported that a monitoring centre's direct influence on an individual's attitude could be attributed to an improved intention to act, as well as better behaviour. Therefore, the theory lays more emphases on existing connections among parameters that influence factors that in human behaviour are more of a staggering effect variable.

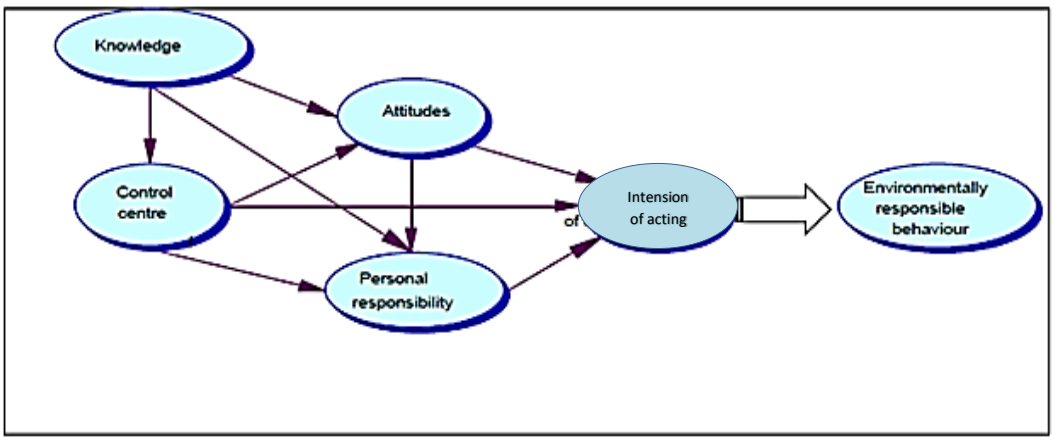

***Figure 2*: Theory of Environmentally Responsible Behaviour**
Source: Peggy and Korsching, (1996)

In garbage collection practices, no one element is responsible to cause a change in existing behaviours or adequate to introduce a new behaviour otherwise effect a change in behaviour. An instance where residents heap up their garbage at vantage points or around the principal streets in large metropolises, irrespective of the guidelines and principles from the garbage collection authorities, which prohibit these acts. Most of these flouters engage in these acts at odd times when regulation implementation agencies are not around to enforce the law whilst other people emulate this irresponsible garbage controlling behaviour from other community members. However, some residents still find decent means to dispose off their garbage.

The model argues that, information alone is insufficient to function responsibly regarding the surroundings. Whilst information concerning the surroundings and the set of rules governing it, may possibly hasten some individuals to engage in wholesome intentions to act, others might also go through the internal and external control, such as being inclined by other peoples' actions or embracing strongly to a belief to act properly with regards to the surroundings. Even though distinct ideas of attitudes, control centre and intention of acting may not be adequate for creating a purpose to act, united under one overarching concept, they become a base on which predispositions for pro-environmental behaviours are formed.

The Trans-Theoretical Model of Change

Prochaska and Di-Clemente (1982) developed the trans-theoretical model of behaviour change (TTM). They highlighted key concepts needed for an individual to adopt improved health habits and recommended approaches, or processes required for a person to move across the stage of change to action

and to maintenance. They emphasized that behavioural change comprises five stages (pre-contemplation, contemplation, preparation, action and maintenance) and individuals need special applications of these stages to be successful (Prochaska & Di-Clemente, 1982). The Trans-Theoretical Model (TTM) lays emphases on the decision-making of the individual and is a model of intentional change. The TTM operates on the notion that, behavioural change is often not automatic and conclusively for individuals. Instead, behavioural change occurs continuously over a continuing practice.

Each phase of transformation requires diverse interventions and strategies to be introduced. These interventions and strategies are operational at inspiring the individual towards the subsequent phase of transformation and then through the model to repairs, which is the ideal stage of behaviour.

Precontemplation: People do not intend to take action in the near future (defined as within the next 6 months) in this stage. People are often not aware their problematic behaviour or the behaviour that produces undesirable consequences. In this stage people often underrate the experts of changing behaviour and place too much emphasis on the frauds of changing behaviour.

Contemplation: This stage reveals peoples' intention to start the healthful behaviour in the near future (defined as within the next 6 months). People now become aware of their problematic behaviour; they then become more thoughtful of that and take practical actions placing equal emphasis on the pros and cons of changing the behaviour.

Preparation (Determination). People are prepared in this stage to undergo a cause of accomplishment in the subsequent 30 days. Here they begin to initiate

trivial paces towards the behavioural transformation, and they are of utmost belief that their behavioural modifications, can lead to lives full of health.

Action. People in this stage; have just reformed their conduct (defined as within the last 6 months) besides, aiming to retain their forward movement in that behavioural transformation. People through transforming their problematic behaviour or acquiring new healthy behaviours may exhibit this conduct reformation.

Maintenance. People in this stage have prolonged their behavioural change for a while (defined as more than 6 months) and anticipate to continue the behavioural change into the near future. Individuals in this period engage in a lot of work to check reversion to previous phases.

Relapse. People occasionally reach this stage and they lean towards staying in the repair or maintenance period of the TTM. In health promotion programmes, this phase of the TTM, is often not well thought-out or considered.

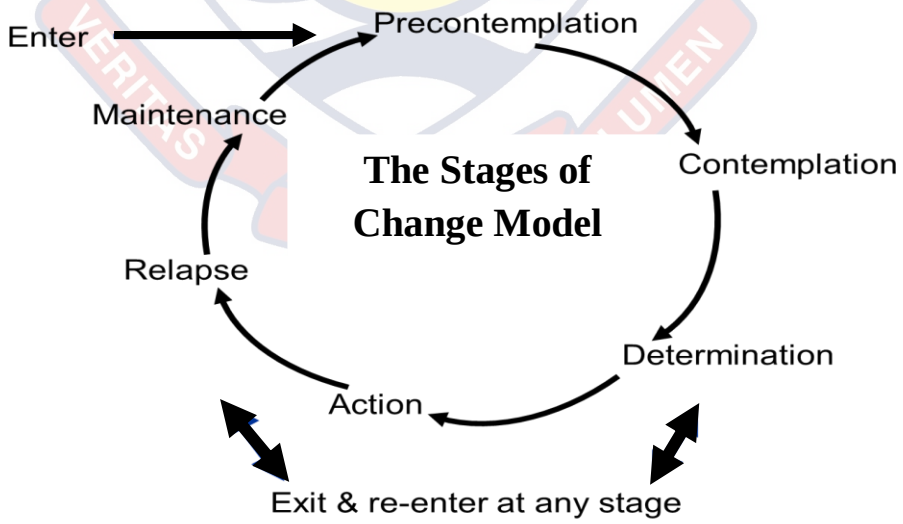

***Figure 3*: The Trans-theoretical model of change**
Source: LaMorte, (2016)

It is revealed in literature that, methods, which do not think through the stage of change where individual, is included; develop a challenge against the behavioural change (Cingözbay, Işılak, Tokatlı, & Uzun, 2011). In other words, the TTM permits the use of suitable interventions for the stage of change where individual is included and intensifies the success. Various studies (Erol & Erdogan, 2008; Evers et al., 2012; Koyun & Eroğlu, 2016; Pantaewan et al., 2012) have used the TTM to predict individual attitudes towards health treating behaviours such as smoking, drinking alcohol and drug use. None of these studies has applied this theory in terms of waste management. Yet, I am fully convinced that, this theory can adequately help predict waste management behaviours.

The Theory of Planned Behaviour

Various studies have sought to determine waste management behaviours using psychological models. The Planned Behavioural Theory (PBT) is the most frequently used psychological standard for assessing peoples' attitude with respect to garbage. Ajzen and Fishbein (1980), generally define attitude to be a person or group of persons' general feeling of favourableness or unfavourableness to refuse. Icek Ajzen developed the theory in 1985. Martin, Fishbein and Ajzen also developed the PBT from the theory of reasoned action (TRA) in 1980.

Theory indicates that, personalities have time to design their means of acting and that; an individual's intention is the best determinant of their actions. In other words, one needs be aware of peoples' intentions, in other to predict their actions. The theory again posits that; a person's behaviour depends on the readiness of them to perform that intention or plan. Three

factors determine an intention. These are (1) attitude (A), which is the person's affirmative or destructive thought of accomplishing a conduct. Also, (2) subjective norm (SN), which is the individual's view of social pressure to participate or not in a behaviour; and (3) perceived behavioural control (PBC), which is the individual's view of his or her ability to accomplish a given act (Zhang et al., 2019).

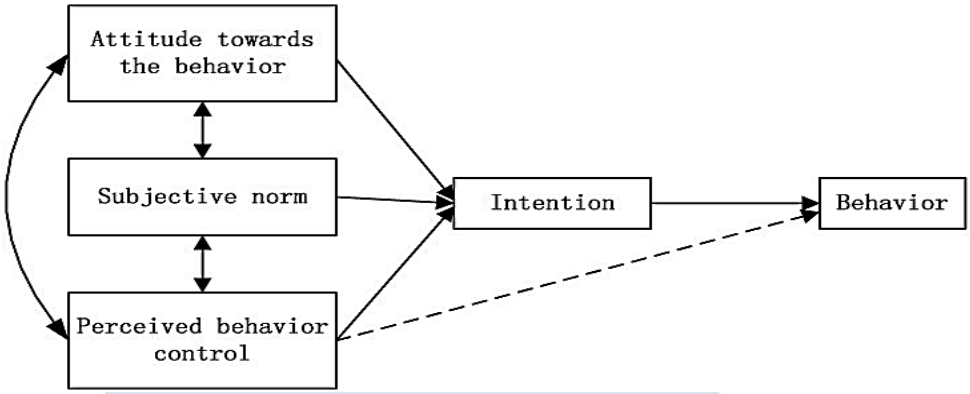

***Figure 4*: The Theory of Planned Behaviour**

Source: Ajzen, (1985)

Many other studies have used the TRA and its extension (Otieno, Liyala, Odongo & Abeka, 2016). The TPB, as an outline, is good for understanding, explaining and predicting behaviours as well as providing a useful guide for designing intervention and strategies to change or maintain behaviours. The theory is based on an assumption that individual's behavioural intents are directly related to their attitudes. The TRA interpretates a person's intent to perform (or not to perform) as the immediate cause of the act. This behavioural intention, in turn, has two elements. One is the individual's approach towards the act. If a person who believes that the accomplishment of a particular act will lead to mostly positive outcomes, she or he would hold a positive attitude towards executing the act.

The independent or the subjective norm follows. If an individual is of the view that most referees with whom she or he is interested to comply think she or he should accomplish an act, then she or he will recognise the need or importance to engage in the act. The beliefs that motivate an individual's point of view towards that same person are referred to as social beliefs, and those that underlie the subjective norm are named, normative principles (Ajzen & Fishbein, 1980).

An action accomplished by a person, according to the Theory of Planned Behaviour, is manipulated by individual enthusiasm, which is also controlled by thought, community maintenance and supposed social control. Attitude, social support and behavioural control are factors rooted in the person's perception of social, personal, and situational consequences of the specified act (Ajzen, 1985; Ajzen & Driver, 1992). Therefore, an individual's attitude and view of garbage is influenced by societal responses and practices concerning garbage collection process.

TPB aims at an improved assessment of an individual's views once choices of involvement are intentional and can be controlled by the person. In conservational investigation, TPB has been widely used to guess an individual's commitment to contribute in proper garbage collection process or environmental practices (Gamba & Oskamp, 1994; Grodzinska-Jurczak, Bartosiewicz, Twardowska, & Ballantyne 2003; Kuhlemier, Van den Berg & Lagerweij, 1999). Many researchers in environmental sciences have used TPB empirically and theoretically, to efficiently examine thoughts, which trace the connection of principles to individuals.

Apart from the theories of Reasoned Action and Planned Behaviour, the theory of Expectancy-Value, has also been documented in literature as having the power to serve as structure for such attitude-behaviour report (Van der Pligt & De Vries, 1998). Most research works concerning socio-demographic variables and environmental perception have enhanced understanding of peoples' opinions, and knowledge concerning garbage collection methods. Studies of such nature must endeavour to envisage conservational consciousness and conducts of people depending on their socio-demographic features. For instance, Raudsepp (2001) reported that age, education and gender have shown strong and consistent relations with environmentalism. Studies by Crump, Nunes and Crossman (1977) suggested that the presence of a sign to remind people to dispose of waste properly could help increase environmental awareness.

Other researchers (Eagle & Demare, 1999; Gigliotti, 1992; Mensah, Herbert, & Whitney, 2008; Sheppard, 1995; Tikka, Kuitunen, & Tyns, 2000) have tried to establish the associates of environmental knowledge and environmental quality awareness and concern. Further research works have also studied the effect of education, income, age, and gender on public awareness and attitude towards environmental quality issues. Chanda (1999) stated that environmental concerns among inhabitants of Gaborone differ with respect to education and income levels, whilst age and gender have no significant effect on variation in concern.

Health Belief Model

The Health Belief Model (HBM), was originally propounded in the 1950s, and was updated in the 1980s. It had since then, been used extensively by several researchers to envisage health behaviours and this study continues to reveal the model's validity (Akintunde, 2017). HBM simply defines an assessment of the suggested solution and its usage, which followed by an arrangement of a personal threat analysis. The model, as a general technique of tackling beliefs, offers an appropriate structure for a wider range of belief-change situations. The model is centred on the assumption that an individual's readiness to change their health behaviours is mostly due to factors such as perceived susceptibility, perceived severity, perceived benefits and perceived barriers. The HBM also acknowledges that, the desire to sometimes, modify a healthful conduct is not sufficient to cause a person to engage in the act. Consequently, it combines two more elements into its estimations about what it actually takes to get an individual to make the leap. These are cues or prompts to action and self-efficacy. Outside measures that quicken a yearning to make a health change, are referred to as, cues to action. Self-efficacy examines a person's trust in his or her capability to effect a health-related change. According to Mattson (1999), the Model proposes that, there is the probability that the individual will stick to recommended preventive behaviours whenever there is a rise in the person's evaluated level of threat. These behaviours depend on the benefits and the expected challenges or efforts in engaging in an action.

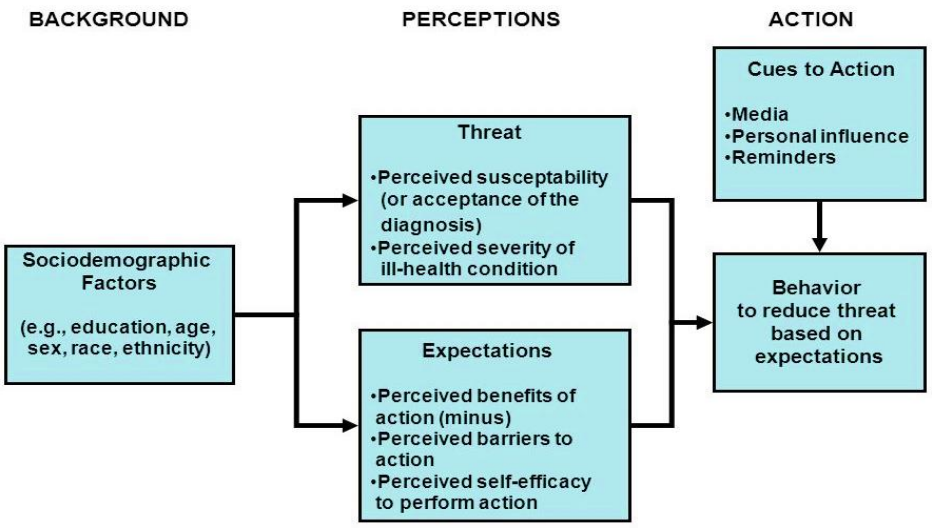

***Figure 5*: The Health Belief Model**
Source: Mattson, (1999)

Conceptual Framework

`According to Ziraba, Haregu and Mberu (2016), to understand the link between waste and its impact on the environment, one has to understand how waste is introduced into the environment, the processes or mechanisms wastes pass through after being exposed to the environment and how they affect the environment (see figure 6). Ziraba et al. (2016). Two categories of wastes identified: organic and inorganic. The biological garbage can further be grouped into three which are; putrescible, fermentable, and non-fermentable. Putrescible wastes constitute products such as foodstuff that decay fast. Fermentable garbage rots fast, but without the unfriendly accompaniments of putrefaction while non-fermentable wastes tend to resist rottenness and, therefore, break down very slowly. Inert garbage consists of metals, plastics, compounds and other non-toxic materials.

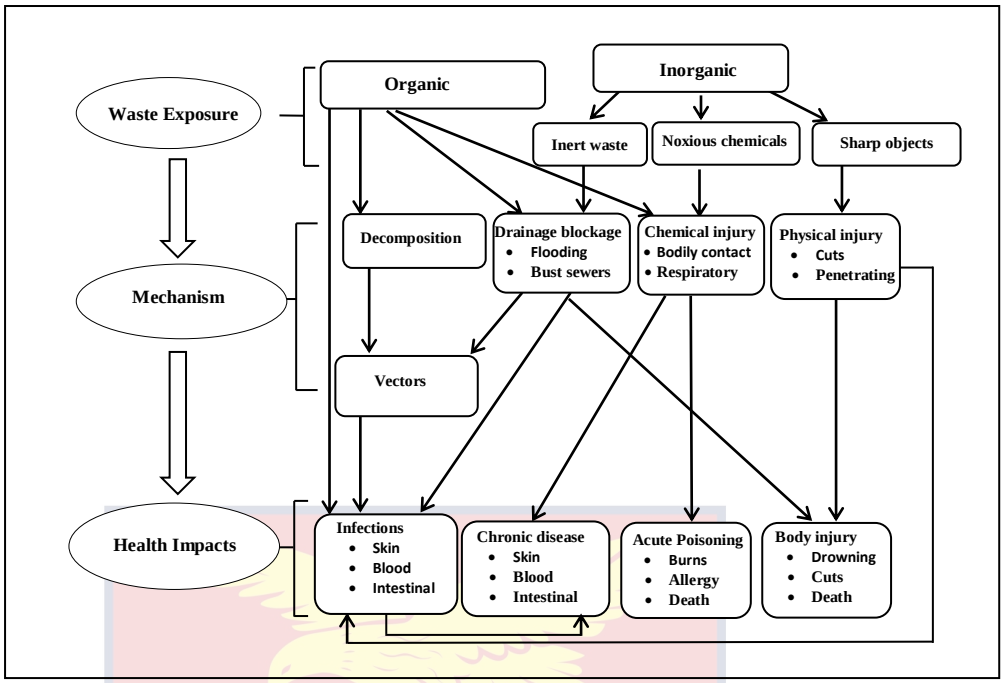

***Figure 6*: The linkages between poor solid waste management and adverse health outcomes**

Source: Ziraba et al., (2016)

According to Ziraba et al. (2016), biological garbage passes through a mechanism of decomposing which becomes a rich medium for vectors such as mosquitoes and flies, which results in the individual infections such as skin, blood and gastrointestinal diseases through contaminated foods and water. Ziraba et al. (2016) further explain that the indiscriminate disposal of waste leads to drainage blockage, physical and chemical injuries. These lead to adverse environmental and health effects such as flooding, infections (skin, blood and intestinal), acute poisoning (burns, allergy and death), chronic diseases (cancers, COPD and death) and body injuries (drowning, cuts and death).

Although the framework summarized the inter connections and likely corridors through which any contact to garbage may be dangerous to health and well-being, the framework was not exhaustive. It might not always be

wholly true to conclude that an exposure to indiscriminate waste disposal and poor waste management would always pass through all the mechanisms and finally lead to adverse health outcomes. Other factors that the authors did not consider may alter the automatic passage from waste exposure through to health impact. These factors may include background characteristics such as age, sex, income, education and awareness or knowledge, as well as policies and regulations. Moreover, the framework was restricted to health impact to the neglect of environmental impacts, which is an import part of this current study.

The weakness of the Ziraba et al. framework could further be traced from the theories adopted for the current study. The theory of planned behaviour, for example, implies that individuals can alter their behaviour in a manner that will affect which of the three wastes identified by the framework would be generated the most. In addition, irrespective of the type of garbage produced by the students, the mechanism identified in the framework may well depend on the garbage collection methods of the students. The kind of waste policy that exist in a given location shall as well mitigate the extent of the effects and the completion of the mechanism through which waste affect the health status of the students when it is exposed into the environment. That notwithstanding the Ziraba et al. framework was consistent to the study setting but required modification to suit the focus of the current study

Ziraba et al.'s (2016) framework was, therefore, adapted to incorporate the background characteristics of students, policies and regulations which may facilitate or impede the mechanism leading to human health as well as and environmental health impact of poor garbage collection practices (see Figure

7). Though a number of background, characteristics could moderate the possible influence of garbage collection practices that affect the environmental health and health status of the students, a number of them were common and could not be considered as variables. That is, most of the respondents were generally within a small age group range (cohorts) since the study focused on only under graduate students for which education was almost a constant attribute.

Hence, gender (male and female) and location (resident and non-resident) were two clear background characteristics that mattered most to the nature and type of garbage collection methods of the undergraduates of the university and the immediate environments. Gender had already been identified as important variable in moderating the planned behaviour and the health belief of individuals but the moderating effects among individuals of common age group and level of education is yet to be fully established (Wild & Kleinjans, 2004; Perlroth & Branco, 2016). The current study introduced gender into the framework to assess the level of moderation in waste management practices and environmental-health impact of waste. Residential location of the students was also included as background characteristic due to its special role in the study context. That is, the authority that manages waste in the central university campus is not the same as that of the surrounding communities that could imply different policies and strategies.

Also, the non-residential students have to use common waste management strategies and infrastructure with a heavy presence non-student population. These factors suggested that the waste management practices of the residential students could significantly differ from that of the non-

residential students. The fact that the non-resident students, after spending one year on main campus, must adapt to the waste management practices of their new area was consistent with the Trans-theoretical model of change (LaMorte, 2016). That is, the non-residential students either succeed in altering the situation in the new residential location or change to suite the new environment, which have implications for environmental-health impact of waste. Thus, the decision to incorporate the location variable into the adapted framework as presented in Figure 7. The adapted framework is not without its own limitation, since it could not consider a number of background characteristics as explained earlier, but fit the context of the study very well.

Finally, awareness can also be a contributing factor that can break the chain of an individual being automatically affected by ill-health after being exposed to the environment. If a person is made aware of the possible health effects of an exposure to indiscriminate waste disposal, he or she might put all structures in place to guard against the poor health outcome. Studies have shown that people who are aware of health outcomes and guard against them are likely to be slowly affected or not affected by the outcome (Ramos, Cruvinel, Meiners, Queiroz & Galato, 2017; Subhaprada & Kalyani, 2017). In addition, enforcement of policies, regulations and byelaws would drastically reduce the indiscriminate disposal of waste, thereby reducing any adverse health outcome from waste exposure. Finally, the adapted framework also expands the original one by adding the environmental impacts resulting from indiscriminate disposal of waste like the ozone reduction, water, air and land contamination.

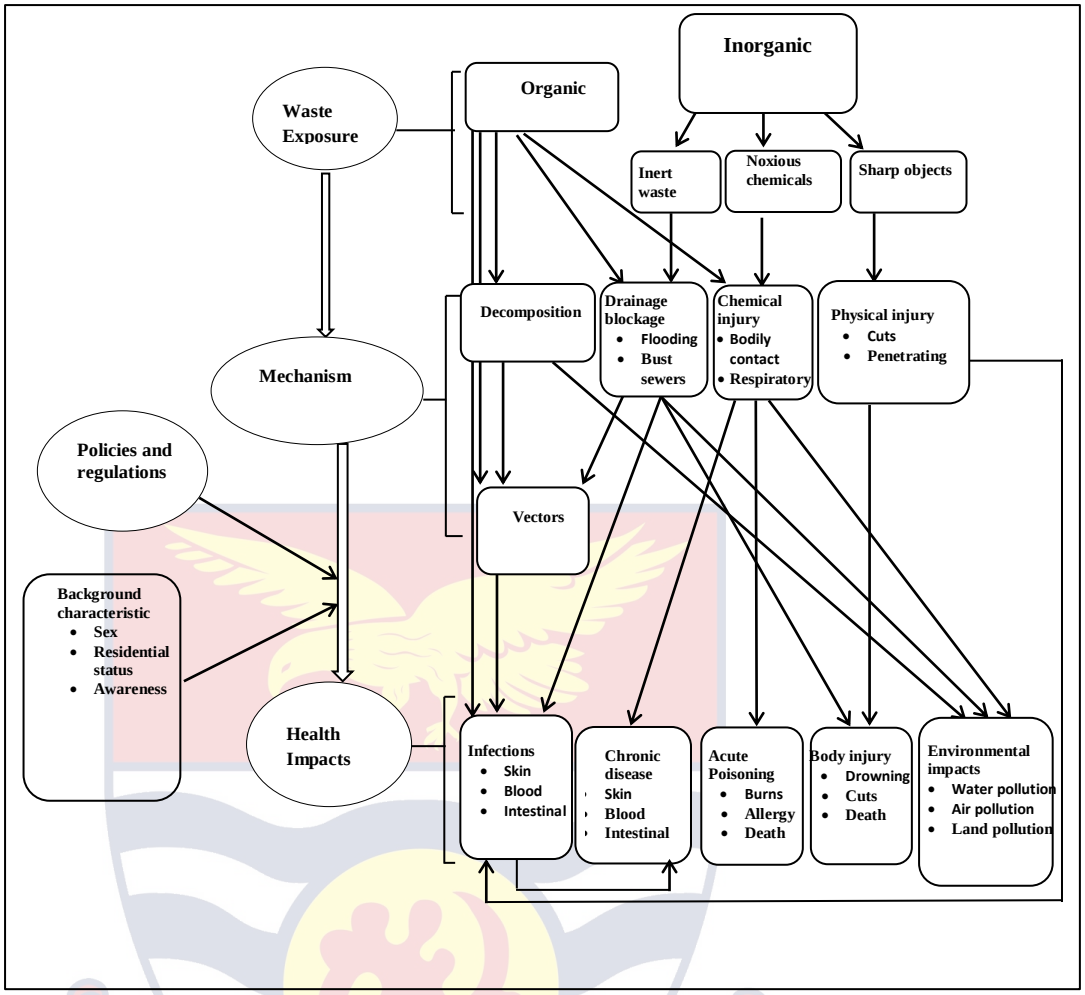

***Figure 7*: The impact of poor solid waste management on environmental health**

Source: Ziraba et al., (2016)

Summary

Waste, has been defined and categorized severally by different authors and institutions. No matter the definition, waste, is generally considered as the by-product of human activity. These by-products are generated from housing as well as manufacturing (non-process wastes), business-related and official locations sources with the exclusion of dangerous and general garbage, building and destruction garbage, and liquid wastes (urine, wastewater, and industrial processes).

Various studies have found various sources of waste generated by different kinds of educational institutions. These include waste that has been generated directly by students and staff. Most tertiary institutions which generate biomedical waste have health facilities attached to them. A greater quantity of this health-care garbage, are dumped in available dumping areas and swamps, causing pollution to shallow and ground water leading to serious well-being dangers. The ultimate aspiration of any university is to minimise the quantity of waste created as well as to ensure its effective and economical disposal. Most universities in the developed countries have well drafted guidelines for ensuring safe disposal of their waste. Most of these universities embark on programmes or initiatives aimed at producing limited waste, or no waste and where waste is inevitable, they ensure the sustainable treatment.

Studies have shown that the effective management of waste is essential for human survival and as such various governments the world over have enacted laws to make sure that the disposal of garbage is prompt as well as safe within their jurisdiction. In Ghana, waste has been defined and classified in various policy documents, regulations and Acts. Despite these legislations, waste management is still a headache for most municipalities in the country. Most metropolises are not well equipped for garbage gathering and controlling.

The lawful duty of metropolises to gather garbage has become a weakness for private sector investment in garbage controlling. Inadequate facilities, poor funding, and poor implementation of policies as well as wrong lifestyle, have contributed to poor state of garbage controlling in the country. However, various studies have accredited the poor controlling of garbage in

the country to the attitude and cultural beliefs of the Ghanaian. Culture offers the stage setting through which human activities occur. Its impact is effective, hence, a host of societal functions, including the controlling of garbage. Garbage discarding practice of the people could be well thought of, depending on the values, culture and opinions of the residents as well as the local information and experiences shown by them.

The production of garbage and the gathering, treatment, transportation and discarding of garbage, the process of 'garbage controlling', are significant for both the health of the residents as well as visual and environmental reasons. Indiscriminate discarding of garbage is realised as one of the most essential challenges in many communities in Ghana now.

According to empirical review, although garbage-controlling methods of universities have been studied within and outside the country, the distinctions are hardly made on the modifications in the garbage controlling management practices of resident and non-resident students. Again, studies in Ghanaian universities have focused more on waste generation and waste management practices with inadequate attention paid to the consequences of such processes. The current study identified gaps in the literature in the areas of health and well-being as well as environmental health impact of garbage controlling methods of university students. The current research, therefore, sought to contribute to the discourse through the studying of the environmental health impact of garbage controlling, involving the resident and non-resident students of the university.

CHAPTER THREE

RESEARCH METHODS

The purpose of this study was to assess the environmental health impact of garbage controlling methods in the University of Cape Coast. It covered areas such as nature of garbage produced by students, garbage-controlling approaches of students, challenges of waste management practices, environmental health and health impacts of poor garbage-controlling approaches including policies and strategies of poor garbage-controlling approaches. This chapter deals with the method and included the research design, population, sampling procedure, data collection instrument, data collection procedure and the data processing and analysis.

Research Design

This study employed the descriptive survey research design and the phenomenological design to conduct the study. The choice of the two designs was because of the focus of the study, which sought to examine the effects of garbage controlling approaches on environmental health impact while gaining insight to challenges and the garbage controlling policies of the university. That is, a part of the analysis required large respondents for an objective view while a part required an in-depth understanding of the issues under consideration. The quantitative design required the descriptive survey design that enabled me to gather hard data on large respondents for extended analysis. The phenomenological design allowed me space to identify the essence of some of the observed quantitative responses.

The descriptive survey design was employed since the study had a wider scope and proposed to describe the current state of garbage controlling

approaches of the students of the University of Cape Coast. The descriptive survey research design enabled me to describe, explain, and portray characteristics of garbage controlling approaches of the students, challenges related to garbage controlling approaches, environmental and health impacts as well as the existing waste management policy and strategies of the University to mitigate waste management practices. Numerous research works in relation to garbage controlling approaches, found descriptive survey design to be the most suitable research design in a context such as that of this study where the responses of several respondents were sought for on a topical issue (Mungai et al., 2014). Thus, the descriptive survey design gave me the opportunity to ascertain widespread responses under natural conditions such as the state of garbage controlling approaches of the undergraduates in the halls, hostels and apartments (Auka, Bosire, & Matern, 2013). Another reason for adopting the descriptive survey design was that it afforded me the options to investigate possible relationships among the variables.

The phenomenological design offered me the opportunity to involve some qualitative responses such as interview and pictures taken during observational visits to refuse dumps. The design allowed the participants to offer information about reality from lived experiences, which allowed for the proper understanding of the underlying issues (Auka et al., 2013).

The usage of quantitative and qualitative designs together gave allowance for some level of triangulation of data in the analysis. Creswell (2003) supported the position of this study by stating that the quantitative and qualitative data complement each other and yield a more complete analysis when the two methods were used concurrently. Quantitative data was

collected using questionnaires whereas qualitative data was collected using semi- structured interview guide; hence, the objectives were addressed from the angle of both quantitative and qualitative analyses. The questionnaire allowed for larger respondents to be included in the study which supported statistical testing of hypotheses whilst the face to face interviews allowed for few participants to give in-depth views regarding the issues of garbage disposal and controlling in the area where the current study is taking place. That is, the results from the sample was generalised to the population because the approach allowed for rigorous statistical analysis.

The mixed method approach helps to meet the criteria of both the positivist objectivity of research and the constructivist subjectivity of research outcome (Creswell, 2013). That is, the study pursues the value free stance of research while making up for subjectivity to complement the weakness of trading of value free for in-depth analyses of the situation. However, like all other research designs, the methods have their own constraints. The use of both quantitative and qualitative designs needed lots of care and proper synthesis of issues in analysing both kinds of data to avoid undue biases (Classen, Lopez, Winter, Awadzi, Ferree, & Garvan, 2007). The self-reporting of the respondent from personal experience under the phenomenological design also has inherent tendencies for biases since individual tend to under-report themselves and over-report others (Classen et al., 2007).

Despite these constraints, I was of the view that the method is the most appropriate design for exploring the current issue under study. That is, the blend of the two designs had the ability to presents the results from both qualitative and quantitative. I also ensured that the triangulation or integration

of the quantitative and qualitative responses were consistent and coherent to give a clearer view of the issue discussed. I had already used the quantitative method to examine waste management practices of residential students of the University of Cape Coast which provided the niche for me to extend the study to cover the non-residential students and the qualitative analysis (Akai-Tetteh, 2014).

Study Area

University of Cape Coast is sited on two campuses: southern and northern sectors, also known as the old site and new site respectively. There are eight halls of residence on campus. Three halls, consisting of Adehye (Female only), Atlantic (Mixed), Oguaa (Mixed) are found in the southern or the old site and five which are Casely Hayford (male only), Valco (mixed), Kwame Nkrumah (mixed), Students Representative Council (SRC) (mixed), and Ghana Universal Superannuation Scheme (GUSS) (mixed) are located at the northern campus or the new site (Student Handbook, 2017). These halls are for the under graduate students but there is a Graduate Hostel for the graduate students. Apart from these halls and hostels, the university has some private hostels for the students. The communities surrounding the university also have many private hostels, where students who are not in the halls of residence live (GNA, 2006).

Like any other university in Ghana, five communities surround UCC; Kwesipra, Apewosika, Amamoma, Kwapro and Kokoado (see Figure 4). Kwesipra is to the South-West of the University, Apewosika is to the West, Amamoma and Kwaprow are to the North whilst Kokoado lies between Apewosika and Amamoma. Ghana Statistical Service (2010) population and

housing census revealed that, the estimated population of Kwesipra was 1,351; Apewosika 3,721; Amamoma 7,689; Kwaprow 2,919 and Kokoado 2,870. With Ghana's population growth rate of 2.18% (Knoema, 2018), the current estimated population of the communities are: Kwesipra, 1,587; Apewosika, 4,370; Amamoma, 7,857; Kwaprow, 2,983 and Kokoado, 2,933.

Per a policy established by UCC in 2006/2007 academic year, the halls of residence are to house all level 100 students and executives of the various halls (GNA, 2006). The new policy of student accommodation on campus known as in-out-out-out compulsorily houses all level 100 students (SRS, 2018). These students then move out into the private hostels in the communities for levels 200, 300 and 400 respectively. Because of the increased number of students in the university and its surrounding communities, waste generation has been on the increase. This increment has the tendency of impacting the waste management practices of the university community.

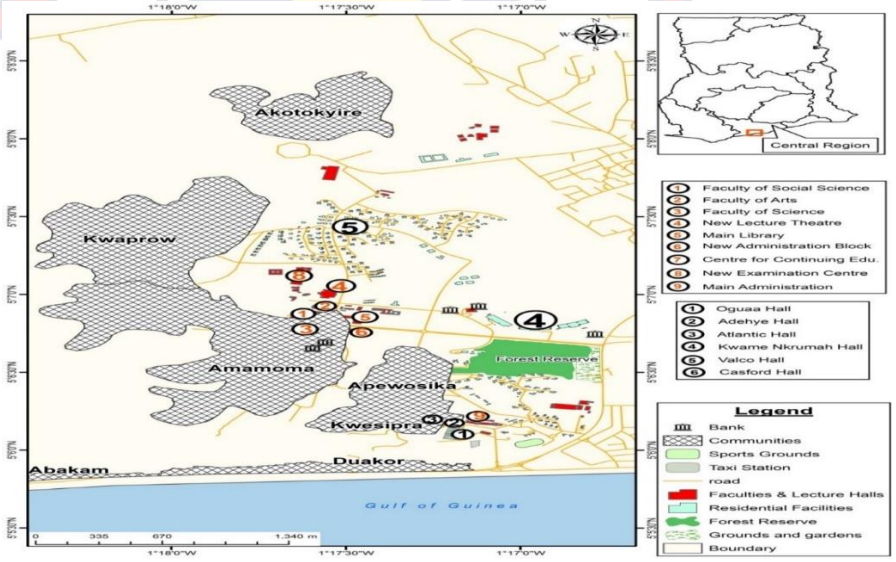

***Figure 8*: Map of UCC and its surrounding communities.**

Source: Cartography, GIS and Remote Sensory Unit, Department of Geography and Regional Planning, 2016

Population

A study population involves all the study subjects that are the focus of the research project (Jennings 2001). In this study, the population consists of all undergraduate students of UCC (N = 17,864) for the 2018/2019 academic year (Students Record Section [SRS] UCC, 2018) and the principal officers of the Environmental Health Section UCC, the Environmental Health and Sanitation Unit CCMA, and the University Hospital. The resident students comprise Adehye (472 Females), Atlantic (N = 609; Males 388, Females 221), Casely Hayford (828 Males), Kwame Nkrumah (1,052 Males 608, Females 444), Oguaa (1013, Males 563, Females 450, Valco (1195, Males 679, Females 516), SRC (510, Males 296, Females 214) and GUSS (192, Males 125, Females 27). The non-resident students comprise Adehye (956 Females), Atlantic (N=1,206; Males 787, Females 419), Casely Hayford (1,530 Males), Kwame Nkrumah (2,103 Males 1338, Females 766), Oguaa (1,833, Males 1,235, Females 598), Valco (2,247, Males 1,372, Females 875), SRC (1,686, Males 1,009, Females 677) and GUSS (431, Males 220, Females 211).

Undergraduate students are post-secondary students who have been given admission into the university to pursue a four-year programme in a mixture of generalized educational requirements and courses specific to an a person ‘s area of study or degree of concentration to obtain their first degree (Students Record Section [SRS] UCC, 2018). These students were normally found in the halls of residence and the private hostels and apartments in the neighboring communities. The students were selected because they form the larger segment of students residing in the eight traditional halls of residents in the university as well as the private hostels in the communities. They are also

responsible for greater part of waste generation on campus and hence their responses are likely to give a valid reflection of waste management issues in the halls and the hostels.

In addition, the officers of the Environmental Health Section of UCC, Environmental Health and Sanitation Unit of the Cape Coast Metropolitan Assembly [CCMA], and the Director, Directorate of Health Services UCC Hospital are the heads of their respective departments and the overseers of health and environmental health issues confronting the university and the communities that surround the university. They allocate schedules and account for happenings in their respective units for waste management, health prevention and promotion. Their responses, therefore, would provide valuable information to the cause of the study.

Sampling Procedure

The multistage sampling technique was adopted to sample a representative sample to represent the study population. The process involved four stages. These were the determination of the sample size in the halls of residence using proportional stratified sampling technique. Again, the random selection of five surrounding communities, the quota sampling of the non-residential students based on size of community. Furthermore, an estimated gender ratio and the purposive sampling of the key informants. The total population was initially stratified into resident and non-resident students and the proportional stratified sampling technique was used to determine the appropriate sample for each stratum. Two of the halls were single sex (Adehye, Female and Casford, Male), and hence each already exited as a stratum. The

remaining six mixed halls (Atlantic, Kwame Nkrumah, Ogua, Valco, GUSS and SRC) were also stratified into males and females.

The Yamane formula (Yamane, 1967) was adopted to estimate the sample size because it usually leads to a theoretically higher minimum sample size than the Krejcier and Morgan (1970) table for the same population size and margin of error. The Yamane's formula is stated as:

$$n = \frac{N}{1 + Ne^2} \quad \text{.....(1)}$$

Where N is the population size, n is the minimum sample size and e is the margin of error. This study was based on the 95 percent confidence level, which implied an error margin of 5 percent (0.05). The sample size n is written as a function of only the specific target population (N) as:

$$n = \frac{N}{1 + 0.0025N} \quad \text{.....(2)}$$

Two options were available at the first stage of the multistage sampling process for the halls of residence. That is, either to determine the sample size for the entire population before distributing the sample across the respective halls based on their proportion; or to use the sub-population to determine a representative sample from each hall and total the results. However, this process also implied further stratification of the sample for the mixed halls based on gender, which resulted in very small sample size for the male and female students. The second option was to sample at the hall level for a representative sample of males and females in each halls using the population of the halls and aggregating the results to generate the total sample. The later approach resulted in lager sample size with significant representation of males and females in the mixed halls. Since the central limit theory supports the

validity of a large sample size that has the appropriate variations, the study settled on the second option for the sample size determination as estimated below. In the single sex halls, the sample size was simple the results of estimated sample from the Yamane's formula. However, the sample sizes for the mixed halls were further stratified into males and females.

The sample size was first determined for each hall using the total student residents (non-residential) in the hall in which case the population size (N) is the total residential students of the given hall. The estimation gave the following samples in each hall: Adehye (217 Females), Atlantic (N=241), Casely Hayford (270), Kwame Nkrumah (290), Oguaa (287), Valco (300), SRC (225) and GUSS (130).

The proportional stratified sampling technique was further employed to break the sample for each hall into males and females using the relation:

$$\text{Male sampled} = \frac{\text{number of males in hall}}{\text{Hall population}} \times \text{Total sample from hall}$$

$$\text{Female sampled} = \frac{\text{number of females in hall}}{\text{Hall population}} \times \text{Total sample from hall}$$

The residential hall and gender breakdowns were: Adehye (217 Females), Atlantic (N=241; Males 154, Females 87), Casely Hayford (270 Males), Kwame Nkrumah (N=290; Males 168, Females 122), Oguaa (287, Males 160, Females 127), Valco (N=300, Males 170, Females 130), SRC (N=225; Males 131, Females 94) and GUSS (N=130; Males 85, Females 45).

The second stage was the determination of the sample size for the non-residential students. The names of the major communities surrounding the university were initially listed to form a sampling frame from which a simple random sampling was used to select five out of the seven identified

communities. The selected communities were Kwesipra, Apewosika, Amamoma, Kwaprow and Kokoado. The two communities that did not make it into the sample were OLA and Akotokyire.

There was inadequate statistics on the actual number of students in each of the communities selected as well as their distribution by halls. A quota was therefore randomly assigned to each community based on proximity to the university and the perceived concentration of student populations to give the required non-resident sample. The quota assigned were Amamoma (732, Males 438 and Females 294), Apewosika (610, Males 365 and Females 245), Kokoado (610, Males 365 and Females 245), Kwaprow (366, Males 219 and Females 147) and Kwesipra (122, Males 73 and Females 49). The stratification into males and females was done to reflect the male-female ratio in the total sample of non-resident students that was estimated to be 3 to 2 respectively (1,459:981). That is, the total sample of male and female non-resident students was known and was used as a guide on what ratio to expect in the respective communities keeping other factors constant.

The process gave rise to a total sample size of 4,400 students comprising Males (2,597; Residential 1,138, Non-residential 1,459) and Females (1,803, Residential 822, Non-residential 981). The sample size of 4,400 out of the 17,864 undergraduate students resulted in a percentage of 24.63% of the total population. Practically, the representativeness of a sample does not only depend on the sample size but also on the variations in the sample units (Polit, 2010). Hence, the adoption of a probability sampling procedure and stratifications along gender and residential status makes the

sample proportion of about 24.63% relatively large enough to allow for efficient and consistence outcomes from the quantitative analyses.

For the qualitative data, the sampling units (The Officer of the Environmental Health Section-UCC, the Officer of Environmental Health and Sanitation Unit, Cape Coast Metropolitan Assembly (CCMA) and the Director, Directorate of Health Services (UCC), were selected purposively as key informants for face-to-face interview with the researcher.

Bonett (2002: 335) argues that, "in a reliability analysis, sample size is perhaps the most important element", which suggests that the sample size has implication on the type of analytic tools that can be employed in a study. The sample size I used was consistent for all the statistical tests used, and post-estimation test suggested the results were all consistent and efficient. Muijs (2004), also, stated that an honest selection of the sample is similarly significant in quantitative research just as the sample size and which has a concern for generalization. Muijs added that fair sampling techniques are the ones, which are random, proceeding from an appropriate sampling technique and having a relatively large sample size. There was an assurance that the sample process was random and has significant representation of well-defined strata in the population to reduce biases.

In terms of size, the existing literature suggest that, there is no essence of keeping the sample size very high due to accessibility since it is likely to get more consistent results with enhanced planning and reduced sample size (Muijs, 2004). That is, though the traditional halls of residence are easily accessible, the inclusion of the neighbouring communities introduced some difficulties into the accessibility of the respondents. Yıldırım and Şimşek

(2006) and Ross (2004) suggested a sample size between 30-500 respondents if parametric tests are to be used otherwise non-parametric analysis techniques should be employed. The consistent use of non-parametric test which does not depend on the large sample properties or central limit theorem is a further means to ensure that the sample size does not influence the outcomes of my analysis (Yıldırım & Şimşek, 2006), though the sample size used, was relatively large.

The sample size in this study, 4,400, was about 9 times the maximum sample suggested by Yıldırım and Şimşek (2006) and Ross (2004). Lenth (2001:187) stated that "an under-sized study can be a waste of resources for not having the capability to produce useful results, while an over-sized one uses more resources than are necessary". The normal practice is to use a relatively large proportion of the study based on accessibility, resource availability, and variability in the population (Asiamah, Mensah & Oteng-Abayie, 2017). The inclusion of the non-resident students and the decision to sample a representative number from each community made the population variable in nature despite the fact that the students could be thought of as concentrated on campus.

The selection of a total sample of 4,400 respondents that represents about 25% of the total student's population was therefore considered appropriate for the focus of the study since the results was supported by qualitative data from interviews and observations. This study used three key respondents for the interview which was appropriate based on the fact that the issues in the qualitative analysis were not broad, and was supported by the observation. Malterud, Siersma and Guassora (2016:5) affirmed that "a

(qualitative) study will need the least amount of participants when the study's aim is narrow, if the combination of participants is highly specific for the study aim, if it is supported by established theory, if the interview dialogue is strong …". This study selected three main respondents from the three key areas which were the Officer at the Environmental and Sanitation Section of UCC for main campus, the Officer at the CCMA for the communities and the Officer from the University hospital for the university hospital with regards to biomedical waste. Hence, together, the study had a final sample of 4403 for the quantitative and the qualitative analysis in all.

Data Collection Instruments

The made use of questionnaire, semi-structured interview guide, and observational checklist for data collection. I used questionnaire to collect data for the quantitative component of the study, and semi-structured interview guide and observational checklist for the qualitative aspect. In designing the questionnaires, a literature search was conducted on the topic to identify relevant questions and concepts on environmental health as well as health impact of garbage controlling approaches. The choice of questionnaires was motivated by their effectiveness for eliciting precise information about practices and conditions of which the respondents are assumed to have understanding. Again, their ability of enquiring into opinions and attitudes of subjects as well as their easy administration as compared with other instruments like interviews. Finally, the ability of the questionnaires to cover a larger number of respondents (Mathers, Fox & Hunn, 2002).

Five research questions were responded to by the questionnaire. The questions are: what are the types of waste generated in UCC the campus and

its surrounding communities?, what are the existing waste management practices in the UCC and its surrounding communities?, what are the challenges associated with managing waste in the UCC and its surrounding communities?, what are the environmental health impact of waste management practices in the UCC and its surrounding communities?, and what are the health impact of waste management practices in the UCC and its surrounding communities?

The items measuring types of waste generated were adapted from studies by Mariwah (2012); 2014 Ghana Demographic and Health Survey (GDHS) (Ghana Statistical Service, 2014). Items that measured the existing waste management practices were inspired by studies by Gyimah, Mariwah, Antwi and Ansah-Mensah (2019) and Bernstein (2004). The items on challenges of waste were adapted from Gyimah et al. (2019) and Mariwah (2012). Items on environmental health impact of waste were further developed from GDHS 2014 (Ghana Statistical Service, 2015). Items that measured health impact of waste, were also developed from Yawson (2014). I searched the literature for related questions and adapted the wording to suite the aim of this study, I then created other related questions on areas on which less questions were found. The final instruments were, therefore, my creation but with reference to the cited literature, which explains why the instrument was pretested.

The semi-structured interview guide was established based on the Theory of Planned Behaviour (GSS, 2015; Zhang et al., 2011) as well as extant literature. The guide addressed four research questions: what types of waste are generated in the UCC campus and its surrounding communities?

what are the environmental health impact of waste management practices in the UCC and its surrounding communities? what are the health impact of waste management practices in the UCC and its surrounding communities? and what policies and strategies are there to mitigate the environmental health impact? The items that guided the research questions were adapted and motivated by Mariwah (2012), Bernstein (2004), Ghana Statistical Service (GSS) (2015) and Gyimah et al. (2019).

In the observational checklist, items included authorized and non-authorized dumping sites, the nature of dumping sites, their location, conditions and distance from residential areas, composition of dumped waste (plastics, paper and food waste), collection frequency, procedures, and management practices were observed.

The questionnaire had 35 items (see Appendix A) with six main sections (A-F). Section A had nine items (questions 1-9) that measured students' socio-demographic characteristics such as residential status, gender, marital status, age, religion, residency (where do you currently stay), hall of affiliation, level, and college. The items were mostly multiple-choice types. Students responded by placing a mark in the boxes provided for the multiple-choice types items while they wrote in the space where such was the demand.

Section B of the questionnaire contained 5 items in one question (question 10). These items measured types of waste mostly generated by students. This was measured on 5point rating scale on which undergraduates responded on the degree at which a particular type of waste is generated in their residence (where the rating scale comprised *very high (5)* as the highest, *high (4), moderate (3), low (2*) and *very low* (1) as the least agreement).

Students were asked to tick (√) against the column that indicated the most accurate option(s) that represents their opinions.

Section C of the questionnaire consisted of 39 items (15 questions from 11-25). These items measured existing waste management practices of the University of Cape Coast and its surrounding communities. The items consisted of rating scale (11, 12, 24 & 25), multiple-choice options (13-23). The rating scale items were constructed on 5-point rating scale (where the rating scale comprised *strongly agree (5)* as the highest, *agree (4), moderately agree (3), slightly agree (2*) and *do not agree* (1) as the least agreement). The multiple-choice items had options in which students were asked to tick (√) against the columns the most accurate option(s) that represent(s) their opinion(s). However, question 13 had rating scale as very satisfied (5), satisfied (4), uncertain / undecided (3), unsatisfied (2), and very unsatisfied (1). Thus, a higher score such as 5 or such aggregation indicated better waste management practices of students (Ware & Kosinski, 2001). For the items in the rating scale, the participants responded by ticking the best option that described their perceptions. For the multiple-choice items, students were asked to tick (√) against the most accurate option(s) that represented their opinions. In some cases, the respondents were given the option to select as many options as applied.

Section D of the questionnaire contained 9 item (question 26). This item measured challenges to students' waste management practices. This was measured on 5 point Likert scale on which students responded on the extent to which the items provided were challenges to them in their attempts to manage waste in their halls of residence or hostels. All the responses in the scale were

classified as strongly agree (5), agree (4), moderately agree (3), slightly agree (2) and do not agree (1). Students were asked to tick (√) against the column that indicated the most accurate option(s) that represents their opinions.

Section E of the questionnaire contained 7 items (question 27). This item measured the environmental health impact of waste management practices. The item was measured on a 5-point rating scale on which students responded on the extent to which they experienced or saw those negative environmental effects as a result of reduced garbage controlling approaches. All the responses in the scale were classified as strongly agree (5), agree (4), moderately (3), slightly agree (2) and do not agree (1). However, the response in item 34 was classified as very likely (5), likely (4), don't know (3) unlikely (2) very unlikely (1). Participants responded by ticking the best option that described their perceptions.

Section F of the instrument comprised 52 items (8 questions from 28-35) that measured health impact of waste management. The items consisted of multiple-choice options (28, 29 and 35) and rating scale (30-34). The rating scale items were constructed on 5-point rating scale, multiple-choice items had options in which students were asked to tick (√) against the most accurate option(s) that represented their opinion(s). All the responses in the scale were classified as strongly agree (5), agree (4), moderately agree (3), slightly agree (2) and do not agree (1). For the items in the Likert scale, the participants responded by circling the best option that described their perceptions. For the multiple-choice items, students were asked to tick (√) against the column the most accurate option(s) that represented their opinions.

Interview guide

An interview guide was developed for gathering the qualitative data from the Officer of Environmental Health Section – UCC, the Officer of the Environmental Health and Sanitation Unit, CCMA and the Director, Directorate of Health Services-UCC (see Appendix B). The responses from the interview were used to answer research question six as well as to provide support to the quantitative results in research questions one, four and five. This was because the study triangulates the quantitative and qualitative responses to answer research questions one, four and five. The development of the interview guide was informed by the research questions and extant literature on waste management practices. Planned Behaviour (GSS, 2015; Zhang, Zhao, Gan, Jin, Gao, Chen, Guan, and Wang (2011) as well as extant literature. Four research questions guided the discussion: what are the types of waste generated in the UCC campus and its surrounding communities? What are the environmental health impact of waste management practices in the UCC and its surrounding communities? what are the health impact of waste management practices in the UCC and its surrounding communities? and what policies and strategies are there to mitigate the environmental health impact?

Fifteen questions with five sections (A- E) guided the interview. Two questions with four items under them guided the interview on the socio-demographics on the respondents. Three items in one question, guided the interview on the types of waste generated on campus and the surrounding communities. Four questions guided the interview on the environmental health impact of waste whereas respondents answered four questions on the health impact of waste management. Finally, four questions guided the interview on

the existing policies and strategies to mitigate the environmental health impact.

Observational guide

To augment the responses from the questionnaire and the interviews, an observation was further done. In the study, five communities (Apewosika, Amamoma, Kwesipra, Kokoado and Kwaprow) were closely observed with regards to their waste disposal and management practices. According to Moser and Korstjens (2017), observation involves three stages, namely; descriptive, focus, and selective. At the descriptive stage, observation was made on whatever happened in the setting. The focus observation involved watching certain situations for some period, with some areas becoming more conspicious whereas in selective observation, observation was made on only specific issues about the phenomenon (Moser & Korstjens, 2017). Moser and Korstjens suggest that each inspection made ought to provide responses to questions such as 'who do you observe?', 'what do you observe?', 'where does the observation take place?', 'when does it take place?', 'how does it happen?', and 'why does it happen as it happens?'

Two months were used to do the observation at all the five communities. Each community was visited three different times in the day (morning, afternoon and evening) to see the trend at which waste management practices were practised by the community members. Guided by the observational check list and Moser and Korstjens (2017), a number of authorized dumping sites, unauthorized dumping sites, nature of dumping sites, location of the sites, number of public toilets, open defecation and composition of dumped sites were observed (see Appendix C). During the

observation, some photographs and field notes were taken. The field notes provided supplementary notes and aided in the interpretation of data. This was done to offer me the opportunity to observe the waste disposal and management practices of the University community and its surrounding communities rather than just reporting what the study participants told me. This is because people are sometimes unwilling to write down their true views on a questionnaire or tell a stranger their actual opinions in an interview, which will give a true reflection of the phenomenon under study (Choi & Pak, 2005).

Validity of the instruments

Validity signifies the degree to which a test is able to measure what it is purposed to measure. There are several aspects of validity, which includes face validity, content validity, and statistical validity, concurrent validity, and construct validity (Cohen, Manion, Morrison, & Morrison, 2007). Oliver (2010) considers validity to be a necessary requirement for all types of studies. Validity is not a static concept that may possibly be assessed with a single statistical test, but rather a concept that permeate the entire research process (Dudovskiy, 2018).

This study focused on achieving validity right from the choice of instruments through data gathering and analysis. The selection of the questionnaire and type of questions on it were done in line with approved questions from the literature to improve internal and content validity among others. The selection of statistical methods that allows for ordinal variables to be used for logistic regression and testing all hypothesis at the 95 percent significance level was to improve statistical and external validity of the results

of the study (Oliver, 2010). Again, the triangulation of the data from both the quantitative and the qualitative methods to address the same research question, was to improve several aspects of internal and external validity such that the outcome can be generalised to the study population. Five undergraduates responded to the questionnaire. Respondents were made to read the items critically and indicated those that were difficult and ambiguous. Extra sheets of paper were attached to the questionnaire for respondents to comment on any identified inaccuracies and inadequacies. Comments, suggestions, corrections, and ambiguities were taken into consideration in the final write up of the instrument.

To establish content validity and construct, the instruments were given to my supervisors to scrutinize and make any correction or comments needed. Experts from environmental health and waste management validated the instruments after which they were again shaped by my supervisors. The selection of questions from the existing literature, pilot testing and paraphrasing questions that had low reliability scores were geared towards ensuring that the instruments measure the concepts it was intended to measure (construct validity).

Reliability of the instruments

The current study had five research questions that used quantitative analysis with data from the structured questionnaire. Since the Cronbach's alpha can be biased as the number of items increases, the test was done for the questions in each research question as presented below:

Table 1: Reliability Test Using Cronbach's Alpha

Item	Reliability test
Waste generation	Number of items in the scale=5
	Average inter-item correlation=0.3536
	Scale reliability coefficient=0.8704
Waste management practices	Number of items in the scale=28
	Average inter-item correlation=0.3570
	Scale reliability coefficient= 0.8601
Challenges	Number of items in the scale=9
	Average inter-item correlation= 0.3726
	Scale reliability coefficient=0.8538
Environmental impact	Number of items in the scale=7
	Average inter-item correlation=0.3623
	Scale reliability coefficient=0.8017
Health impacts	Number of items in the scale=50
	Average inter-item correlation=0.3679
	Scale reliability coefficient=0.8329

Source: Field survey, (2020)

All the reliability coefficient was between 0.80 and 0.90 which from the earlier interpretations indicated a good reliability (Namdeo & Rout, 2016). Much as this does not mean the questionnaire was good, it does indicate that the outcome is reliable enough for analysis and policy recommendations. Since the Cronbach alpha is not entirely enough to measure the reliability of the instruments, the average inter-item correlation was also presented. The inter-item correlation does not measure the degree at which the diverse questions on the scale measure the same construct, low nor are high values preferred. A very low value indicates the items are not measuring the same construct, while a very high value indicates the items are almost identical and some could be dropped. An acceptable ranger for the average inter-item

correlation has been given as 0.15 to 0.5 (Glen, 2018; Phelan & Wren, 2018). The results, as presented in Table 1, indicated that all the average inter-item correlations were within the acceptable range (waste generation=0.3536, waste management practices=0.3570, causes and challenges=0.3726, environmental health impact=0.3623, and health impact=0.3679).

Pre-testing of questionnaire

The questionnaire was pre-tested with students from Sasakawa Centre for residence and Akotokyire for non- residence using the convenience sampling method between the 26th of January, and 1st of February, 2019. A total of 120 undergraduates (60 males and 60 females) answered the questionnaires. One week was given to the students to return the filled questionnaire, after which FAs went back to retrieve. The pre-testing enabled the assessment of the validity and reliability of the instrument. The internal consistency reliability of the items was tested and reported using the pre-tested data. The Cronbach coefficient alpha, a measure of internal consistency was used in the determination of the reliability of the questionnaire after which the questionnaire was improved before final administration.

Data Collection Procedures

Collection of data continued after the research protocols had been approved, ethical clearance gained and the necessary permissions sought. The Institutional Review Board (IRB) of the University of Cape Coast gave the approval of the research protocols. The ethical clearance sought from DRIC (see Appendix D; ID: UCCIRB/CES/2019/11) paved way for the data collection. This was preceded by the approval of the research protocols by my supervisors. In addition, permission was sought from the Registrar of UCC to

enable me study the students in the eight traditional halls of residence. Introductory letters (see Appendix E) were obtained from the Head, Department of Health, Physical Education and Recreation (HPER), to introduce me to the administrators of the eight halls in the university as well as the three key informants (The Officer of the Environmental Health Section-UCC, the Officer of the Environmental Health and Sanitation Unit-Cape Coast Metropolitan Assembly CCMA, and the Director, Directorate of Health Services-UCC) for the interview. The documents obtained (ethical clearance and introductory letters) offered me the opportunity to introduce myself to the administrators or the authorities in the halls of residence as well as the respondents and to establish a good rapport with the respondents. The objectives of the study were also communicated to the respondents.

Twenty-six (26) field assistants (FAs) assisted in the administration of the questionnaire. The FAs were National Service personnel from different departments in the university. They were given four days training of one hour each on the purpose and the objectives of the study. This was to make them abreast of the work and also to prepare those who might encounter some challenges in responding to some of the items in the questionnaire. The FAs were further tutored on how to handle ethical issues on the field and to give respect to students.

On the first and second days of data collection, I with the help of the FAs, visited the halls of residence in the university as well as the private hostels in the communities to explain the purpose of our visit to the students. The students were given the assurance that there was no right nor wrong answers and that their responses would be handled confidentially. After this,

the questionnaires were given to students who agreed to take part in the study. Students were given enough time to respond to the questionnaires. The FAs collected the completed questionnaires. Data collection begun from the third week of April 2019 through to the end of May 2019. Data collection showed 100% return rate.

Prior to the interviews, preliminary visits were made to the Officer of the Environmental Health Section-UCC, the Officer of the Environmental Health and Sanitation Unit (CCMA), and the Director, Directorate of Health Services-UCC to familiarize with them and to explain my role and the purpose of the study. This preliminary visit helped me sought their permission and support for the study. The participants were made aware that they could give either written or verbal consent to be part of the study. Participants were made aware of their rights outlined in the consent form and assigned an identification number to assure them of privacy before each interview began. All the participants gave verbal consent to be part of the study. Appointments including date, time and venue for interviews were also scheduled. All the interviews were held in the offices (a convenient location agreed by the respondents) of the respondents and lasted between 20 to 30 minutes. The respondents were encouraged to feel free to express their opinions on the various issues that were interviewed on. They were also given the assurance that their responses were very important and that there were no wrong nor right answers. The interviews recordings were done using Infinix Notepad 4. The collection of the qualitative data lasted for three weeks.

Trustworthiness of the qualitative data

The trustworthiness or the sstrength of the results is the basis of excellent qualitative research (Birt, Scott, Cavers, Campbell, & Walter, 2016). Validity in qualitative research depends on the determination of whether the findings are accurate from the viewpoint of the scholar, the participant, or the readers of an account (Creswell & Miller, 2000). Trustworthiness implies that the scholar checks for the accuracy of the results by engaging certain techniques. Languages or expressions thrive in the qualitative literature that address trustworthiness, authenticity, and credibility of the account (Creswell & Miller, 2000).

Throughout the processes of data collection and the analysis of the qualitative phase of this study, there was the assurance that the findings and interpretations were accurate or credible. Creswell (2013) indicated that validating findings in qualitative research means that the accuracy or credibility of the findings are determined by employing certain strategies. In view of this, four main rigorous and credible strategies were approved to ensure the trustworthiness of the data. The first strategy was member checking.

Creswell (2013) explained member checking as "a process of ensuring that the transcribed data is sent back to the participants to verify their responses and to ensure that the transcribed data are authentic" (p. 259). According to Birt et al. (2016), member checking, also known as participant or respondent validation, is an approach for investigating into the reliability of results by giving participants the opportunity to check whether survey results are resonant with their experiences. A comprehensive review of the checklist

for assessing the quality of qualitative research reported by Tong, Sainsbury and Craig (2007) posited that out of the 22 items on the checklist developed indicators for assessing the quality of qualitative data, 13 were focused on respondents' validation. Studies by Oroei, Momeni, Palenik, and Askarian (2014) on the reasons of unsuitable separation of contagious garbage at Nemazee Hospital, Shiraz, Iran used member inspection as means of guaranteeing the trustworthiness and credibility of their data.

An on-going dialogue was kept with the participants regarding the interpretation of the respondents' reality and meanings with the aim of ensuring the true value of the data collected. This was done by sending the findings back to the participants and asking them about the accuracy of the report in terms of how realistic the descriptions were, whether the themes were accurate and also if the interpretations represented fairly the situations.

The second strategy was neutrality, where the researcher based the findings on participants' responses and not on their potential bias or personal motivations. This includes making certain that the researcher's preference does not tilt the interpretation of what the research respondents said to fit a certain narrative. To establish neutrality, an inspection trail was provided which highlighted every step of data analysis in order to ensure that results are not prejudiced by any bias developed from the literature and my personal experience (Perry, Murphy, & Dovidio, 2015).

The third strategy employed was to provide rich, thick, and detailed descriptions to convey the findings so that anyone interested in transferability (the extent to which the outcomes of qualitative research can be generalized or conveyed to other context or settings) shall have a solid framework for

comparison. According to Bryman (2012) and Loh (2013), qualitative researchers can make use thick description to show that the research study's findings can be appropriate to other settings, environments, and conditions. Marshall and Rossman (2011) indicated that qualitative methods such as providing in-depth descriptions is essential to adding value to waste characterization and management studies.

The final strategy was the use of an external examiner to review the entire research. The external examiner looked at the various characteristics of the study such as correctness of the transcription, relationship between research questions and the data, the level of data analysis as well as interpretation. The external auditor gave his objective assessment of the research process and this helped to enhance the overall trustworthiness of the qualitative phase of this study.

Data Processing and Analysis

For the quantitative phase, the questionnaires collected were collated, coded and moved into a computer and analysed using the Statistical Package for Social Sciences (SPSS) Windows version 20.0 software and STATA version 14. The SPSS was used mainly for data entry because the enumerators were all conversant with SPSS than STATA. STATA, however, was used throughout the analysis after exporting the data from SPSS to STATA. Data were screened for missing values and outliers. This was done by generating frequencies for each variable to identify obvious errors in data entry. Data which were wrongfully entered were corrected by referring to the original questionnaire. Data were then cleaned before analyses were run.

Research Question One, Two, and Three: Types of waste generated, existing waste management practices and challenges associated with managing waste in the University of Cape Coast.

Rresearch question one required to find the types of waste generated by the students as well as major waste produced by students, both within and outside the halls of residence. This research question was answered using frequencies and percentage counts. The second research question required to find out the garbage controlling approaches ongoing on campus. The question was analysed using frequencies and percentage counts while the third analysis sought to identify the causes of poor waste management practices among students and the challenges that stakeholders face in their attempt to efficiently manage waste. Frequencies and percentages were used for the analysis of the two thematic areas.

Research Question Four: What are the environmental health impacts of waste management practices at the University of Cape Coast?

This research question sought to examine the environmental health impacts of poor garbage controlling on the students of the University of Cape Coast. The Wilcoxon rank sum test of median comparison was used to compare selected health impact across residential status and gender of the respondents. The choice of Wilcoxon test was dependant on the fact the Likert-scale variable was placed on ordinal scale for which the median is the best choice central tendency to use. The decision to use median then requires the use of non-parametric test or a distribution free test such as the Wilcoxon test since all the categorical variables had two factors. The Wilcoxon test reports the Z-statistics along with it probability value (P-value) and an extended probability which indicated the probability that the first factor shall be greater than the second factor.

Research Question Five: What are the health impacts of waste management practices of the University of Cape Coast?

Binary logistic regression analysis and structural equation model (SEM) were used to analyse the research question to establish the influence of waste on the healthiness of the university community. Binary logistic regression was expended to estimate categorical assignment in or the probability of category membership on a dependent variable based on several independent variables (Diekmann & Jann, 2008).

The choice of SEM for the study depends on its strength to analyze more relationships at the same time and that it can overcome the obstacles that appear when latent, variables require measurement (Hox & Bechger, 2000). This study had to deal with a quantity of latent variables such as reduced garbage controlling, state of the environment and health status of the students for which observed predictors exist. That is, poor waste management is not a single construct to be measured since it has several aspects which are observable but the actual construct cannot be directly observed. The SEM allows for the latent variables to be measured using the observed variables that were obtained from the administration of the questionnaire. Three major latent variables were estimated in the path analysis after which their direct and indirect effects were examined.

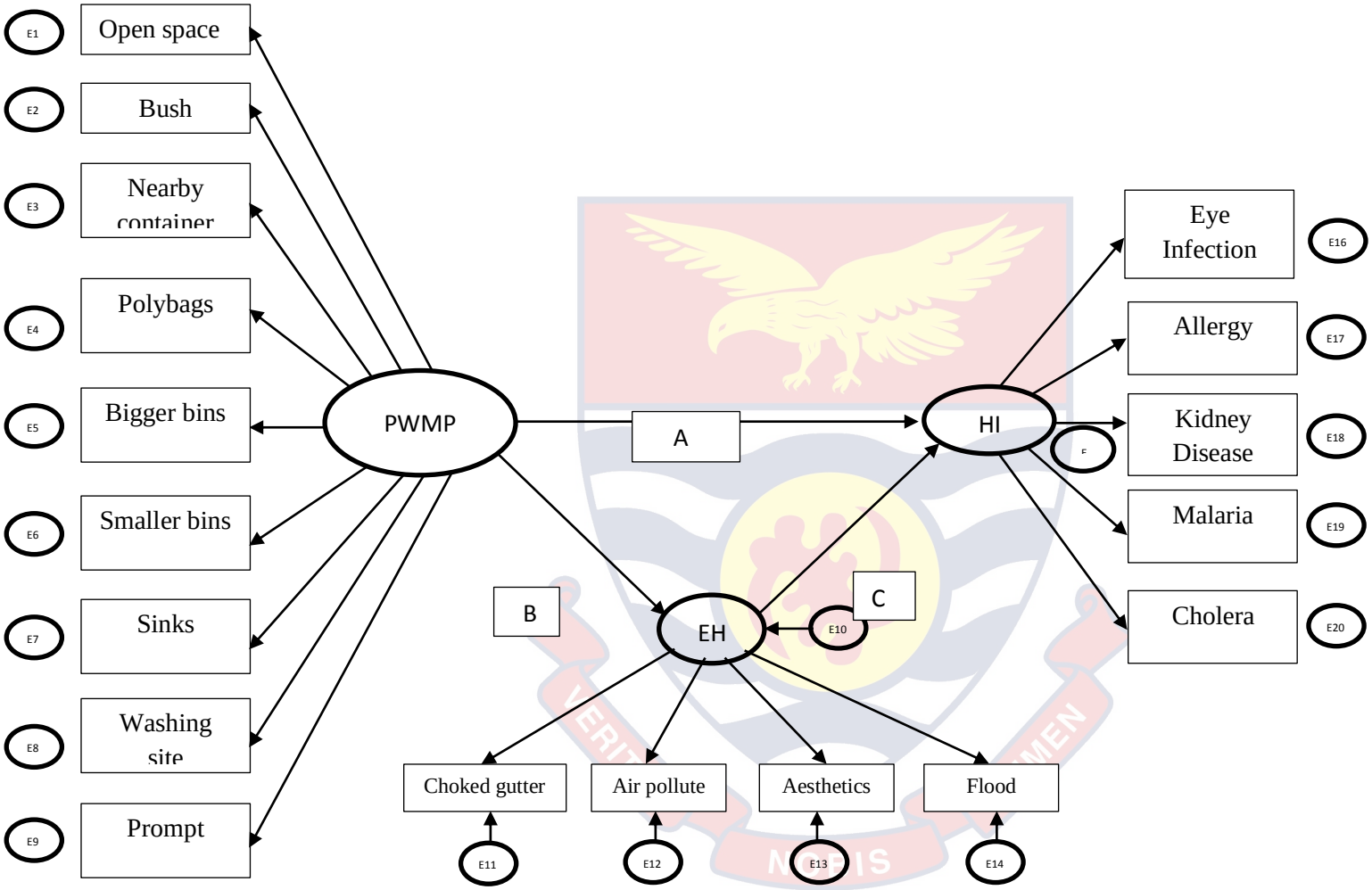

***Figure 9*: SEM model structure for estimation and analysis**

Source: Field survey, (2020)

Figure 9 presents the structure of the SEM model that was eventually estimated for the analysis. The three latent variables were PWMP (Poor Waste Management Practices), Estate (State of the environment) and H status (Health Status of the students). The variables dumping into open space, dumping into bushes, dumping into nearby container, collecting waste in polybags, presence of bigger bins, presence of smaller bins, availability of sinks, dedicated site for washing and existence of prompts were the observed aspect of the latent variable, PWMP. The observed aspect of environmental waste impacts was chocked gutters, floods, aesthetics devaluations and air pollution. The variables eye infection, allergy, kidney infections, malaria and cholera were the observed aspect of health status of the students as a result of the effects of poor waste management practices. The major parameters of interest in the model were denoted by A, B and C in the paths among the latent variables. The estimated value of A captured the direct effects of reduced garbage controlling while B and C captured the indirect influence of reduced garbage controlling on the health status of the students.

The full SEM contains both a measurement component and a structural component. The measurement components of the model estimated the factor loading of the exogenous observed variables that predict poor waste management practices, environmental impact and health status of the students. The structural component was in the form of path models in which causal process among the latent variables were estimated. According to Johnson and Hallquist (2017:3), “in full SEM, the structural (regression) component of the model often reflects relationships among the latent variables defined by the measurement component of the model”.

Obtaining a unique solution to a system of equations is not always guaranteed in practice since it involves a number of factors, which includes the type of identification. According to Suhr (2010), identification involves the study of conditions to obtain a specific, exceptional result for each free parameter indicated in the model from the observed data. MacCallum and Austin (2000) stated that in order to obtain a solution to a SEM model, the number of free parameters, q, must be equal to or smaller than the number of non-redundant elements in the sample covariance matrix, denoted as p* with p* = p(p + 1)/2 where p is the number of measured variables in the covariance matrix (q =< p*). The model estimated contained three latent variables with 18 measured variables which translate to p* to be 171, which far exceeded the number of free parameters that were estimated including the error terms. Schumacker and Lomax (2004) specified that an appropriate aim in achieving identification is to have a 20:1 ratio for the number of subjects to the number of model parameters. However, a 10:1 may be a realistic target. If the ratio is less than 5:1, the approximations may be unbalanced. In the traditional approximation of the **GSE**M model perform the pre- approximation test of model identification to ensure that the model is over identified before estimation, otherwise the model will not estimate. Over identification is the condition in which there are more equations than unknown independent parameters (Schumacker & Lomax, 1996). The **GSE**M model is believed to be over identified, if a value for one or more free parameters can be obtained in multiple ways from the observed data.

The measured variables used in this study were mostly dummy variables, which reduce the tendency of high correlation, and hence greater

fear of multicolinearity. The nature of the measured variables also reduces the issue of scaling of the variables, since they were all in the same units (Suhr, 2010). In the actual estimations, the open space, eye infections and choked gutters were constraint to 1 in the poor waste management, health status and the environmental impact models respectively. Another practical issue considered in the estimation was to standardize the variables to allow for comparison of the magnitudes of the estimated parameters in the model. Unstandardized parameter approximates retain scaling information of variables and can only be interpreted with reference to the scales of the variables, while standardized parameter estimates are alterations of unstandardized estimates that remove scaling and can be used for informal comparisons of parameters throughout the model (Schumacker & Lomax, 1996). Standardized approximates correspond to effect-size approximates (Johnson & Hallquist, 2017). The estimation used the standardized coefficient estimates which made the effect size comparison done valid.

Irrespective of the manual estimation done with the measured variables, the final statistical test rests on the pre and post-estimation test that were done. The estimation, therefore, tests the stability of the model and passed the stability test, as well as used the robust standard error to control the effects of possible hetroskedasticity in the model.

The estimation process employed the maximum likelihood estimation technique for the estimation. The fitness of the model was tested using LM test of model verses structure, which comes with the estimated results in STATA. The Wald test of overall significance was also done.

Logistic Regression Model specification and Estimation Techniques

The assessment of the health impact of reduced garbage controlling approaches based on gender and residential status adopted by the binary logistic regression model and estimations. The dependent variable, health status of the students, was define into a dichotomous variable with the definition of health impact (1) or no health impact (0). The analytic model specification, therefore, assumes a latent variable y (a proxy for health status) which can be measured by the observed variables y^* that can be defined as:

$$y^*_i = \alpha + \beta_1 Gender_i + \beta_2 \text{Res}_i + \beta_1 Gender_i X \text{Res}_i + \varepsilon_i \ldots\ldots\ldots\ldots (1)$$

where Gender and Res (residential status) are the explanatory variables, B_1 , B_2 and B_3 are the slope coefficients estimated and ε is the stochastic disturbance terms expected to be independent and identically distributed (iid). Also, y^*_i is the dependent variable (health status) and α is the intercept term. Then the latent variable y can then be defined as:

$$y = 1 \text{ if } y^*_i > 0$$
$$y = 0 \text{ if } y^*_i < 0$$

The logistic distribution can then be used to transform the binary variable outcomes into a linked variable bounded between 0 and 1 as probabilities.

The logistics model cab be stated as

$$\Pr(Yi = 1|Xi) = \frac{1}{1+e^{y^*}} \ldots\ldots\ldots\ldots (2)$$
$$\Pr(Yi = 0|Xi) = 1 - \Pr(Yi = 1|Xi) \ldots\ldots (3)$$

The odd ratio captures the ration of probability $\Pr(Yi = 1|Xi)$ over that of $\Pr(Yi = 0|Xi)$ as given as

$$e^{y^*} = \frac{\Pr(Yi = 1|Xi)}{1 - \Pr(Yi = 0|Xi)} \ldots\ldots(4)$$

Taken the natural log of equation (3) produce

$$y^* = \ln\left(\frac{\Pr(Yi = 1|Xi)}{1 - \Pr(Yi = 0|Xi)}\right) \ldots\ldots(5)$$

Equation (5) is referred to as the logit function which form the theoretical basis for the three empirical models stated under the analytics framework and estimate (Diekmann & Jann, 2008).

A special case of the marginal effects are the *predicted margins* which give the probability of experiencing adverse health impact had everyone in the sample belongs to a particular group of interest (Long, 2016). The contrast is an extension after predictive margin that test the statistical significance of the difference between the predictive margins. The contrast is available for categorical variables after logistic regression as in the case of this study. All the independent variables were categorical, hence the predictive margins and contrast were used for the analyses.

Research Question Six: What are the existing policies and strategies to mitigate the environmental health impact?

In this research question, the views of three key informants, the Environmental Health Officer of UCC Environmental Health Section (Respondent 1), the Environmental Health/Sanitation Officer of CCMA (Respondent 2) and the Director, Directorate of University Health Services-UCC (Respondent 3) were employed on the existing policies and strategies to mitigate the environmental health impacts. To answer this research question, the thematic analysis was used. The process of identifying patterns or themes within qualitative data is referred to as thematic analysis (Braun & Clarke,

2006). The identification of important or interesting themes and patterns in the data and their usage to address and make sense of the research signifies the aim of thematic analysis.

For the purpose this study, the six-phase framework for conducting thematic analysis prescribed by Braun and Clarke's (2006) was followed. This was to allow for an in-depth summary of the discussions and elicit information on existing policies and strategies to mitigate environmental health impacts of waste. At the first step, the audio recordings were transferred onto Windows Media player to enable easy control of audio playback. Each of the recordings was replayed, and transcribed verbatim with the use of Microsoft Word 2007. Control of the audio playback ensured accurate transcriptions of the interviews. The transcribed data was read line-by-line and re-read in order to familiarize with the entire body of data being generated. This was followed by the second step where initial codes were generated.

A code is a pithy label that captures what is interesting about the information. Coding decreases many data into small chunks of meaning (Theron, 2015). The data was then structured in a meaningful and organized manner. Codes were written in the margin of each transcript. These codes were prearranged into categories with the usage of terms from the actual language of the respondents (Creswell, 2013). The search for the themes began with the third step. A theme is supposed to capture essential portions in the data in relation to the research question (Braun & Clarke, 2006). The themes in the analysis were identified at the semantic level, that is, the themes were within the explicit or surface meanings of the data and also all that was being looked for was what participants have said or what have been written

(Braun & Clarke, 2006). The analysis was also theoretical in nature rather than inductive as explained by Braun and Clarke (2006), because the concern was to address a specific research question and to analyze the data with that in mind.

At the fourth step, the various generated themes were then reviewed to make sure they measured what was intended to measure. At this point, all the statistics that was appropriate to each theme was gathered. This was done using Microsoft Excel (Bree & Gallagher, 2016). Themes were checked to ensure that the coded extracts correspond to the entire data set. The information connected to each theme was colour-coded.

The fifth step involved definition of themes. The analysis sought to refine the specifics of each identified theme by producing clear descriptions and names for each theme. Each of the identified themes was related back to the research question. The aim here was to identify the essence of what each theme was about, what the themes were saying and how they were relating to each other (Braun & Clarke, 2016). A thematic map was then generated to illustrate the relationships.

***Figure 10*: Thematic map on Environmental Health impact of waste management practices in UCC**

Source: Field survey, (2020)

CHAPTER FOUR

RESULTS AND DISCUSSION

The purpose of this study was to assess the environmental health impact of waste management practices of the University of Cape Coast and its immediate environments. It covered area such as type of waste generated by students, waste management practices, causes and challenges, environmental and health impact as well as policies of waste management practices. The results and the discussion of the major findings are found in this chapter.

Profile of the respondents

Gender, residential status, locality of residency and hall of affiliation were the respective strata used in the stratified proportional sampling under the methods section. Totals on these variables were strictly adhered to during the data collection and hence the distribution remains as presented in the chapter three. Marital status and age of the respondent were variables that emerged from the data collection process and were discussed as the profile of the respondents.

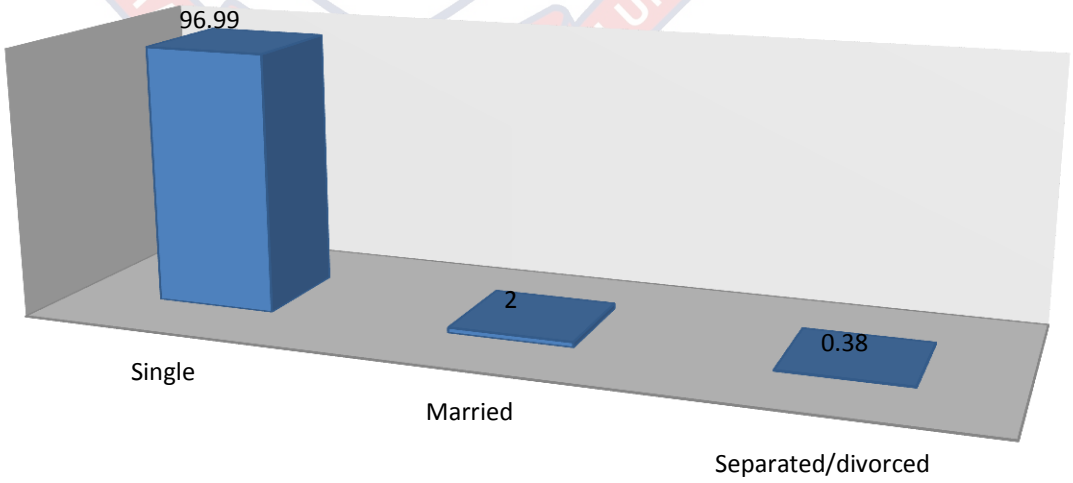

***Figure 11*: Marital status of the respondents**

Source: Field survey, (2020)

residential students were predominantly level 100 students who had an average age of about 19 years, as compared to non-resident students who are continuous students with mean ages of ranging from 21 to 25 years. The males and female students had relatively close mean ages but that of the males was slightly higher than that of the females. The age range of the respondents suggested that they are cohorts; hence, no comparison was done with age.

Research Question One: What Types of Waste are Generated on the University of Cape Coast Campus?

The reason for this analysis was to define types of garbage generated by the students as well as major waste produced by students, both within and outside the halls of residence. The types of waste generated were analysed using frequencies and percentage counts. In addition, data from the qualitative interviews with the Environmental Health Officer of UCC (Respondent 1) and the Environmental Health and Sanitation Officer at Cape Coast Metropolitan Assembly (CCMA) (Respondent 2) as well as observation were used to support the quantitative results.

The results, as presented in Table 2, showed that garbage associated with food was the most generated garbage, 43.3% (1907), followed by plastic waste 35.3% (1551), paper waste 23.4% (1031), boxes/cartons, 10% (442), and the least, electronic waste 7% (307).

Table 2: Types of Waste Generated by Students

Types of Waste	Very High		High		Moderate		Low		Very Low	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Food	1,907	43.3	1,084	24.6	807	18.3	399	9.2	203	4.6
Plastic	1,551	35.2	1,011	23.0	883	20.1	604	13.7	351	8.00
Paper	1,031	23.5	1,026	23.3	1,224	27.8	793	18.0	326	7.4
Box/carton	442	10.0	810	18.4	1,265	28.8	1,165	26.5	718	16.3
Electronic	308	7.0	429	9.8	785	17.8	1,246	28.3	1,632	37.1

Key: Freq.= Frequency **Sample size: n= 4,400**

Source: Field survey, (2020)

The university hospital is unique in its waste generation due to its role as health institution; hence, its management were interviewed for information on type of waste it generates. The responses from the interview confirmed the waste generation pattern of the students observed in the quantitative analysis with the exception of biomedical waste. The interview data indicated that the major waste generated by the University hospital was biomedical, organic, and inorganic waste. Extract:

> *Actually, the waste that is usually generated on university campus can be categorized into two or three. One being that, the university has hospital which generates waste. So, we have hospital or biomedical waste, but the general waste that we can say that the university generates is domestic waste which the communities also generate (Respondent 1).*
>
> *Basically, we have different ways in classifying waste. If we go to let's say considering organic and inorganic issues, we would*

say basically we have a lot of organic waste and then the inorganic, the inorganic waste looks very visible but when you quantify, you would realize that the organics are more but they are not visible. For instance, we have a couple of plastics in the waste, all you see are plastics because they are very conspicuous but if you go closer, you would see silt and a lot of organic waste being dominant (Respondents 2).

Pictures from the two authorised dumping sites at Amamoma located on the road to Ayensu hostel were taken to support the results.

***Figure 13*: Refuse dump sites at Amamoma**

Source: Field survey, (2020)

Thus, the main waste generated by students of the University of Cape Coast, in order of magnitude, were garbage associated with food, plastic, manuscript, boxes and cartons as well as electronic gadgets. The general finding was that the students produced more organic garbage than inorganic garbage. The sorts of garbage generated depends on activities carried out in that institution. Students in and outside the university would obviously produce a lot of food waste because of their perishable properties. Coupled

with this, most undergraduate students do not have enough storage facilities to keep these food items (Oppong-Ansah, 2020).

Food remains on top of the basic daily needs of students, hence respondents placing their frequency of generating food waste as high above all other types of waste they generate on daily basis. This may be because of the stressful nature of the academic environment students find themselves. Research evidence suggests that individuals in stressful environment have higher tendency to eat and snack a lot (Sominsky & Spencer, 2014), increasing the generation of food waste among the students. That is, the need to meet deadlines, write quizzes, submit term papers, final examination, and complete projects almost always put students on limited time and stress. Evidence suggested that individuals resort to foods as a means to control stress since they interpret their energy drain to mean hunger (Sominsky & Spencer, 2014). Students, therefore, have higher tendency to generate more food waste by eating and snacking continuously in response to energy demands from stressful schedules. A recent study by Ozcicek-Dolekoglu and Var (2019) found out that university students generate more food waste than academic staff due mainly to left over foods. That is, based on the culture of the students, there is a high tendency for them to deem it not fit to consume all the food served them and hence intentionally leave a sizeable quantity behind in what is referred to as “plate waste”. This habit of “plate waste” also contributes to the generation of high food waste among university students.

Plastic waste became the second most generated waste by the students because cooking at hall/hostel and/or outsourcing food from the markets come with lots of plastic waste used for food packaging. The student body also

depends mostly on sachet water as their drinking water (Nyavor-Akporyo et al., 2013). Oppong-Ansah (2020) recognised the role of packaging in the plastic waste generation. He reiterated that in the olden days, women do their marketing with woven baskets or cotton bags whilst food was wrapped with leaves but now, because of civilisation and modernization, every food item or prepared food bought in most African countries especially Ghana, is initially wrapped in a single-use plastic and then kept in plastic carrier bags. Thus, a possible avenue in the waste management process is to pay attention to the use of plastics for packaging of foods and other items and resort to the use of biodegradable materials.

A study by Utama, Ambariyanto, Syafrudin and Samudro (2018) on university campuses in Indonesia had earlier made a similar order of waste generation found among university students. Utama et al. emphasized that food waste and plastic wastes were the two most generated waste among university students. In terms of frequency of waste generated, they found out that, almost 40% of organic waste consisted of garbage associated with food as well as leaves. Nonorganic waste consisted of 20% plastic waste, and 20% of paper, cloth, wood, rubber, glass, metal, and harmful waste. Asante (2016) discovered that, a little above half (52.30%) of the garbage produced by selected Ghanaian households are in the form of food debris, 28.60% plastic waste and 19.10% bottles and cans. The consistency of the results in normal households with that of the students can be traced from the fact that the students are most likely to mimic the waste generation pattern from the house, in terms of cooking and drinking pattern. For example, students that take only sachet water in the house are most likely to continue same on campus.

Amoah and Kosoe (2014) recorded that organic waste constitutes about 54.76%, inorganic 25.46% and other types 19.77% in urban Ghana. Also, Yoada, Chirawurah and Adongo (2014) observed in urban area of Accra that 93.1% of households disposed of food debris and 77.8% disposed of plastic materials. The possible implication of the uniform discovery is that students' life does not significantly alter waste generation pattern from that of their homes. Studies by Akai-Tetteh (2014), Zohur-uz-Zaman and Riyad (2014) and Taghizadeh, Ghassemzadeh, Vahed and Fellegari (2012) also observed that compostable organic materials (food waste), plastic wastes, and paper products are the most generated waste on university campuses. The study of Coker, Achi, Sridhar and Donnett (2016) among resident university students in Nigeria observed the same types of waste generated by the students but found paper waste to dominate.

Paper waste was also generated in greater quantity by the respondents. The daily activities of the students always involve the use of paper products in one way or the other. For example, it was noticed that the students have the habits of using less important papers from their previous courses to package or clear waste. Though paper waste was found to be a major waste generated by the students, it did not constitute either the first or second position as expected in academic environment (Starovoytova, 2018; Wakefield, Fredrickson, & Brown, 2015). A plausible reason is the effects of the digital age (Pickin, Randell, Trinh, & Grant, 2018). That is, most students' slides and notes are now on softcopy which limits the volumes of paper carried. Pickin et al. (2018) stated that "the shift from paper to digital communications is greatly reducing

paper wastage". It can therefore be stated that the answer to the challenge of paper waste is naturally embedded in the digital evolution.

Similarly, the reasons for low generation of electronic waste could be explained that though electronic gadget are part of todays digitised world, students' electronic gadgets are durable in nature or their waste are usually left with repair vendors. Despite their low generation, existing empirical evidence suggest they can constitute a major risk to both the current and future generation (Needhidasan, Melvin, & Chidambaram, 2014). Azad, Islam and Hossin (2017) indicated that electronic garbage contains a lot of unsafe substances and metals such as Mercury, Lead, Cadmium, Zinc, and Chromium, which sources of diseases such as brain disorders, kidney, renal, and neurological damage. These diseases can lead to learning disabilities, lung damage and mental retardation, behavioural problems, hearing impairment, fragility of the bones, high blood pressure and even deaths. Moletsane and Venter (2018) drew attention to the need to pay attention to electronic waste since the reduction in paper waste in academic environment could translate to corresponding increase in electronic waste.

The observation that the university through the activities of the university hospital generate tonnes of harmful biomedical waste was consistent with findings from other universities in Ghana. Okyere-Hayford (2016) revealed that 44% of wastes generated at the Kwame Nkrumah University Hospital are pathogenic or hazardous in nature. Since the students generate more organic waste than inorganic waste, the implications are that students of the University of Cape Coast and its communities prepare most of their foods themselves and depend less on food vendors. Since organic waste

such as food waste decomposes quickly, it implies that delays in waste collection could result in bad smells, breed rodents and disease causing vectors.

Research Question Two: What are the Existing Waste Management Practices in the University of Cape Coast?

The research question required to find out the waste management methods ongoing on campus and the surrounded communities. The question was analysed using frequencies and percentages. To answer the research question, three separate analysis were done: major stakeholders in the waste management process, waste management practices of students, and the waste disposal practices in the absence of waste bins. Observation data was also used to support the results of the quantitative analysis.

An analysis was done on the students' view of who they perceive as the major stakeholders in the garbage controlling process. The results, as shown in Table 3, indicated that the stakeholders included Zoom Lion Ghana Limited, 49.2% (2,168); UCC Environmental Section, 47.6% (2096), food vendors, 39.6% (1743); community members, 31.4% (1384); students, 30.1% (1326); opinion leaders in the community, 24.2% (1068); lecturers, 21.1% (929) and other staff of the University, 21.0% (928).

The results in Table 4 showed that the garbage management practices of the undergraduate students included: bigger waste bins were placed outside the halls/ hostels for waste collection, 47.72% (2071), janitors regularly collect waste, 47.06% (2100), there were dedicated sites for washing in the halls/hostels, 45.20% (1989) and there were functional washing sinks, 42.65% (1877). There were also smaller bins for immediate waste collection, 34.74% (1529), effective waste management programmes 33.33% (1467), and disposal

of wastewater over the balcony, 11.73% (516) as aspects of waste management practices of the respondents.

Table 3: Respondents' View on the Major Stakeholders in Waste Management

Items	SA		A		MA		SLA		DNA	
	Fre	%	Fre	%	Fre	%	Fre	%	Fre	%
Zoom Lion	2,16	49.2	997	22.7	658	14.9	326	7.40	251	5.70
UCC	2,09	47.6	956	21.7	501	11.4	216	4.90	631	14.4
Food	1,74	39.6	1,03	23.4	824	18.7	530	12.0	272	6.18
Communit	1,38	31.4	1,03	23.5	967	21.9	591	13.4	421	9.56
Students	1,32	30.1	1,10	25.1	789	17.9	500	11.3	680	15.4
Opinion	1,06	24.2	1,05	24.0	1,15	26.3	624	14.1	492	11.1
Lecturers	929	21.1	955	21.7	829	18.8	637	14.4	1,05	23.8
Other staff	928	21.0	1,06	24.1	966	21.9	688	15.6	754	17.1

N=4,400

Key: SA=Strongly Agree, A = Agree, MA= Moderately Agree, SLA = Slightly Agreed, DNA=Do not Agree

Source: Field survey, (2020)

Additional analysis was to determine garbage controlling practices of the students in the absence of garbage bins. The results indicated students throw waste into the bush, 94.03% (4137), open space 93.25% (4103), and nearby container 65.16% (2867). Thus, bigger waste bins are placed outside the halls/hostels for waste collection, janitors regularly collect waste, there are dedicated sites for washing in the halls/hostels, functional washing sinks, smaller bins for immediate waste collection, effective waste management programmes, and disposal of waste water over the balcony, as perceived by the students of UCC as waste management practices.

Table 4: Waste Management Practices of Students

Items	SA		A		MA		SLA		DNA	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
There are bigger waste bins outside the hall/ hostel for waste collection.	2,071	47.72	1,211	27.52	649	14.75	202	4.60	238	5.41
Wastes on the floor in the hall/hostel are collected by janitors on regular basis.	2,100	47.06	1,175	26.71	690	15.68	255	5.79	209	4.76
There are dedicated sites for washing in the hall/hostels.	1,989	45.20	1,084	24.63	748	16.99	356	8.10	223	5.08
There are functional sinks for washing in the hall/hostel.	1,877	42.65	1,161	26.38	792	18.02	345	7.83	225	5.12
During hall/hostel programmes, leadership embark on activities directed towards ensuring effective management of waste in the hall/hostel.	1,467	33.33	1,191	27.06	1004	22.83	464	10.56	274	6.22
There are smaller waste bins at our floor for immediate waste collection.	1,529	34.75	1,025	23.30	840	19.09	479	10.89	527	11.97
I dispose of waste water by pouring it over the balcony/on the floor.	516	11.73	477	10.85	596	13.54	483	10.98	2328	52.90

Key: SA=Strongly Agree, A = Agree, MA= Moderately Agree, SLA = Slightly Agreed, DNA=Do not Agree

Source: Field survey, (2020)

Again, Zoom Lion Ghana Limited, UCC Environmental Section, food vendors, community members, students, opinion leaders, lecturers and other staff members of the University were the major stakeholders in the waste management process. Finally, students of UCC throw waste into the bush, open space, and nearby containers in the absence of waste bins.

Observations were done at both the halls of residence and the neighbouring communities at bin sites and refuse dumps. The halls of residence have bin sites which were clean and waste bins neatly arranged for most cases, confirming the responses from students that the bins were emptied on time (see Figure 12).

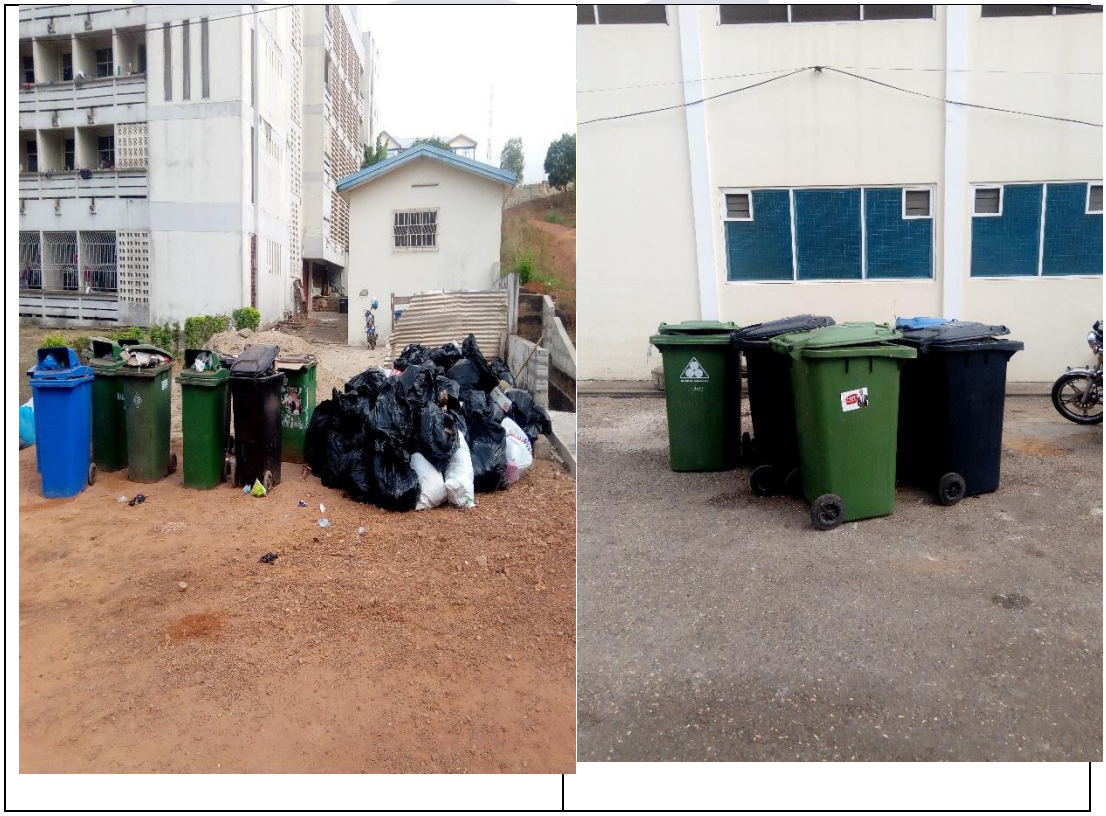

***Figure 14*: Bin sites in the halls of residence**

Source: Field survey, (2020)

The hostels also had bin sites, and the communities have refuse dump sites which were closer to the residence of some students. The observation confirmed two types of refuse dumping sites: authorised and unauthorised ones. The observation data suggested that the authorised sites mostly have at least one attendant who manages it, and hence appear relatively well kept especially in the mornings, except few which were not in good shape. The presence of the overflown waste bin confirmed that the site is authorised but not well kept (see Figure 13). However, unauthorised sites are mostly closer to residence. These sites look messy because they have no attendant. They were mostly found in the newly developing areas or abandoned plots that are yet to be developed, even at the heart of the community.

Figure 15: **Authorised refuse dump in the communities**

Source: Field survey, (2020)

Figure 16: **Unauthorised dumping sites in Kwaprow**

Source: Field survey, (2020)

The finding indicated that, generally, the students acquire smaller waste bins to facilitate the transfer of waste from their immediate residence to the bigger waste bins provided outside their halls and hostels. Janitors in the halls and Zoom Lion Ghana Ltd in the communities were found to empty waste bins regularly.

The findings support that of Dery (2017) about the waste management practices of students in the public universities in Ghana. Dery emphasized that structures exist at the places of residence, which serves as prompts for proper waste management practices. Paghasian (2017) also observed among Philippine university students that waste management practices were generally very good. Daniel and Ibok (2013) explained the relatively good waste management practices of students indicating that such habits can be attributed to values, and culture and indigenous knowledge inculcated in them by the family members. Coker, Achi, Sridhar, and Donnett (2016) also made a similar observation and concluded that waste made on the university campuses are collected regularly using the appropriate technology.

The observation that students resort to proper waste management practices when they find themselves in an enabling environment such as halls of residence and hostels can be traced to the positive externalities of education as well as the part infrastructure plays in garbage controlling. That is, education is supposed to transform individuals to be better citizens including the ability to manage waste effectively (Villanueva, 2013). Punongbayan, Abu, Arago, Caponpon, Geron, Leyesa, Apritado, and Manzano (2014) indicated that consciousness along with participation is the key for students to be involved in the garbage controlling program of the schools where effective and sustainable implementation of the proper garbage controlling approaches could be attained. Universities are well established as institutions of higher learning and research, to foster sustainable behaviour among their students, faculty members, and staff. The finding, however, contradicts that of Ifegbesan, Ogunyemi and Rampedi (2017) that in public universities of Nigeria, indiscriminate littering and open dumping were the main waste management practices of the students. They further observed open burning of refuse as the only prevailing way of controlling large volumes of garbage produced in the university.

The study also took the garbage controlling approaches in the context of main actors and surviving strategies in the absence of a formal waste management practices. Five major stakeholders in waste management were identified - the Zoom Lion Ghana limited, UCC Environmental Health Section, food vendors, community members and students. The observation that institutions such as Zoom Lion Ghana Limited and the UCC Environmental Health Section, the main waste

management units in Cape Coast Metropolis, must lead the waste management process was also made by Amoah and Kosoe (2014), Owusu-Sekyere, Osumanu and Yaro (2013), Oteng-Ababio et al. (2013) and Desa, Kadir and Yusooff (2011) in urban areas of Ghana. Desa, Kadir and Yusooff stressed that majority of students largely observe that the initiation and the responsibility of resolving their campus's garbage challenge depends on the university's administration and its members. However, the students admitted that they also have a role to play in garbage controlling practices of their halls and communities.

Students agreed to dumping waste into bushes and open spaces in the absence of authorised dumping sites, while the non-residents, mainly in the newly developing sites, create unauthorised site when they cannot easily access the authorised ones. These confirm findings from other studies, Parvez, Agarwal and Kumar (2019), Yoada, Chirawurah and Adongo (2014). Yoada et al. revealed that about 39.0% of participants disposed off their garbage in gutters, streets, holes, and nearby bushes. Gbogbo and Awotwe-Pratt (2008) revealed that only 40% of the overall garbage produced in the University of Ghana (UG) is togethered while the rest are dumped on unauthorized refuse dumps which makes the practice common among Universities in Ghana. Dolipas, Ramos, Alimondo and Madinno (2018) suggested this agreement between the students' garbage controlling approaches and that of the communities. Dolipas et al. stated, after studying the waste management and values of university students, that "students have similar household waste handling practices regardless of their sex and family origin" (P.1).

The finding is also supported by that of Coker, Achi, Sridhar, and Donnett (2016) on university campus in Nigeria. Coker et al. observed that all the garbage produced in the halls were collected using suitable garbage collection bags and mobile bins situated at strategic corners of the university premises. However, Dery, Kuusaana, & Owusu-Sekyere (2018) observed from two universities in Ghana that waste collection on the campuses of the UG were regular and efficient but that of Central University College was irregular. Thus, public universities have improved waste management practices but the situation at private universities needs improvement, but Dangi and Agarwal (2017) pointed to the possibility for even an organised university system to have poor waste management practices.

The fact that the students make good use of the bigger bins outside their halls and hostels to reduce littering was also an indication that if infrastructure for waste management is provided, individual students are most likely to resort to proper waste management practices. It is observed under the 'not in my backyard syndrome,' that is, individuals would want to stay as far away from waste as possible, and hence in the absence of proper waste management infrastructure, individuals shall resort to poor waste management practices.

Research Question Three: What are the Challenges Associated with Managing Waste in the University of Cape Coast?

This analysis sought to identify the challenges that students as well as other stakeholders face in their attempt to efficiently manage waste using frequencies and percentages. The challenges identified as presented in Table 5, were laziness of students in putting waste into waste bins, 43.47% (1913),

students lack of knowledge on waste management, 24.87% (1094), negative attitude of workers/students towards waste disposal, 23.08% (1016). Also, unavailability of sinks in front of rooms, 21.71% (955), waste bins not available, 21.55% (948), waste bins not emptied as expected, 18.56% (817), far distance to waste bins, 18.56% (817), and inaccessibility of waste bins 18.9% (796). Other challenges identified included increasing university population and population in the surrounding communities 42.39% (1865) lack of finances 27.33% (1203) and inappropriate technology 24.41% (1074) in the halls of residence and the surrounding communities.

The outcome of the study lends support to the earlier studies by Antwi (2016) and Fei-Baffoe, Nyankson, and Gorkeh-Miah (2014). Antwi found out in urban communities that the major challenges to WMP are lack of education, funds, and unavailability of waste bins for effective waste collections. Freduah (2007) pointed to lack of resources for effective campaign on proper WMP and inaccessibility of dumping sites by way of poor road networks or distance to dumping sites as among the major challenges in Ghanaian communities. Rotowa and Enisan (2012) confirmed the fact that proximity to waste bins significantly influence students' practice of proper waste management practices. Similarly, Twumasi (2017) asserted in a study done in the Winneba Municipality, a community with heavy university student presence, that individuals do not translate their awareness of solid waste management strategies into actual practice.

The role of attitude has already been evaluated and confirmed as a binding constraint on WMP in Ghana (Adejobi & Olorunnimbe, 2012). The issues of

population increase as a cause of improper waste management practices was also observed in the literature (Antwi, 2016).

The population of the university communities, increases from two major sources: students and workforce, and the population of the nearby communities due to business opportunities the university presents. Early studies such as Adejobi and Olorunnimbe (2012) revealed that manufacturing improvement, growing urban areas and rapid population growth are the major contributing factors to garbage production in many unindustrialised countries.

Again, Dongballe (2016) found out that, the major challenges affecting garbage-controlling procedures in the Cape Coast metropolis include reduced collective involvement in garbage controlling, inadequate logistics and lack of a definite schedule for collecting garbage.

Increasing population and unmatched waste management technologies precipitates all the challenges of garbage controlling practices of the university and its surrounding communities. Growing population increases the volume of waste generation which worsen the tendency of PWM. The argument is that growing population put the strength of the university's waste management strategy to test, and exposes the inefficiencies in the process. Also, since attitude is identified as a driver of PWMP, increase in population simply implies different characters and competition, and push some residents far from the waste bins and dumping sites (Khan & Samadder, 2016).

Table 5: Challenges to Waste Management on Campus and in the Communities

Challenges	Strongly Agree		Agree		Moderately Agree		Slightly agree		Do not agree	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Laziness on part of students in putting waste into waste bins	1,913	43.47	1,001	22.74	753	17.11	441	10.03	293	6.65
Waste bins not emptied as expected	817	18.56	769	17.47	881	20.04	693	15.75	1,240	28.18
Unavailability of sinks in front of rooms	955	21.71	795	18.06	861	19.56	587	13.34	1,203	27.33
Distance of waste bin is too far	817	18.56	769	17.47	881	20.04	693	15.75	1,240	28.18
Negative attitude of workers/students towards waste disposal	1,016	23.08	837	19.01	884	20.10	628	14.27	1,036	23.54
Students lack of knowledge in waste management	1,094	24.87	1,005	22.84	935	21.24	682	15.50	684	15.55
Inaccessibility of waste bins for disposal of waste	796	18.09	759	17.25	9543	21.67	716	16.27	1,176	26.72
Waste bins are not available	948	21.55	887	20.16	694	15.77	596	13.54	1,275	28.98
Increasing population of the university and the communities	1,865	42.39	1,312	29.82	585	13.30	385	8.76	252	5.73
Lack of finances	1,203	27.33	1,451	32.98	772	17.56		12.02	444	10.11
Inappropriate technology	1,074	24.41	1,234	28.04	529	20.43	642	14.59	551	12.53

Source: Field survey, (2020)

The major implication of the findings was that the issue of poor waste management requires more than rules and regulations to include behavioural change on the part of students. Hence, without commitment, the situation shall continuously deteriorate and degenerate into serious health problems.

Research Question Four: What are the Environmental Health Impacts of Waste Management Practices at the University of Cape Coast?

This research question sought to examine the environmental health impacts of reduced garbage controlling of the University of Cape Coast. In addition, I tracked the differences in the perceived environmental health impacts across gender and residential status of the students using frequencies, percentages and median rating, with the Wilcoxon rank sum test. Besides, I interviewed the Environmental Health Officer, UCC (Respondent 1) and the Environmental Health and Sanitation Officer, Cape Coast Metropolitan Assembly (CCMA) (Respondent 2) to support the quantitative results. The results indicated that poor waste management leads to chocked gutters, 71.19% (3132), air pollution (bad odour/ harmful gases), 59.42% (2614), poor aesthetics of the hall/community, 47.33% (2083), plastic bags harm, 45.26% (1991), flood, 41.98% (1847), and land degradation, 29.21% (1285).

Further analysis indicated that there was a statistically significant difference in the perception of effects of reduced garbage controlling on the environment according to the residential status of the students (Resident=1.5, Non-resident=1, Z=6.604, p-value=0.0000<0.05). The positive Z value indicates that the non-residential students held a stronger view that poor waste management practices lead to choked gutters than the resident students did. Statistical major

difference was also found between the level of agreement in the areas of plastic bags harm (Resident=2, Non-resident1.5, Z=15.416, p-value-0.0000<0.05). That is, the non-resident students agreed more that plastic waste has major detrimental environmental impact than the resident students. Flood occurrence was also observed to be accepted more among the non-resident students than the resident students (Resident=2, Non-resident1.5, Z=2.743, p-value=0.0061). The resident students moderately agreed to statement that poor waste management can lead to land degradation while the non-residents just agreed to the statement, and the difference was statistically significant (Resident=3, Non-resident=2, Z=2.743, p-value=0.0000<0.05). Finally, the statement that poor waste management practices can lead to aesthetics devaluation was moderately agreed to by resident students but agreed to by the non-resident students (Resident=3, Non-resident=2, Z=2.903, p-value=0.0037<0.05).

The median test based on gender found that females agree more to the air pollution effects of poor waste management than their male counterparts (Female=1, Male=2, Z=3.757, p-value=0.0002<0.05), and a similar observation was made on plastic harm (Female=2, Male=3, Z=2.518, p-value=0.0118<0.05). Gender appeared not to significantly influence the views of the students about environmental impact of poor waste management practices (see Tables 6 and 7).

Table 6: Perceived Environmental Effects of Poor Waste Management Practices

Negative Effects	Strongly Agree		Agree		Moderately Agree		Slightly Agree		Do not Agree	
	F	%	F	%	F	%	F	%	F	%
Chocked gutters	3,132	71.19	638	14.49	318	7.22	150	3.42	162	3.68
Air pollution (bad) odour/ harmful gases)	2,614	59.42	946	21.49	514	11.69	222	5.04	104	2.36
Running waste water affects the beauty of a hall/community.	2,083	47.33	1,090	24.77	777	17.67	268	6.10	182	4.13
Plastic bags harm.	1,991	45.26	1,051	23.88	817	18.56	372	8.46	169	3.84
Flood occurrences	1,847	41.98	1,031	23.44	681	15.47	394	8.94	447	10.17
Land degradation	1,285	29.21	1,011	22.97	981	22.30	607	13.79	516	11.73
Sample Size: N=4,400										

Source: Field survey, (2020)

Table 7: Perceived Environmental Impact of Poor Waste Management Practices Based on Residential Status and Gender

Negative Effects	Median rating		Wilcoxon	Median rating		Wilcoxon
	Residents	Non-residents	Test Z (p-value)	Males	Females	Test
Chocked gutters	1.5	1	6.604 (0.0000)*	1	1	0.966 (0.3341)
Air pollution (bad odour/ harmful gases)	1	1	1.367 (0.1716)	1	2	3.757 (0.0002)*
Plastic bags harm.	2	1.5	5.416 (0.0000)*	2	3	2.518 (0.0118)*
Flood occurrences	2	1.5	2.743 (0.0061)*	2	2	-0.252 (0.8007)
Land degradation	3	2	8.229 (0.0000)*	2	2	1.549 (0.1213)
Aesthetics devaluation	3	2	2.903 (0.0037)*	2	2	0.801 (0.4230)

Note: * indicate the existence of statistical significance at the five percent significance level. Sample Size: N=4, 400

Source: Field survey, (2020)

The qualitative responses identified some new areas and collaborated a number of findings in the quantitative analysis. The officers narrowed the effects to the university environment and linked it to academic performance. This is evidenced in this extract:

> *The university is here to train people to learn, so the environment itself must be neat and conducive for learning. If we have a lot of litters around, it doesn't make it conducive for learning because it rather creates a good environment for pests and other diseases to grow. When people are sick, they cannot learn, neither can they teach. And they don't feel comfortable within those environments (Respondent 1).*

Another officer also identified some effects of poor waste management and how it could be linked to the personality of the individual and the environment. That is:

> *When someone visits you in your house and all he sees is refuse here, refuse there, the first impression it gives the person is very bad of you so your dignity is also endangered and people have bad notions about you at the individual level …if every house is filled with dirt, everyone is mismanaging their waste, you can imagine the community you would have. … A lot of litters around, it doesn't make it conducive for learning because it rather creates a good environment for pests and other diseases to grow. Poorly managed waste releases some gases into the*

atmosphere and these gases are unhealthy, they contribute to the greenhouse effect we are complaining about and also, some of the effects is that, it even impacts on reproduction on both males and females (Respondents 2).

The analysis identified chocked gutters, air pollution (bad odour/ harmful gases), plastic waste that reduce the beauty of the environment, flood occurrences, land degradation and aesthetics devaluation as the major environmental health impacts of poor waste management. Sanusi and Sarfo (2016) confirmed that poor waste management can harm the aesthetic beauty of an ecosystem using the Keta lagoon environment as a case study in Ghana. Ferronato and Torretta (2019) reviewed several studies on waste management and concluded that environmental impacts are pervasive worldwide in areas such as sea litter, air, soil, and water pollution.

The study also identified the possible extension of the environmental health influence of reduced garbage controlling to the highly discussed global warming through generation of greenhouse gasses. The sources of these gasses are unmanaged decaying of organic wastes and the burning of inorganic wastes. The observation that poor waste management practices can add to the generation of greenhouse gasses was identified in the studies of Taghizadeh et al. (2012) and Ferronato and Torretta (2019). Ferronato and Torretta identified the environmental health impacts of waste to include visual impairments, air pollution, odours, and greenhouse gasses emission, routes of diseases, surface water and under groundwater contamination. Moreover, Manfredi, Scharff, Tonini and

Christensen (2009) observed that the direct emission of greenhouse gases is the major contribution to the global greenhouse gases generation. The systematic review of Zhang et al. (2019) confirmed the significant influence of greenhouse gases from landfills to global emissions.

The results of poor waste management have both direct and indirect effects on health of residence of the affected communities. The outcome confirmed the earlier observation of Kafando, Segda, Nzihou and Koulidiati (2013) who observed that poor waste management practices have numerous negatives impacts which include spread of mosquitoes and flies, bad odours and optical contamination. Kafando et al. further demonstrated that the negative influences of reduced garbage controlling on the environment in turn affect the health of the residents. Moreover, Addy (2013) revealed that poor waste management can lead to flooding, contamination of water bodies, and devaluation of the town due to the odour, which can result in outbreak of diseases.

The observation also revealed that plastic littering is something the non-resident students encounter on daily basis, as they move from their residences to campus. Flood is an annual ritual in the communities of the non-resident students. Evidence of land degradation (erosion) and aesthetics devaluation exist in the communities but relatively well managed on campus. According to Coastal Resource Centre (2013), coastal areas in Ghana including Cape Coast are prone to perennial flooding and one of the major causes is pile of garbage from PWMP. According to Ashong (2019), Frimpong (2019), Obeng (2019) and Gobah and Gyesi (2014), there had been incidence where the University of Cape Coast has

suspended lectures due to flooding on campus and the neighbouring communities because students were not able to access the main campus. Ashong (2019) stated that "communities like Amamoma, Ayensu, Apewosika, Kwaprow and Akotokyere where many students live, were cut off from the university campus" (p.2). The observation that the non-resident students perceive the environmental effects of poor waste management than the residential student was substantiated.

The major implications of this finding are that reduced garbage controlling has detrimental consequences on the environment, which in turn serves as a peril to individual health. That is, the health impact of poor waste management can be controlled if the environmental health impacts are first managed successfully. Flood and stagnant waters which are environmental health impacts of PWM can as well be the breeding grounds for vectors of diseases such as malaria and cholera. The need to encourage proper waste management practices becomes more urgent than ever for all stakeholders.

Research Question Five: What are the Health Impacts of Waste Management Practices of the University of Cape Coast?

The purpose of this analysis was to examine health impacts of waste management practices on the students of University of Cape Coast and its surrounding communities, using SEM. Again, the differences in the perceived health impacts across gender and residential status of the students were tracked using logistics regression. Two of the post-estimation techniques of the logistic regression, the margins and the contrast, were used to confirm the statistical possibility of association among gender, residential status and perceived health impact of poor waste management practices. Three different health outcomes,

cholera/dysentery, headache, and malaria were used as proxies for the health status of the students. For the construction of the binary dependent variables, individuals with at least one of the selected health conditions were given one (1) and those without any conditions were given zero (0). The logistic regression model was fixed with residential status and gender as the main IVs while controlling for age, academic level, marital status, and religion. The *contrast test* is analogous *to post hoc analysis* of ANOVA and it tests the statistical significance of the difference among the predictive margins of a given variable (Baum, 2010; Statacorps, 2019). Furthermore, l interviewed the Environmental Health and Sanitation officer of CCMA (Respondent 2) and the Director, Directorate of Health Services- UCC (Respondent 3) to support the quantitative results.

The structural equation model was fitted to determine the pathways through which PWMP influence the state of health of the students and the health of the environmental. Figure 15 presents the SEM model built with the three latent variables and their respective observed variables, while Table 8 presents the underlying structural regression output that indicate the level of significance. Waste management as a latent variable was measured using dropping waste in open space, bushes, nearby containers, polybags, presence of bigger waste bins, presence of smaller waste bins, functional sinks, and dedicated sites for washing, and existence of prompt factors. Health status as a latent variable was measured using malaria, headache, skin rushes, allergy, and cholera. Environmental health impact was measured using chocked gutters, air pollution, aesthetic devaluation,

and floods. The estimation used the standardised coefficients, which allows for the estimated coefficients to be compared in terms of size and magnitudes.

The initial estimation indicated the possibility of hetroskedasticity and hence the robust standard errors were used as a correction. The Likelihood ratio test (LR) confirmed adequacy of the structural model (Chi2(227) =1801.74, Prob.>chi2=0.2451>0.05). The Bentler-Raykov R-square was about 64% which was relatively good for a cross-sectional data (Carrodus & Giles, 1992; Huber, 2014; Gales, 2013). Finally, the Wald test rejected the null hypothesis that an empty model with only the intercept is better than the fitted model. Hence, the observed variables were considered to be real manifestation of the latent variables. The SEM model was therefore adjudged to fit for interpretation and further analysis.

The results of the structural equation diagram suggested that open space, bushes, and nearby containers, polybags, presence of bigger waste bins, and presence of smaller waste bins, functional sinks, dedicated sites for washing, and existence of prompt factors were significant observed aspects of the latent variable PWMP in the study area. Also, chocked gutters, air pollution, aesthetic devaluation, and floods are manifestation of impact of PWM in the study area. Finally, malaria, headache, skin rushes, allergy, and cholera are significant measures of health status as a latent variable.

In terms of the structural effects, the results suggested that poor waste management practices had significant n*egative impacts on health status of the students (coef.=-0.019, Z=-4.89, p-value=0.*000, CI={-0.026, 0.045}). That is, a

unit increase in PWMP has the significant tendency to reduce the health status by about 0.019 units, keeping all other factors constant, and increase the environmental health impact by about 16 (Z=2.85, p-value=0.006<0.05, CI={14.71, 17.94). It was also observed that increases in adverse effects on environmental health impacts had significant negative effects on the health status of the students (coef.=-0.010, Z=-2.50, p-value=0.012<0.05, CI={-0.018, -0.002}). That is, a unit increase in environmental health impact has the tendency to reduce the health status of the students by about 0.01, when all other factors remain constant. The total effects of PWMP could be estimated as the direct effects and the indirect effects as (see Figure 15 and Table 8).

$$\text{Total Effect} = \underset{\text{direct}}{-0.019} + \underset{\text{indirect}}{16 \times -0.1}$$

$$= \underset{\text{direct}}{-0.019} - \underset{\text{indirect}}{1.6}$$

$$\text{Total Effect} = -1.619$$

Hence, a unit increase in PWM as a variable has the tendency to reduce the health status of the students by about 1.619 units. The finding implies that improving waste management practices among students on campus and in the nearby communities shall significantly improve the health status of the students in about one and a half folds. However, deteriorating waste management practices shall directly reduce health status by about 0.019 units and indirectly reduce by about 1.6 through reduced environmental quality. The results imply that focusing only on the direct effects of PWM can lead to serious underestimation of the adverse effects, until a holistic environmental health impact is correctly factored into the analysis.

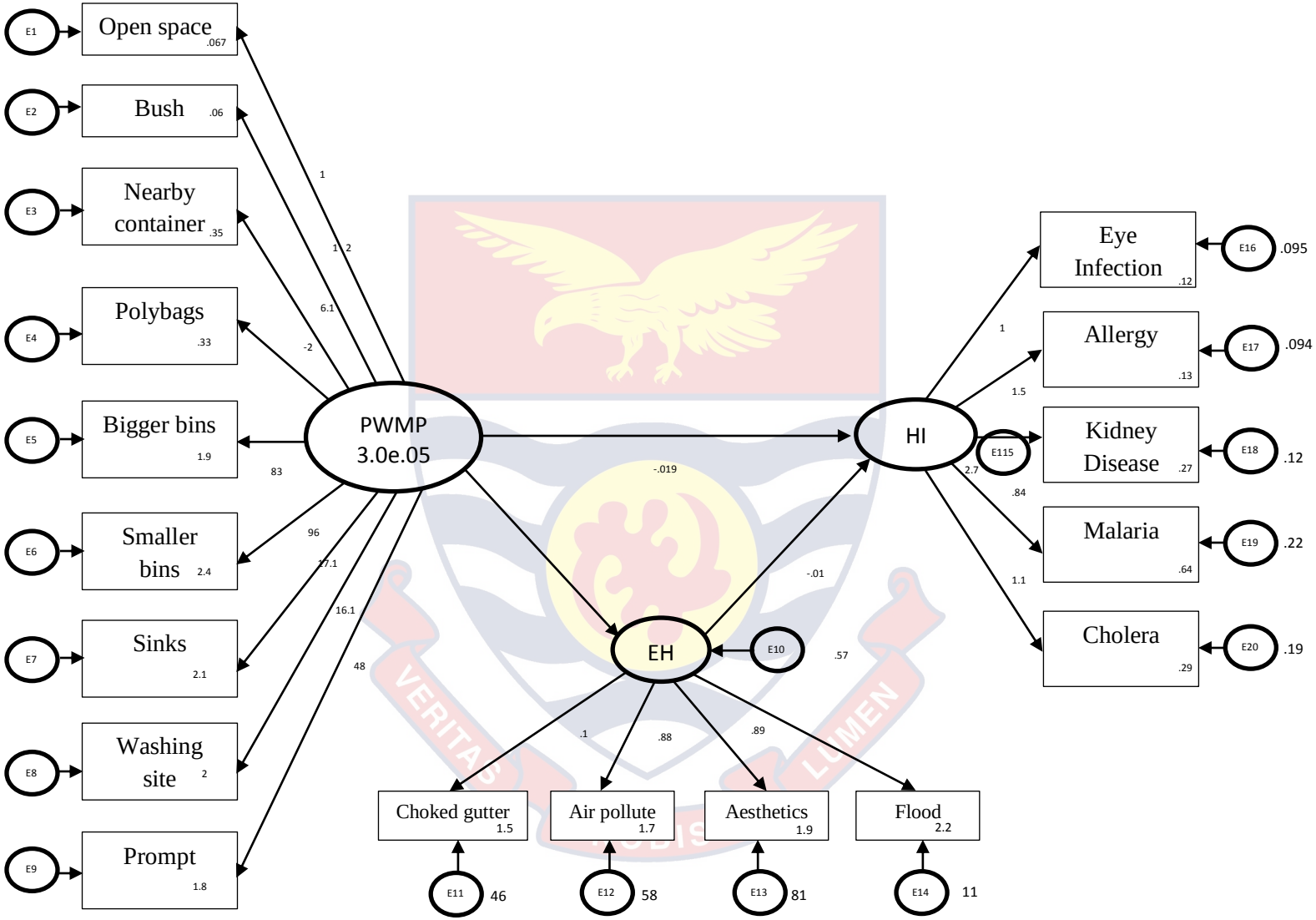

***Figure 17*: Structural Equation Model**
Source: Field survey, (2020)

Table 8: The SEM regression outputs of poor waste management practices (PWMP), Environmental Health Impacts (EHI) and health status

Standardized	Coef.	OIM Std. Err.	Z	P>IZI	[95% Conf.	Interval]
Structural						
HI← WMP	-0.019	0.039	-4.89	0.000	-0.026	0.045
EHI← PWMP	15.61	5.47	2.85	0.006	14.717	17.938
HI← EHI	-0.010	0.004	-2.50	0.012	-0.018	-0.002

Source: Field survey, (2020)

The logistics regression outputs on cholera, malaria and headache as dependent variables are presented in Table 8, their margins and contrasts coefficients in Table 9. The results revealed that, compared to the non-resident students, the odd of a non-resident student experiencing an adverse health impact as a result of PWM is multiplied by 1.64, and that the non-resident students are 1.64 times more likely to experience adverse health condition (OR=1.64, p-value=0.000<0.05, CI=[1.131, 2.04]). Also, compared with the males, the odd that a female will experience adverse health condition as a result of PWM is multiplied by 1.751, making the females more likely to experience adverse health condition (OR=1.751, p-value=0.000<0.05, CI=[1.345, 2.319]). The interaction between residential status and gender was statistically significant level (OR=0.616, p-value= 0.032 < 0.05, CI= [0.398, 0.959]).

Table 9: Logistic Results of Perceived Health Impact of Waste Management Practices Based on Gender and Residential Status.

	Odds Ratio	Std. Err.	Z	P>z	[95%Conf. Interval]	
Resident (base)					Lower	Upper
Non-residents	1.639	.186	4.35	0.000	1.31	2.05
Male (base)						
Female	1.751	.244	4.13	0.000	1.345	2.319
Resident#gender						
residents#Female	.616	.138	-2.15	0.032	.398	.959

Source: Field survey, (2020)

The results of the predictive margin indicated that if all the students were residents, 23.45% of them would have suffered from adverse health impact as a result of PWM (Margin=0.2345, p=0.000<0.05, CI=[0.21, 0.26]); however, if all the students were non-resident, 33.56% would have suffered (Margin=0.3356, p=0.000<0.05, CI= [0.31, 0.36]). Also, if all the students were females, 17.40% of them would have suffered from adverse health impact as a result of PWM (Margin=0.174, p=0.000<0.05, CI= [0.149, 0.195]), but only 12.70% would have suffered if they were all males (Margin=0.127, p=0.000<0.05, CI= [0.112, 0.141]). Therefore, male students, whether resident or non-resident, have reduced probability of experiencing adverse health impact as compared to females. Therefore, residential status, gender of the students and their interactions are significant predictors of the health impact of reduced garbage controlling within the University of Cape Coast and its immediate communities.

Table 10: Predictive Margins and Contrasts Based on Residential Status and Gender

	Delta-method				[95% Conf.		Contrast		
Variable	Margin	Std. Err.	Z	P>z	Interval]		Df	Chi2	P>chi2
Residential status					Lower	Upper			
Resident	.235	.0118	19.91	0.000	.211	.258	1	3.61	0.0574
Non-residents	.336	.014	23.92	0.000	.308	.363			
Gender									
Male	.125	.0075	16.92	0.000	.112	.141	1	8.62	0.0033
Female	.174	.0117	14.69	0.000	.149	.195			
Residential status # Gender									
Resident#Male	.127	.0113	11.26	0.000	.105	.149	1	4.61	0.0318
Resident#Female	.204	.017	12.31	0.000	.172	.237			
Non-resid#Male	.126	.011	11.65	0.000	.105	.147			
Non-res.#Female	.136	.018	7.54	0.000	.101	.172			

Source: Field survey, (2020)

The response from the interviews confirmed that of the quantitative analysis. The Environmental Health and Sanitation officer of CCMA confirmed cholera as the leading environmental and sanitation related illness reported to the hospitals in the Cape Coast Metropolis. He emphasized that the university communities report more cholera cases than the coastal areas which were considered to be more prone to such infection. Extracts:

> *What has been reported to us basically is cholera. Series of cholera episodes around the university campus, surprisingly, where we were suspecting so much, we don't get it coming from there especially like along the coast rather, the incidences are coming from the university campus and the surroundings communities. We build a link with the hospitals where we normally have the top ten diseases in the Metro* (Respondent 2).

The Director of Health Services-UCC added to the claim. He identified diarrhoea and cholera as the most reported cases in the university communities. His response further identified food and water as the mediums of infection. He noted that:

> *....like I was saying, diarrhoea is a very common thing and we also have cholera as an option ... Any infection that is transmitted through food and water contribute to it (health impact of poor waste management) or any disease you can think of (Respondent 3).*

The findings were consistent from both the quantitative and qualitative that PWM has both direct and indirect adverse influence on the state of health of the students of the University of Cape Coast. Females indicated higher chances of suffering the adverse consequences of PWM of than the males, while non-resident students were found to be more prone to it than the resident students. The results from the analysis were consistent with the earlier observations of Yoada, Chirawurah and Adongo (2014), and Yoada, Chirawurah and Adongo who identified that majority of the respondents were aware that improper garbage controlling contributes to infection causation, that it could lead to malaria and diarrhoea.

The identification of cholera and diarrhoea as the most frequent health impact of PWM was in line with the earlier observations of Boadi and Markku (2005); Ziraba, Haregu and Mberu (2016). Ziraba et al. established a link between PWM and health outcomes in developing countries including Ghana. Similarly, Boadi identified gastro-intestinal infections such as typhoid fever, polio virus infection, hepatitis E infection, and cholera as often transmitted through contaminated food or water resulting from PWM. Suleman, Darko and Agyemang-Duah (2015) also found ailments such as malaria and skin infections as results of inappropriate refuse disposal in Ghanaian communities. Similarly, Addo, Adei and Acheampong (2015) discovered diarrhoea, intestinal worms, typhoid fever, and cancer as diseases perceived to result from improper garbage management.

From school campuses, Nwakile, Eze and Okanya (2017) observed that, the consequences of reduced sanitation on students' health include students being disturbed by diarrhoea, typhoid, cholera infection, malaria, and death in dangerous cases. The effect of poor sanitation on students' health is also in line with the findings of WHO (2006), which estimated that about 88% of diarrhoeal/cholera disease is a consequence of unsafe water supply and inadequate sanitation and hygiene. According to Ecube and Labs (2016), one of the consequences of spilling over garbage is air pollution, which causes various respirational diseases and other adverse health effects as pollutants are absorbed from lungs into other parts of the body.

The unanimous acceptance of cholera and malaria in this study could be attributed to their relative popularity among an elite group like undergraduate students who could connect well with how filth can contribute to the spread of the two diseases. Papadopoulou (2011) made reference to theory-in-action and concluded that individual's understanding is mobilised by individual's subjective experiences and perceptions that guide their interpretations of their world and fields of action. Minsaas (2015) added that the extent to which personal and shared knowledge influence our perception of truth is dependent on our personal engagement and proximity to the situation, as well as the relationship between the shared and personal knowledge pertaining to the situation. The position was better understood from the perspective of the health professional interviewed who connected well with most of the diseases that were not unanimously endorsed by the students. It was concluded that the students are able to identify effects that

manifest physically (such as cholera/diarrhoea and malaria) than those that are more of internal (such as eye and psychological effects) as the impact of PWMP.

The findings also revealed that females have higher tendency to suffer from the adverse health consequences of PWM than males, while the resident students have reduced probability than non-resident students. The observation could be traced to the earlier finding that halls of residents have improved waste management practices than the communities where the non-resident students live. For example, sights such as open drains and running water were common in the communities but hardly seen in the halls of residence. Though much attention has not been given to this area of health impact of PWMP in the empirical literature, studies such as Alkazemi (2019) asserted that staying within the formal school residence has positive impact on behaviour patterns and hence health outcomes. Hence, the non-resident students suffer from exposure to the hazards of PWM than the resident students (Muchangos & Vaughter, 2019). Zhu, Asnani, Zurbrugg, Anapolsky and Mani (2008) found out that, people living close to garbage dumps have a greater risk of being affected by the diseases. Similarly, Suleman, Darko and Agyemang-Duah (2015) found out among urban dwellers in Ghana that, residents living closer to open dumpsites have been affected by connected diseases such as malaria, skin infections among others as a result of inappropriate garbage discarding. Ogundele, Rapheal and Abiodun (2018) used four communities in Nigeria, two practicing proper waste management and two poorly managing waste, and established that communities with proper waste

management practices had reduced probability of contracting waste related diseases such as cholera and malaria.

The results that females suffer more of the adverse health impact of PWM could be drawn to biotic factors, beyond the scope of this study. As observed during the analysis, the females had better waste management practices than male students. However, within the same environment, the health impact of PWM does not necessarily fall on the culprits engaged in the PWM but on the individuals or groups prone to the vectors of the diseases that resulting from the PWM. This is supported by the position of Muchangos and Vaughter (2019) that, by being the custodians of informal waste management, females are in constant exposure to waste. Hence when the structures do not exist for proper management, females receive the adverse effects the most as compared to the males. Moreover, Díaz, Beleña and Zueco (2020) supported the fact that females are generally resistant to diseases than males, yet it remains that exposure is the major determinants of the effects of PWM on health outcomes. Another twist to the finding is that the current study used self-rated health for which empirical evidence suggest females have poor self-rated health (Matud, Garcier, & Fortes, 2019). That is, the female students had higher tendency to over-report their health conditions as opposed to the males.

The findings imply that the external effects of PWM practice can have adverse health impact on the entire community, making proper waste management a public good that must be provided by the university authorities. The free riding aspect of public goods makes the issue of health impact of waste a

delicate one. That is, individuals may enjoy the health benefits of a clean environment but may be less willing to contribute to its creation. The tendency for individuals to free rides on proper waste management is more likely in the communities than in the halls of residence, since the halls have formal waste management structures put in place.

The finding also implied that studies that use respondents with less knowledge on causes of health condition and dynamics of poor waste management may reach a less reliable conclusion. That is, the fact that most respondents accepted or rejected a condition as not depending on PWM may not be enough ground to draw any concrete conclusion about the relationship until an expert view is sought on the issue. The educational level of the respondents as well as the popularity of a health condition among the respondents must be carefully considered in the assessment of health impact of PWMP through self-reporting data collection.

Research Question Six: What are the Existing Policies and Strategies to Mitigate the Environmental Health Impact?

This analysis explored the existing policies and strategies to mitigate the environmental health impact, using semi-structured interview guide. Three key environmental/sanitation and public health experts were interviewed because they are the heads of the various departments in charge of environmental health and sanitation and public health in their institutions. The result produced six themes; national policies, the work of the policies and strategies, environmental health programmes, health screening for food vendors, health education and clean-up exercise. Extracts from the transcripts were included in the form of quotes to

illustrate the results.

National policies

The respondents attested that there are national policies but the one in use is the National Sanitation Policy, drafted in 2009 and reviewed in 2010. An officer responded:

> *Well, policy guides for waste management? Yes, we have policy guide for waste management on campus. We refer to the National Sanitation Policy. It has segmented the work and responsibilities for all sectors, private sector, governmental sector, individuals and institutions. So we work with that policy (Respondent 1).*

The second respondent further reiterated that:

> *Yes errrhmm…there are policy guides for waste management and there is a policy…National Environmental Policy, which has assigned roles and responsibilities to all the organizations that we have. If you refer to the National Sanitation Policy, that was drafted in 2009 and reviewed in 2010, it has delineated the activities and responsibilities of everybody. (Respondent 2)*

Another reported:

> *Yes, we have policies that guide waste management and like I told you earlier, it all falls under the Environmental Health Service. With these policies, we have categories of workers*

doing particular jobs in particular areas at particular times. So there are policies. Without policies, you cannot manage waste…we also follow some WHO and MOH protocols in most cases (Respondent 3)

The work of the policies and strategies

The officer explained that the work area has been zoned with each zone having assigned workers and supervisors. He stated:

Well, one thing is that! we have been able to categorize it. We've rather zoned them. So each zone or category, with its own supervisor and workers who usually tackle these places. The waste is then dumped at Nkanfowa (a suburb of Cape Coast). *Supervisors are therefore expected to write a report of work done at the end of every month. (Repondent1)*

The head of Environmental Health and Sanitation at CCMA Section explained that the policies and strategies gave directions and therefore there were no conflict of roles. He retorted:

It gives us direction and so there are no conflict of roles, everybody knows what they are supposed to do. (Respondent 2)

The Director of Health Services-UCC also explained how the policies affect their works;

We have a unit, under the Directorate of Health, in charge of curative and preventive aspect of diseases, which works with the University Environmental Health Services section to

management waste and its impact on health and environment within the University Territory at large. We have categories of workers doing particular jobs in particular areas at particular times working under their respective supervisors.

Environmental health programmes

The respondents confirmed that they use environmental health programmes as strategies for managing waste. They all explained that they have programmes for students on campus, those in the communities, and the community members as well as food vendors. These programmes included: health screening for food vendors, health education for students, community members and food vendors and clean up campaigns in the halls and the communities.

Health screening for food vendors

The respondents admitted that, in March every year, all the food vendors and restaurant operators undergo proper health screening exercise at the University hospital to guarantee that they are in best state of health. Sharing their views, they stated:

Food hygiene is much of a concern to us. We have policy for food vendors. We have to make sure that by March each year, all food vendors and restaurant operators on campus have under gone the required medical screening (Respondent1).

Another explained that:

We have an annual programme at our office with the university. We do health screening and that is for the food

vendors and restaurant operators to ensure that they are safe to sell food to the public and we do it collaboratively with the university. (Respondent 2)

Another informant stated:

Yes, there is annual medical screening exercise organized in the hospital for food vendors and restaurant operators in the university and the surrounding communities. If any disease is detected, treatment is prescribed. If they need to be excused from operation, they are told to do so (Respondent 3).

Health education

The officer of the Environmental Health Section at UCC stated that:

The sanitation section of UCC is invited during hall weeks, orientation and akwaaba fests programmes, Officers from the section give health education talks to students on the need to ensure the halls and the lecture theatres are neat by not littering round. We educate them to keep the washroom and the toilet always usable and report any problem for prompt action. Students are again advised to use the dustbins provided on the floors and not to throw waste or waste water over the balcony unto the lawns (Respondent1).

The officer of the Environmental and Sanitation Unit at CCMA also stated:

We collaborate with UCC and all other stakeholders in the community to improve health and wellness. Community health

> *education looks at the health of a community as a whole, seeking to identify health issues and trends within the population and work with stakeholders to find solutions to these concerns (Respondent 2).*

The Director of Health Services – UCC further retorted:

> *We give education to all members who come to the facility to seek medication. They should make sure they observe personal hygiene, keep their homes and the communities clean, ensure healthy waste management practices and clean gutters and above all eat healthy foods* (Respondent 3).

Clean ups

It emerged from the interview that clean up campaigns are periodically organized in the halls and the communities to ensure cleanliness in all areas. As noted:

> *Well, sometimes we meet hall executives and student bodies. At other times, they themselves invite us. We also give them some equipment such as wheelbarrow, rake and long broom to work and also organize clean up exercises with them (Respondent1).*

Furthermore, an officer added:

> *We collaborate and share resources with UCC to organize clean up sessions in the communities and inside the university campus that is around the old site and Science market. We*

> *closed down a few food joints at the Science market when there was a suspected case of cholera because a number of students reported eating from there and then coming down with the signs and symptoms of cholera.* (Respondent 2)

The waste management policy of the University of Cape Coast and its surrounding communities are guided by the National Sanitation Policy, drafted in 2009 and reviewed in 2010. The Environmental Health Section in UCC, the Environmental Health and Sanitation Unit of CCMA and the Health Services in UCC, are all making conscious efforts to use the National Sanitation Policy as well as other realistic strategies. These strategies are periodic medical screening for food vendors and restaurant operators, public health education, and periodic clean ups at the various halls and the communities surrounding the university. The aim is to mitigate the health impact of waste on campus and the communities that surround the university. Garbage poses a threat to public health and the environment if not properly dealt with. This was in accordance with observations by Athira and Subha (2017) who intimated that every country has some form of policies and strategies for managing its waste. Such policies and strategies are set out from nationally agreed position and plan for managing waste. This clearly determines the importance of national organizations in properly management of waste. Athira and Subha emphasized that policies and strategies guiding waste management ought to be framed in a manner suitable for the type of wastes generated in the area, nature of generation, and characteristic of the area.

Respondents in the current study confirmed that the national policies guide different types of waste, and the policy is being used in managing waste in their respective departments. The observation that the University simply adopts the national waste management policy with or without major modification was not consistent with the situations in other well established universities. Donkoh (2016) confirmed that the use of public policies can be very useful for institution in waste management in most parts of the world including Ghana. Donkoh found that only five percent of the daily generated solid waste in urban Ghana was recycled. He concluded that the low recycling is purely due to policy direction to increase the number of actors in the recycling business. A study by Staniškis (2005), however, has shown that garbage controlling approaches cannot be similar across counties and subdivisions because individual garbage controlling approaches cannot deal with all possible garbage materials in a maintainable means which explains why the university must develop its own policy with the national policy as a guide.

Waste management technologies are fast expanding than what the national policy can incorporate due to its wider scope but the university can take the lead to adopt emerging trends in waste management which shall be only possible if a localised policy is drafted at the university level (Lucero-Sanico, 2019). The suggestion is that several higher institutions have adopted the waste hierarchy as the cornerstone of most waste minimisation strategies (Albert, 2011). The aim is to make the greatest useful benefits from products and to produce the least amount of end waste (Thakur & Katoch, 2012). The University of Strathclyde in Glasgow, for example, has a university level waste management policy that

follows the hierarchy as prevention, reuse, recycling, recovery and disposal in a decreasing order of volume (Sustainability and Environmental Management, 2017). Popescu, Artelle, Pop, Manolache, and Rozylowicz, (2016) argued that though the waste management policy of a university cannot be independent of that of the state or the city, there is the need for universities to adopt their own policy that can incorporate smart waste management practices. Popescu et al. contented that the cost of waste management technologies was fast declining, which presents an avenue for a university to improve their waste management process by adopting specific policy at the university level.

Since biomedical waste poses serious environmental and health implications when not well managed, the Ministry of Health (Ghana) has laid down procedures which supersede any localised policies. For example, the respondents at the university hospital indicated that *"…there are policies. Without policies, you cannot manage waste…we also follow some WHO and MOH protocols in most cases".* The empirical evidence suggested that the UCC Hospital's policy to adopt incinerator as it was stated by a respondent was consistent as a WHO approved policy for biomedical waste management (Med Pro, 2018). The observation that the Cape Coast Metropolis through the services of Zoom Lion Ghana follows the National Sanitation Policy was consistent since the policy was designed to be used at the community level where the Zoom Lion Ghana Limited mostly operates (Republic of Ghana, 2019).

The respondents further attested that policies help work in their respective units by giving directions and help collaborate with other sectors for effectiveness

and efficiency of work. The respondents stated that *"there are policy guides for waste management and there is a policy…Nation Environmental Policy, which has assigned roles and responsibilities to all the organizations that we have"*. This position was affirmed by the National Waste Report that national garbage policy offers the basis for teamwork among stakeholders to deliver effective and efficient methods to national garbage challenges, to decrease the production of waste, volume of waste for discarding, and control garbage as a resource to provide economic, environmental, and social benefits (Pickin et al., 2018). The report further explained that, enactment of the policy means all garbage, including harmful wastes, are controlled in a manner that is consistent with national responsibilities and for the safety of human health and the environment.

The observation that waste management policy assigns responsibilities to the actors in the waste management process could be linked to coordination and transaction cost of the waste management process. The respondent from CCMA stated this: *"with these policies, we have categories of workers doing particular jobs in particular areas at particular times. So, there are policies. Without policies, you cannot manage waste"*. Time is the most important resources in economics and by saving time, the whole waste management process is put into the right perspective. That is, when policies are well adhered to, it reduces coordinating cost by ensuring that every actor is aware of his or her duty (Nozharov, 2018). Hence, the transaction cost increases in the absence of a proper garbage controlling policy, which ensures that every part of the waste management process works effectively. Dubois (2012) concluded that proper

waste management policy could minimise that transaction cost of waste management. Reduction in cost obviously gives the authorities the financial space to pursue other policy items that further decrease the adverse influences of reduced garbage controlling methods on the university and its environment.

The results further suggested that the existing policy provides avenue for students and the general public including food vendors to be educated on proper waste management. Food vendors were further screened through a collaboration of the University Waste Management Section, Hospital and the Cape Coast Metropolitan Assembly waste management division. The respondent from the UCC hospital stated that, *"we give education to all members who come to the facility to seek medication; they should make sure they observe personal hygiene"*. These measures provide avenue to decrease the human health and the environmental health impacts of PWM within and around the university.

Evidence suggest that waste management education and routine checks reduce the environmental and health impact of PWM (Furtak, Ksiazek, & Warchol-Slawinska, 2011; Mohammed et al., 2016; Przybylska et al., 2014). These authors observed that, environmental education is essential to raising consciousness, enlarge information, acquire skills, and shape the health-oriented attitude of community members. Therefore, through community clean-up campaigns, communities are able to improve their physical environments as well as create a sense of community and pride among the residents. Again, to create a good impression on prospective employers, professionals, and other visitors who tour the communities. Furthermore, to improve the health of the communities by

eliminating places for insects and rodents to live, provide an opportunity for residents to get involved and to show immediate visible results (K- State-Research and Extension, 2016). The results imply that the university waste management system may not meet the ever- changing complexity of waste on campus if it continues to fully relay on the National Sanitation Policy, without major innovations.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study was to research into the environmental health impact of waste management practices in the University of Cape Coast. The study covered area such as type of waste generated by students, waste management practices, challenges of waste management, environmental health and health impacts as well as policies and strategies of waste management practices. This chapter presents summary, main findings, conclusions, and recommendations.

Summary

Waste management is a challenge in low and middle-income countries. The increase in garbage production can be mainly connected to factors such as high population growth rate, changing consumption pattern, rapid rate of urbanization and rural urban migration. With the economic development, the total quantities of municipal and industrial universal waste are likely to increase to 3.40 billion tonnes by 2050. The rising quality of life and high rates of resource consumption patterns have had an unplanned and negative impact on the environment. The effects are far beyond the handling capacities of urban governments and agencies. Though there are ways to keep the environment free from the negative effects of waste, the indiscriminate disposal and exposure of waste pose serious threat to the environment and human health. This is because poorly managed waste contaminates the world's oceans, clogs drain and causes flooding, transmits diseases via breeding of vectors, increases respiratory problems through airborne particles from burning of waste, harms animals that

consume waste, and affects economic development through diminished tourism. The sustainability of a healthy environment claims freedom from all kinds of garbage whatever the source of the garbage.

Academic institutions and the manner in which they generate and manage waste are of greater research interest considering the strategic position universities occupy in research and development in every country. The growing university population has not only increased waste generation on campuses but also in the nearby communities where most of the students live. Again, as waste culture is a behavioural issue, the rapid expansion in the human communities of academic institutions connotes waste generation implications. Furthermore, successful academic work depends mainly on the health of the students and the university staff. Therefore, the impact of any disease outbreak from poor waste management on the university campus or in the nearby communities shall have adverse consequences on the university hospital, its administration, the students, and the inheritance of the nearby communities.

Studies have been conducted on the quantum of wastes generated worldwide; threats waste poses to the surroundings, and the barriers to effective garbage controlling in Africa. These studies have indicated that the storage, collection, transportation, and final management or discarding of garbage are major problems for most countries in Africa. Over the years, most universities in the developed world have sought to minimize the quantum of waste going to landfills through waste minimization and recycling programmes. However, in Ghana, most studies are confined to the communities to the neglect of the

universities. Studies that looked at the universities, focused on types of WMP among university students. In addition, such studies did not assess the environmental health impact of WMP of the university on the university environment, and the surrounding communities.

Six research questions guided this study. The study employed quantitative and qualitative tools to gather primary data for the analysis. A questionnaire was used to gather data for the quantitative analysis, while structured interviews and observation checklist were used to gather the qualitative data. Stratified proportional sampling was used to select 4,400 undergraduate students from the eight traditional halls of residence and the five communities that surround the university. In addition, three key informants; the Officer of the Environmental Health Section of UCC, the Officer of the Environmental Health and Sanitation Unit of CCMA and the Director, Directorate of Health Services-UCC were purposively sampled and interviewed. Observations were made to the bin sites in the halls of residence and dumpsites in the communities. Data analysis tools included frequencies, percentages, median rating, Wilcoxon rank sum test, logistic regression analysis, and structural equation model. The qualitative responses were analysed through thematic content analysis.

Key findings

The analyses of the study made a number of findings based on the stated objectives. First, the students of UCC generate food waste, paper, plastic wastes and spoilt electronic gadgets on daily basis. Garbage associated with food was found to be the mostly generated waste by undergraduate students on campus.

Secondly, the waste management practices in the University and the surrounding communities included placing bigger waste bins outside the halls/ hostels for waste collection, janitors regularly collect waste, creating a dedicated site for washing, organisation of effective waste management programmes. The waste management practices of the undergraduate students included, acquisition of smaller bins to collect waste in the rooms and kitchens and emptying the smaller bins into the larger bins on time. The university waste management team also collect bigger bins regularly for final delivery into the refuse dumping site of the Cape Coast metropolis. Moreover, Zoom Lion Ghana Ltd, UCC Environmental Health Section, food vendors, community members, students and lecturers of the University are identified as the major stakeholders in the waste management process in the university and the adjunct communities.

Moreover, increasing university population, rapid upsurge in garbage production, inadequate finances and inappropriate technology were some of the main challenges of reduced garbage controlling in the halls of residence and the surrounding communities. Moreover, laziness on the part of students to put waste into waste bins, students' lack of knowledge on management of waste, negative attitude of workers/students towards waste disposal were other challenges students reported in their waste management practices.

Also, some of the impacts of reduced garbage controlling on the environment included choked gutters, polluted air, stagnation of wastewater, littering plastic and food waste, land degradation and aesthetics devaluation of the university campus and the surrounding communities.

Furthermore, the students identified malaria, cholera and diarrhoea as among the major disease manifestation of poor waste management, and the university hospital confirmed these disease as the diseases that UCC students mostly report to the hospital. It was further observed that females had higher tendency to suffer from the adverse health consequences of poor waste management than males, while the resident students had reduced probability of suffering the health impact of poor waste management than non-resident students. Moreover, poor waste management was found to have higher indirect effects through the environment onto the health status of the students than direct effects. The significant adverse effects of reduced garbage controlling on the wellbeing of the undergraduate students and the extended environments was confirmed in the study.

Finally, the waste management policy of the University of Cape Coast and its surrounding communities were designed based on the National Sanitation Policy. That is, the university adopts wholly the National Sanitation Policy to guide its waste management practices. The Environmental Health Section of the University as well as the Environmental Health and Sanitation Unit of the Metropolis, employed three strategies to mitigate the adverse effects of reduced garbage controlling practices in the university and the surrounding communities. These strategies are health screening of food vendors and restaurant operators, health education for students, food vendors as well as community members and clean-up exercises in the halls of residence and the surrounding communities. The policy was found to reduce time and cost of waste management practices by defining roles for workers of the waste management sections of the university and

the Metropolis. The policy again encouraged the involvement of all stakeholders to manage waste effectively and minimize its adverse effects on health and the environment.

Conclusions

This section discusses a number of conclusions that were drawn from the study using the findings as premises.

The conclusion was made based on the garbage controlling practices of the study area that the modalities of waste generation and management within and outside the university have a higher tendency to contribute significantly into the global warming phenomenon by increasing the emission of greenhouse gasses. This conclusion was based on the observation that the students mostly generate organic waste and most of them, especially in the communities, are allowed to decay in an open authorised dumping site to generate tons of methane gasses. It was also concluded that waste management practices of UCC and Ghana at large is still within reach of effective management at the least possible cost. This conclusion was based on the fact that organic wastes decompose easily as compared to inorganic waste, and hence does not require sophisticated technology or loads of funds to manage them. That is, with the right approach and technology, waste management is likely to be less problematic where organic waste dominates than where inorganic waste dominates. It was again concluded that waste generation shall be especially easy for the university to practice since all organic waste can be collected in the same bins and inorganic in another for proper recycling and management. This conclusion was based on the fact that

organic wastes are more homogenous than inorganic wastes which was found to be generated in smaller quantities by the students.

Another conclusion was that the refuse dumps and the general environments of the university are disaster in the waiting since they are filled with filths that can easily engineer an outbreak of diseases; however, it also concluded that, the students had good knowledge of garbage controlling practices and its possible influence on the environment and human lives. The implication of this finding could be that policies aimed at improving waste management are likely to be met with less friction when well implemented with broader consultation of the student body.

The study confirmed earlier findings on the fact that, poor waste management has adverse influence on students' health. The major contribution of this study to the impact of reduced garbage controlling on health status was the derivation of the indirect effects of reduced garbage controlling on health status through the environment. It was concluded that a greater proportion of the impact of poor waste management on health status of the immediate residence actually manifest through the environmental health impacts. The students who are at the centre of the waste generation and management process were found to having varying views and low level of commitment to proper waste management process. These findings suggested that without proper education on waste, a section of the student would always go contrary to the expected norms because they held a different view in the first place. This explains why some level of littering could be witnessed in the lecture rooms, Junior Common Room (JCR) and very tidy part of

the halls of residence and the university at large, despite the supposed level of exposure to all the students.

The results also pointed out to the fact that the university is far behind in its quest to modernise waste management since it still relies on the generic national waste management policy. Much as the university is a public institution, it has special group of individuals with different level of education, awareness, and attitude towards waste which demands that the national policy is tailored to suit the situation. It was concluded from this observation that the university's lack of commitment to waste segregation and recycling hinges on the fact that the national sanitation policy is not too stern on them. The observation that the Zoom Lion depends on the national waste management policy is consistent since they serve all forms of communities (rural, urban, institutions) and must strictly stay within the national policy.

The final conclusion was that the students lack commitment to the waste management process despite their understanding of its consequences and must be helped to appreciate the situation. It was evident from the study that the students failed to appreciate the fact that janitors are helpers in the waste management process, and their work can be made easier if the students show commitment by leaving waste at more visible places for collection.

Recommendations

From the findings, the following recommendations have been made;

1. The Environmental Health Section of UCC and the Environmental and Sanitation Unit of CCMA need to increase their frequency in the collection of organic waste.
2. The Environmental Health Section of UCC need to provide different garbage bins to collect the different types of garbage generated in each hall of residence.
3. The hall authorities in each hall of residence need to make some time to talk about the students' role in proper garbage controlling as well as to educate the students on the need for attitudinal change.
4. A forum must be instituted on waste management in the university community when students report to the university and during hall week celebrations by the Environmental Health Section of UCC
5. The Environmental Health Section of UCC should endeavour to venture into improved waste management practices that are yet to be enshrined in or enforced by the National Sanitation Policy.

Suggestions for Further Study

1. Future studies may focus on students' perception about waste segregation and recycling.
2. Finally, though the study covered both the halls on the University campus and the immediate communities, it left three of the main actors out; lecturers, non-students in the communities and food vendor. Future studies can focus on them.

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APPENDICES

APPENDIX A

UNIVERSITY OF CAPE COAST

COLLEGE OF EDUCATION STUDIES

DEPARTMENT OF HEALTH, PHYSICAL EDUCATION AND RECREATION

QUESTIONNAIRE FOR STUDENTS

Dear Respondent,

This questionnaire seeks to **assess the environmental health impact of waste management practices in the University of Cape Coast**. It is part of research work in partial fulfillment of Doctoral Degree from Faculty of Education. I would be grateful if you could complete the items below to help in the achievement of the intended objective. Your participation in this study requires that you complete a 35 items survey. This may take between 15 to 20 minutes of your time. The study is purely for academic purpose and therefore any information you provide shall be treated with outmost confidentiality and anonymity and will be used solely for academic purpose. You may contact my supervisors, Prof. J. K. Mintah (0540499131) and Dr. Edward W. Ansah (0247703379) for any clarification.

Name: Vida Adjeley Akai-Tetteh: 0243432382

SECTION A: BACKGROUND CHARACTERISTICS

Instruction: Tick (√) the appropriate box that applies to you.

1. Residential status

   a. Resident ☐ b. Non-resident ☐

2. Gender

a. Male ☐ b. Female ☐

3. Marital status

a. Single ☐ b. Married ☐ c. Separated ☐

d. Divorce ☐ e. widowed ☐

4. Age as at last birthday.....

5. Religion

a. Christianity ☐

b. Islam ☐

c. Traditional ☐

d. Others (specify) …….

6. Residence (where you currently stay)

a. Adehye ☐ b. Oguaa ☐

c. Valco ☐ d. Casford ☐

e. ATL ☐ f. KNH ☐

g. SRC ☐ h. Amamoma ☐

i. Apewosika ☐ j. Kwaprow ☐

k. Duakor ☐ l. Kukuodo ☐

7. Hall of affiliation……..

8. Current level at the University

a. 100 ☐ b. 200 ☐

c. 300 ☐ d. 400 ☐

9. College

a. College of Agriculture and Natural Sciences ☐

b. College of Education Studies ☐

c. College of Health and Allied Sciences. ☐

d. College of Humanities and Legal Studies ☐

SECTION B: TYPES OF WASTE GENERATED IN THE UNIVERSITY

Please tick (√) against the column the most accurate option that represents your opinion. There is no 'correct' or 'wrong' answer.

10. Rank the following types of waste mostly generated in your hall/hostel.

Types of Waste	Frequency/Extent of waste generation				
	Very High	High	Moderate	Low	Very Low
i. Food waste					
ii. Paper					
iii. Box/cartoon					
iv. Plastic					
v. Electronic gadgets					
vi. Others					

SECTION C: EXISTING WASTE MANAGEMENT PRACTICES

Please tick (√) against column the most accurate option that represents your opinion. There is no 'correct' or 'wrong' answer.

11. In your opinion, which of the following are major stakeholders in the management of waste on campus / your community?

Items	**Strongly Agree**	**Agree**	**Moderately agree**	**Slightly agree**	**Do not agree**
i. UCC Sanitation Section					
ii. Students					
iii. Lecturers					
iv. Other staff members					
v. Food Vendors					
vi. Opinion leaders					
vii. Community members					
viii. Zoom Lion Ghana limited					

Please tick (√) against column the most accurate option that represents your opinion. There is no 'correct' or 'wrong' answer.

12. Indicates your level of agreement with the following statements

Statement	Strongly Agree	Agree	Moderately Agree	Slightly agree	Do not agree
i. Waste generated on the floor/hostel is collected by janitors on regular basis.					
ii. There are bigger waste bins provided outside the hall/ hostel for waste collection.					
iii. Students have a role to play in the proper management of waste on campus/ community					
iv. During Hall programs, leadership embark on activities directed towards ensuring effective management of waste in the hall					
v. We have a smaller waste bin at our door for immediate waste collection					
vi. There are functional sinks for washing in the hall / hostel					
vii. There are dedicated sites for washing in the hall/ hostels.					
viii. I do not pour waste water over the balcony or on the floor in the hall/hostel					

13. How much do you pay per month for waste collection services?

……

14. How many times do janitors and cleaners clean the hall / hostel within a week?

a. Daily ☐ b. Once a Week ☐

c. Twice a week ☐ d. No janitor / cleaner ☐

e. Other Specify……

15. How satisfied are you with the duties discharged by the janitors for waste management in your hall/hostel?

a. Very unsatisfied ☐ b. Unsatisfied ☐

c. Uncertain/ undecided ☐ d. Satisfied ☐

e. Very satisfied ☐

16. What is/are the reason(s) for your response in question 14?

……

……

……

17. Do you have a centralized waste bin in a designated area in your hall/hostel?

Yes ☐ No ☐

18. If there are waste bins in the hall/hostel, how many times is waste collected in a week? ☐ ☐

a. Two times b. Five times

c. Throughout the week ☐ d. I don't know ☐

19. If there are no waste bins in the hall/hostel, how do you dispose of your waste? (Select as many as apply)

a. Put it in any empty space ☐ b. Open spaces ☐

c. Nearby container ☐ d. Bushes / lawns near hall/hostel ☐

e. Collect the waste into a polythene and put it into a bigger waste bin outside. ☐

20. Does your hall or hostel embark on clean-up activities? Yes ☐

No ☐

(If answer is no move to Q 21 otherwise answer Q20)

21. If YES, how often?

a. weekly ☐ b. fortnightly ☐

c. monthly ☐ d. quarterly ☐

22. Do you have bye-laws regarding waste management in the hall/ hostel?

Yes ☐ No ☐

23. What sanctions are given to members who disobey hall/hostel bye laws regarding waste management? (select as many as apply)

a. made to pay fines ☐ b. made to sweep the hall/hostel ☐

c. caution for the first time ☐ d. made to clear gutters ☐

e. made to pick the rubbish up ☐

f. banned from putting waste in the waste bin ☐

g. others (please specify)……

Please tick (√) against column the most accurate option that represents your opinion. There is no 'correct' or 'wrong' answer.

24. What are your responsibilities as a student when it comes to the management of waste on hall/hostel?

Responsibility	**Strongly Agree**	**Agree**	**Moderately Agree**	**Slightly agree**	**Do not agree**
i. Sweep my room regularly.					
ii. Prompting colleagues to put waste in the waste bins provided.					
iii. Encourage students to leave the washrooms clean after use.					
iv. Tidying my surroundings to ensure aesthetics value of the hall.					
v. Obeying bye-laws regarding waste.					
vi. Correct colleagues who dispose of waste indiscriminately.					
vii. Prompting colleagues to adhere to rules and regulations regarding waste.					

25. What department or people is\ are responsible for waste collection on campus/ community?

Department	Strongly Agree	Agree	Moderately Agree	Slightly agree	Do not agree
i. Community members					
ii. Assembly members					
iii. Town council					
iv. Zoom Lion Ghana Ltd					
v. Environmental/ Sanitation section of UCC					

SECTION D: CHALLENGES TO WASTE MANAGEMENT PRACTICES

26. To what extent are these challenges to waste management practices in your hall/hostel?

Challenges	Strongly Agree	Agree	Moderately Agree	Slightly agree	Do not agree
i. Waste bins are not available					
ii. Waste bins not emptied as expected					
iii. Unavailability of sinks in front of rooms					
iv. Distance of waste bin is too far					
v. Negative attitude of workers towards waste disposal					
vi. Students lack of knowledge to management of waste					
vii. Inaccessibility of waste bins for disposal of waste					
viii. Laziness on part of students to put waste into waste bins					
ix. Others (specify)					

SECTION E: ENVIRONMENTAL HEALTH IMPACT OF WASTE

Please tick (√) against column the most accurate option that represents your opinion. There is no 'correct' or 'wrong' answer

27. Which of these negative environmental effects do you see or experience due to poor waste management practices?

Negative Effects	**Strongly Agree**	**Agree**	**Moderately Agree**	**Slightly agree**	**Do not agree**
i. Chocked gutters					
ii. Flood occurrences					
iii. Land degradation					
iv. Aesthetics devaluation					
v. Air pollution (bad odour/ harmful gases)					
vi. Plastics bags harm.					
vii. Running waste water affect the beauty of a hall/community.					

SECTION F: HEALTH IMPACTS OF WASTE

Please tick (√) against the box that accurately represents your opinion. There is no 'correct' or 'wrong' answer.

28. In your opinion, is waste disposal and management a health problem?

a. Yes ☐

b. No ☐

c. Not sure ☐

29. Improper management of waste adversely affects human health. Yes ☐

No ☐

Please tick (√) against column the most accurate option that represents your opinion. There is no 'correct' or 'wrong' answer.

30. These diseases do occur as a result of poor waste management practices. Indicate your level agreement to the occurrences.

Diseases	**Strongly Agree**	**Agree**	**Moderately agree**	**Slightly agree**	**Do not agree**
i. Cholera					
ii. Dysentery					
iii. Allergies					
iv. Typhoid					
v. Cuts/ injuries					
vi. Asthma					
vii. Bronchitis					
viii. Abdominal pan					
ix. Dental disorder					
x. Malaria					
xi. Eye infection					

Please tick (√) against column the most accurate option that represents your opinion. There is no 'correct' or 'wrong' answer.

31. Indicate your level of agreement with indiscriminate disposal of sharp objects such as syringes, scalpels and razor blades on the following people.

People affected	**Strongly Agree**	**Agree**	**Moderately Agree**	**Slightly agree**	**Do not agree**
i. Waste scavengers					
ii. Waste management workers					
iii. Health care workers					

32. Indicate the extent to which these serious public health threats are posed when hazardous chemicals from solid waste are washed into surface and ground water.

Public health threats	**Frequency of occurrence**				
	Very High	**High**	**Moderate**	**Low**	**Very Low**
i. Headache					
ii. Diarrhea					
iii. Low metal capability for learning					
iv. Irritability					
v. Typhoid					
vii. liver diseases					
viii. kidney damage					
ix. Others					

Please tick (√) against column the most accurate option that represents your opinion. There is no 'correct' or 'wrong' answer.

33. Students are likely to be attacked by these waste related health problems. Indicate your level of agreement with the statement.

Effects	**Frequently**	**Occasionally**	**Rarely**	**Very Rarely**	**Never**
i. Skin disorders such as allergies					
ii. Respiratory Abnormalities such as bronchitis and asthma.					
iii. Skeletal Muscular System such as back pains.					
iv. Dental disorders such as dental carries and dental pains.					
v. Eye Infections such as allergic or bacterial eye infections.					
vi. Central Nervous System such as headaches.					
vii.Communicable Diseases such as chicken pox.					
viii.Others such as malaria.					

34. How often do the following diseases occur in your campus or hostel?

Diseases	Frequency of occurrence				
	Very High	High	Moderate	Low	Very Low
i. Cholera					
ii. headache					
iii.Epilepsy					

iv. Malaria					
v. Skin diseases					
vi. Eye infection					
vii. Dental disorders					
viii. Vomiting					
ix. Abdominal ache					

35. Which of the following diseases have you personally experienced on campus/ hostel? (select as many as apply)

a. Eye infections ☐ b. Epilepsy ☐ c. Malaria ☐ d. Cholera ☐

E toothache ☐ f. Typhoid ☐ g. Headache ☐ h. Back pain ☐

i. Allergy ☐ j. Skin rashes ☐

Thanks for taking part in this study

APPENDIX B

UNIVERSITY OF CAPE COAST

COLLEGE OF EDUCATION STUDIES

DEPARTMENT OF HEALTH, PHYSICAL EDUCATION AND RECREATION

SEMI-STRUCTURED INTERVIEWED GUIDE

Topic: Environmental Health Impact of Waste Management Practices in the University of Cape Coast.

INTERVIEW GUIDE FOR SENIOR ENVIRONMENTAL OFFICER AND DIRECTOR OF HEALTH (UCC)

SECTION A BACKGROUND INFORMATION

Department/Unit : ……..……..

Qualification …….

How long have you been working in this department? ……..

SECTION A: HEALTH IMPACT OF WASTE.

1. What types of waste are generated on the university campus and the communities surrounding the university?
2. Why are the mandates of your office?
3. Do you think improvement in waste management practice in the university and its environment can reduce pressure on your outfit?
4. What are some of the waste related illness/disease /epidemic reported in your outfit?
5. What waste management programme(s} do you have for the UCC community?

SECTION B: ENVIRONMENTAL HEALTH IMPACT OF WASTE.

6. What are some of the effects of poor waste management on the campus environment?
7. What are some of the waste (products) which pose major management practices?

8. What / Which other ways does waste affects UCC campus and environment?

SECTION C: EXISTING POLICIES AND STRATEGIES TO MITIGATE THE ENVIRONMENTAL HEALTH IMPACT.

9. Which policies guide waste management on campus?
10. Any policy implementation committee in place?
11. . Any policy on environmental health programme?
12. How are these policies helping your work?
13. When was the last time the policies were reviewed?

SECTION D: CHALLENGES ASSOCIATED WITH MANAGING WASTE.

14. Are you resourced enough to effectively manage waste on campus?
15. What is your staff strength in relation to waste management on campus?
13. What other challenges does your outfit encounter in managing waste?

APPENDIX C

UNIVERSITY OF CAPE COAST

COLLEGE OF EDUCATION STUDIES
DEPARTMENT OF HEALTH, PHYSICAL EDUCATION AND RECREATION

OBSERVATIONAL CHECK LIST

Topic: The Environmental Health Impact of Waste Management Practices in the University of Cape Coast

OBSERVATION CKECK LIST

DAY	OBSERVATIONS	Number/ Description	Yes	No.
Day 1	Number of authorized dumping sites			
Day 2	Number of unauthorized dumping sites			
Day 3	Nature of dumping sites			
Day 4	Location of the sites			
Day 5	Number of public toilets			
Day 6	Conditions of public toilets			
Day 7	Visible open defecation			
Day 8	Composition of dumped wastes			
Day 9	Others			

APPENDIX D
ETHICAL CLEARANCE

UNIVERSITY OF CAPE COAST
INSTITUTIONAL REVIEW BOARD SECRETARIAT
TEL: 0558093143 / 0508878309/ 0244207814
C/O Directorate of Research, Innovation and Consultancy
E-MAIL: irb@ucc.edu.gh
OUR REF: UCC/IRB/R/1/501
YOUR REF:

3RD JUNE, 2019

Ms. Vida Akai-Tetteh
Department of Health, Physical Education & Recreation
University of Cape Coast

Dear Ms. Akai-Tetteh,

COMMENTS ON YOUR RESEACH PROTOCOL (UCCIRB/CES/2019/11)

The University of Cape Coast Institutional Review Board (UCCIRB) has approved your request for ethical clearance to conduct a research titled *Environmental Health Impact of Waste Management Practices of the University of Cape Coast.* The approval is subject to you considering the comments below and making the necessary revision in your current protocol:

1. Correct all typographical errors in the work.
2. The first and second sentences of the Executive Summary are not clear. Kindly rephrase them.
3. Kindly merge objective two and three to form one objective. Again, objective 6 should be rephrased to accommodate possible solution.
4. Reference all citations in the proposal. Is the reference related to the number of students or the waste generated?
5. The quadrupled used does not give a bigger sample size and clearer sampling procedure. Kindly use a sampling formula for residents and non-residents separately to give a bigger and clearer procedure. Moreover, accidental sampling can be used when one does not have a sampling frame but in your case, the frame can be obtained from the University of Cape Coast Students Records, Management and Information System (SRMIS). Revise this.
6. The length of administering the questionnaire can cause discomfort. State how you propose to deal with this discomfort.

You are required to revise your protocol by incorporating the above comments and submit two hard copies as well as a soft copy of the revised protocol to the UCCIRB Administrator for the Board's consideration. Please provide us with a write up on how you have effected the changes in your revised protocol. We look forward to hearing from you.

Yours faithfully,

Samuel Asiedu Owusu, PhD

UCCIRB Administrator

ADMINISTRATOR
INSTITUTIONAL REVIEW BOARD
UNIVERSITY OF CAPE COAST
Date: 7/06/19

APPENDIX E
INTRODUCTORY LETTER

UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION
DEPARTMENT OF HEALTH, PHYSICAL EDUCATION & RECREATION

TELEPHONE: +233 - (0)206610931 / (0)543021384 / (0)268392819

TELEX: 2552, UCC, GH.

EMAIL: hper@ucc.edu.gh

Cables & Telegrams:
UNIVERSITY, CAPE COAST

Our Ref: ED/HTP/15/0006/8

6th February, 2019

TO WHOM IT MAY CONCERN

INTRODUCTORY LETTER:
MRS. VIDA ADJELEY AKAI-TETTEH (ED/HTP/15/0006)

The bearer of this letter, Mrs. Vida Adjeley Akai-Tetteh, is a PhD (Health Promotion) student of the Department of Health, Physical Education and Recreation in the University of Cape Coast. She is working on her thesis titled **"Environmental Health Impact of Waste Management Practices in the University of Cape Coast"** as part of the requirements for the programme.

She would like to collect data from your outfit for her research work. The data will be used for academic purposes only and be assured that the information collected will be treated with utmost confidentiality.

We would therefore be very grateful if she is given the permission and also offer her any assistance needed from your outfit.

We count on your usual co-operation.

Thank you.

Yours faithfully,

Dr. Daniel Apaak
(Head of Department)
Tel.: +233 (0)208587866
Email: daniel.apaak@ucc.edu.gh