

**INFORMAL SETTLEMENTS AND POLLUTION BEHAVIOUR IN THE
ADENTAN MUNICIPALITY, ACCRA.**

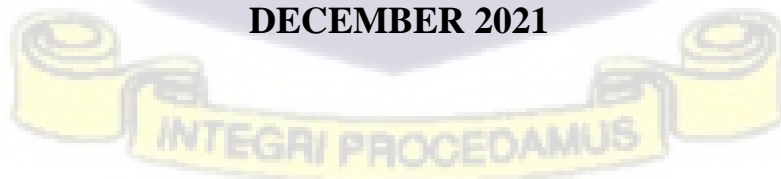
BY

EUGENIA AMA AKOFUA ANNAN

(10534264)

**THIS THESIS IS SUBMITTED TO THE SCHOOL OF GRADUATE
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DEGREE IN ENVIRONMENTAL SANITATION**

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DECLARATION

I, Eugenia Ama Akofua Annan, hereby declare that this thesis is my conceptualized work under supervision. This thesis has never been presented in whole or in part in this University or any other institution for the award of any degree. All sources of information cited in this thesis have duly been acknowledged.



20/12/2021

.....
Eugenia Ama Akofua Annan

.....
Date

(Student)



20/12/2021

.....
Dr. Benjamin Ofori

.....
Date

(Principal Supervisor)



December 20 2021

.....
Dr. Adelina Maria Mensah

.....
Date

(Co- Supervisor)



20/12/2021

.....
Dr. Samuel Yaw Aboagye

.....
Date

(Co-Supervisor)



DEDICATION

I dedicate this work to the Almighty God for giving me strength, myself for not giving up, my mum and dad, Capt. George Maxwell Annan, and Mrs. Juliet Annan. Mr. Collins Opong and Mrs. Yaa Frimpomaa Kankam, my foster mother, for their love, inspiration, and unflinching support throughout my education. I also dedicate this work to The RAIN project and the Ghana Scholarship Secretariat.



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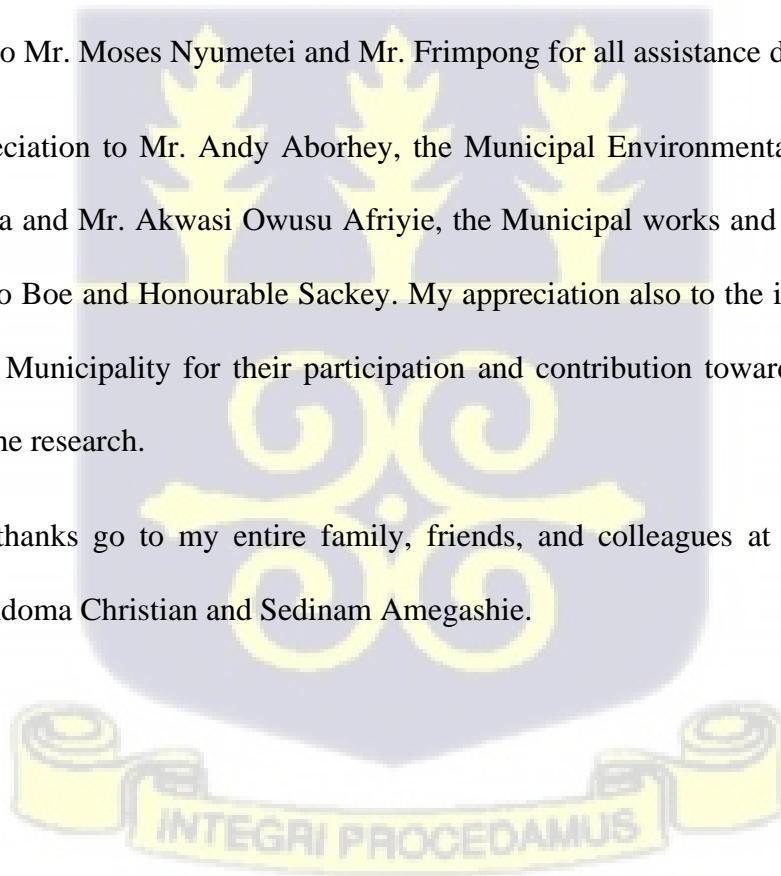
I wish to express my heartfelt gratitude to the Almighty God for the strength, knowledge and understanding given to me to pursue my studies. I would also like to say a special thanks to my supervisors, Dr. Benjamin Dankyira Ofori, Dr. Adelina Maria Mensah, and Dr. Samuel Yaw Aboagye for their immense contributions and constructive criticisms throughout the study. Without their guidance this project would not have been a success. I wish to express my profound gratitude to the RAIN Project for sponsoring this project in terms of finance, without them this project would not have sufficed.

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Finally, many thanks go to my entire family, friends, and colleagues at IESS, especially Marilyn Ama Adoma Christian and Sedinam Amegashie.



ABSTRACT

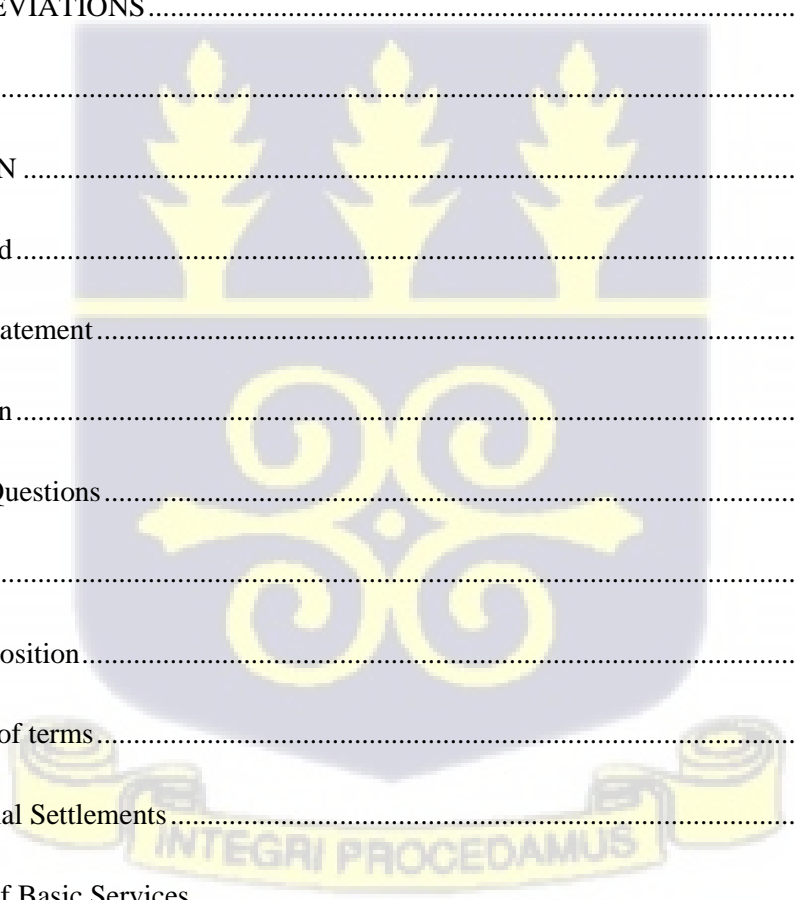
City authorities have disapproved of the proliferation of informal settlements due to the pollution caused in such environments. This study sought to identify the sources of pollution in informal settlements and determine behaviour change techniques to reduce pollution in terms of indiscriminate waste disposal behaviour in these settlements. The mixed method approach was used. GPS and a structured listing form were used to identify informal settlements and characterized them, respectively. Overall, 350 respondents (female: 186 and males: 164) were selected randomly to participate in a questionnaire survey aimed at identifying the primary sources of pollution in their environs and the effect of pollution on settlers' health and the environment. The RANAS model for behaviour change was used to identify critical behavioural factors and targeted behavioural techniques. Interviews were also conducted with municipal experts such as the municipal works and planning officer and the environmental health officer. SPSS and Excel were used to analyse the data collected. The results indicated that the significant sources of pollution include indiscriminate solid waste disposal, lack of grey water containment, and lack of toilet facilities. The population structure of the studied community is youthful, with the age groups of 26-35 years recording the highest responses. The age structure indicated that informal dwellers are young migrants searching for greener pastures. Among the participants, 56% (94) had basic level education 87.9% (307) engaged in informal businesses, and 86.7% (303) fall within low-income earners. Also, 54.4% (189) of the participants were squatters and had no security of land tenure as the occupied lands were owned mostly by private individuals and the government. In comparing the health of dwellers to the indiscriminate waste disposal behaviour and their environment, a weak positive ($\rho = 0.393$) and a strong positive ($\rho = 0.714$) correlation existed between the health of the dwellers and the environment, respectively. Behaviour change techniques identified include information, persuasive, infrastructural, skills and ability, norm, planning, and relapse prevention BCTs. In

conclusion some critical behavioural factors influenced the indiscriminate waste disposal behaviour of informal settlers in the Adentan Municipality. This thesis recommends further studies in the waste disposal and collection interventions using the Behaviour Change Techniques identified. pastures.



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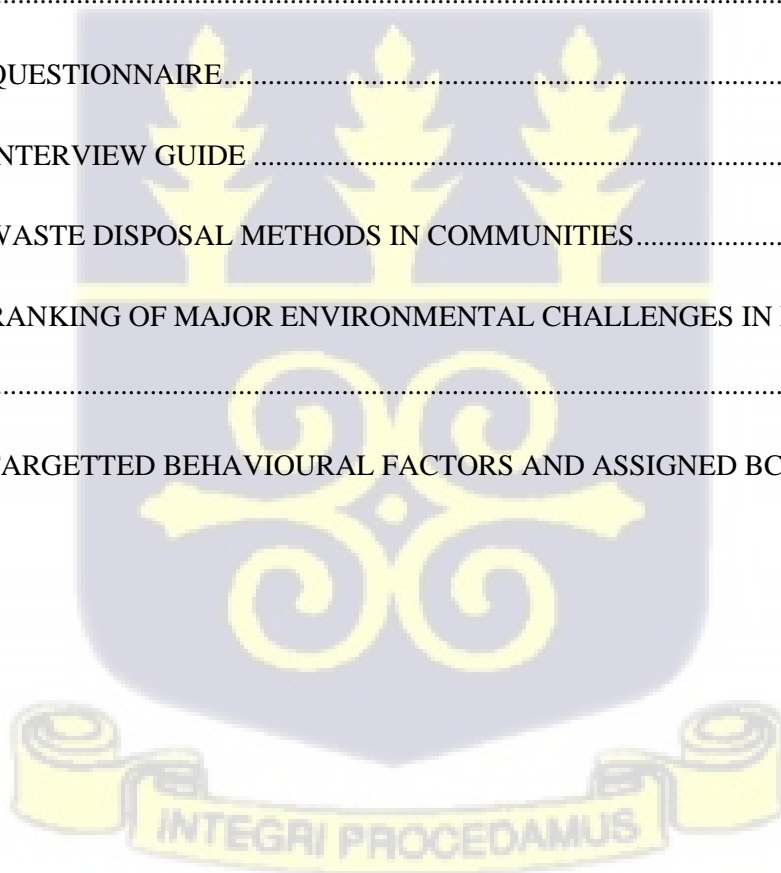
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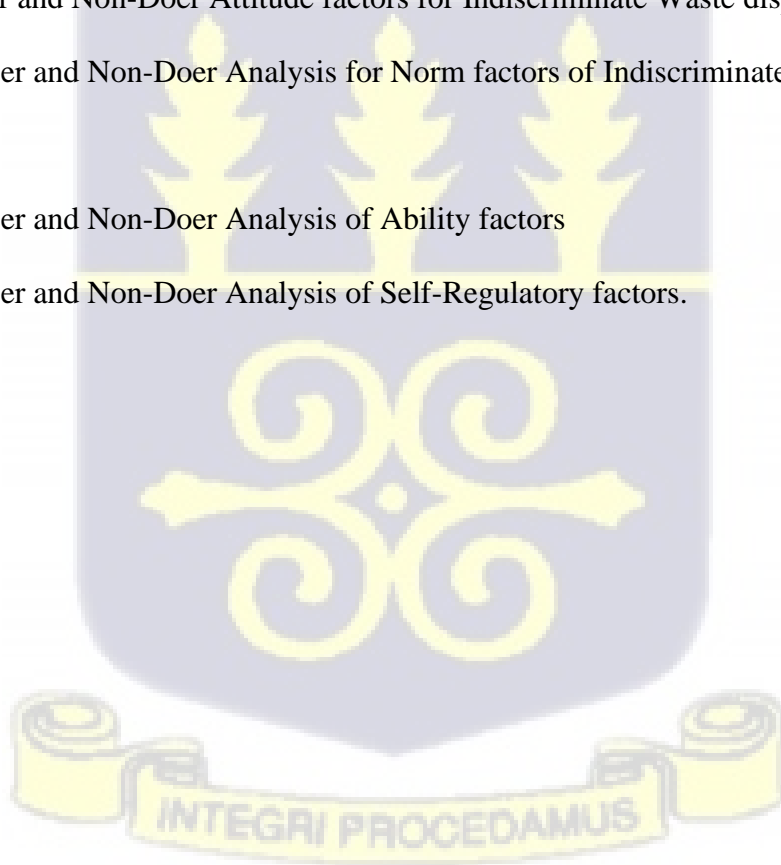
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LIST OF ABBREVIATIONS

AMA	Accra Metropolitan Assembly
APEC	Asia-Pacific Economic Cooperation
BCT	Behaviour Change Technique
FIFA	Fédération Internationale de Football Association
GIS	Geographic Information Systems
GPS	Global Positioning System
GSS	Ghana Statistical Services
M&E	Monitoring and Evaluation
PRIA	Participatory Research in Asia
RANAS	Risks, Attitudes, Norms, Abilities and Self-regulation
RS	Remote Sensing
SDG	Sustainable Development Goals
SERI	Socio-Economic Rights Institute of South Africa
UN- HABITAT	United Nations Human Settlement Programme
UN-DESA	United Nations Department of Economic and Social Affairs
UNICEF	United Nations Children's Fund
WASH	Water Sanitation and Hygiene
WHO	World Health Organisation

The image contains a large, semi-transparent watermark of the University of Ghana crest. The crest features three golden trees on a blue background, with a banner at the bottom that reads "INTEGRI PROCEDAMUS".

CHAPTER ONE

INTRODUCTION

1.1 Background

The world is urbanizing at a fast rate. 55% of the world's population currently lives in urban areas and it is projected that by 2050, the world's urban population will increase to 68% (UN DESA, 2018). This unprecedented increase in urban population exerts pressure on city infrastructure, especially on housing supply, which leads to the mushrooming of informal settlements. Informal settlements are places of abode where dwellers lack security of tenure for land, basic services, and city infrastructure; also, the housing may not comply with housing regulations and standards (UN-Habitat, 2016; Brown, 2015). According to available statistics, 1 billion people in the world live in informal settlements (UN-Habitat, 2020; UN-Habitat, 2018; UN-Habitat, 2016). This vast population in informal settlements is a cause for alarm, as the unplanned nature of these settlements is a major problem that denies settlers of essential services. These services, mostly lacking in informal settlements, include access to potable water, improved toilet facilities, waste storage, and disposal facilities. Numerous studies have revealed that the lack of basic services, especially toilet facilities and waste, in these settlements poses health risks to dwellers and degrades the environment (Abia, Ubomba-Jaswa, Schimdt, & Dippenaar, 2018; Gangoo, 2003).

As a result of these environmental challenges faced in these settlements, global and national institutions introduced slum upgrading strategies mainly on infrastructure development to improve living conditions. This approach has barely recorded success. Also, software techniques such as behaviour change strategies to uplift these settlements exist. However, little attention has been given to that effect; thus, it is relevant to identify software strategies such as behaviour change techniques that can decrease activities that pollute the environs of these

dwellings. For the purpose of this study, indiscriminate waste disposal behaviour will serve as the target behaviour to be changed as these settlements lack safe waste management infrastructure. Historically, global targets to improve living conditions in informal settlements influenced national policies to achieve global targets. To achieve global targets, programs were designed to address challenges in informal settlements. These programs include ‘Cities Without Slums’ (CWS) and ‘Slum Upgrading Facilities’ (SUF) by the World Bank in the 1960s and ’70s to improve living conditions such as access to electricity, healthcare facilities, and educational facilities, which were unsuccessful. (Arimah &Branch, 2011). Also (Walker, 2016; Marais & Ntema, 2013; Wekesaa, Steyna, & Otieno, 2011) are of the view that the preferable option for improving informal settlements is the settlement upgrading approach. Which only focused on infrastructure, housing, and basic services, a top-down approach that usually fails (Oppong, 2016).

In contrast, other studies have also explored software interventions for improving living conditions and sanitation, which deals majorly with changing behavioural factors. Different procedures are considered in generating such behavioural factors and how behavioural factors generated are utilized for behavioural change interventions targeting water, sanitation, and hygiene. The approaches for generating behavioural factors have been classified into five categories which include; Behavioural factors obtained from layperson psychological knowledge, Behavioural factors drawn from qualitative research, Behavioural factors developed out of participatory formative project phase, Behavioural factors obtained from psychological theory and finally, Behavioural factors deduced from theory and measured to derive interventions.

All the factors mentioned above, except the fifth, lack the tool to measure and identify behavioural factors using psychological theory. The only method that measures and among all

these approaches, popularly known as the RANAS model of behaviour change, was employed to identify behaviour change techniques relevant to the study area.

1.2 Problem Statement

In 2014, the population of slum dwellers in Ghanaian cities was estimated at approximately, 5.37 million which represents 37.6 % of the total urban dwellers (UN-Habitat, 2016). The rapid increase of informal settlement has been largely disapproved by city authorities in Ghana due to the negative impacts they have on the environment, including the erection of household structures in waterways, which results in flooding such neighbourhoods (Abubakari & Twum, 2019). The major reasons for the propelling of informal settlements as reported by Gaisie, Boansi, & Adarkwa (2018), in Ghana includes rapid population growth, increasing urban poverty, as well as weak institutions and governance.

Informal settlements are viewed as an alternate housing supply to low-income earners (Misselhorn, 2012), nevertheless, Ferguson (1996) is of the view that, the accompanying public costs accumulated to public infrastructure extension and environmental pollution are expensive. Environmental pollution in informal settlements is attributed to the lack of basic services and the unplanned nature of these settlements which results in negative behaviours towards the environment (Mensah et.al., 2013), including indiscriminate disposal of both solid and liquid waste and unsafe excreta management, consequently serving as threats to the quality of environmental resources including lands, water sources and the atmosphere (Msimang, 2017).

Ghana's policies for managing these settlements are inconsistent. During the Colonial era, the colonial government instituted developments on housing schemes which was targeted at enhancing health and sanitary conditions in low-income settlements. This scheme was

spearheaded in New Zongo, Kumasi after the emergence of a Cholera outbreak in the 1920's. It was later expanded to Accra after an earthquake in 1939 and subsequently, to other parts of the country including Takoradi and Cape Coast.

In response to the improvement of these low-income settlements the State Housing Corporation and the Tema Development Corporation were established after independence to build low-cost houses in urban areas. However, due to political instability and economic pressures, this initiative did not reach its peak.

Regardless of the failure of the Tema Development Corporation and State Housing Corporation, governments of the 1980's era, adopted sites and services upgrading schemes with support from the World Bank in 1985. Schemes such as the Accra District Rehabilitation project benefited 19000 people in Mamoobi East. Developments included improvement in road and footpath networks, drainage, water, and sanitation.

All these upgrading approaches were hardware approaches involving the provision of only infrastructure which usually fails (Oppong, 2016). It is thus, necessary to consider software approaches in the like of behaviour change interventions in order to achieve sustainability of projects implemented.

Recently, behaviour change interventions used in Accra by the United Nations Development Program yielded encouraging results. Using effective targeted communication mainly on the need to register for waste services improved collection from 2% to 60% (Annie, 2020). As studies in Ghana have focused mainly on the prominent informal settlements which includes Old Fadama, Glefe and Agboloshie in Accra Metropolitan, Oforikrom in Kumasi Metropolitan, The Adentan Municipality, which is majorly planned, faces threats of growth of informal settlements on its peripheries and inlands. Having 13.9% of its households living in improvised settlements (Ghana Statistical Services, 2014), rightly classified as informal settlements due to their characteristics. These characteristics include wood as a major construction material for

structures that is not of building regulations and standards, lack of security of tenure, lack of sanitary facilities and lack of proper waste management services. Indiscriminate waste disposal, a common method of waste disposal in informal settlements is a major cause of pollution which consequently affect the environment and health of residents. These characteristics borne by the informal settlements have implications for achieving the SDG Goal 3; Good health and well-being, target 3.3 which seeks to end epidemics by 2030. Malaria, a common disease in the informal settlements since waste management practices in these settlements serve as breeding grounds for mosquitoes and other rodents. as these settlements lack access to basic sanitation services and waste disposal services. Also, the lack of basic services serves as a hinderance in achieving the SDG goal 6; target 6.1, 6.2, 6.3; that reflect the universal and equitable access to safe and affordable water for all, adequate and equitable sanitation and reducing pollution by eliminating dumping and halving the proportion of untreated water. Also, to ensure sustainable cities and communities, the SDG 11 provides a watershed for this opportunity however, the existence of informal settlements serves as a barrier to this particular global target.

Several studies have been done on informal settlements in Ghana , Malawi (Doe et al., 2020) ,South Africa (Gangoo, 2003), Kenya ,and Nigeria (Wokekoro et al., 2014) however, there is scant literature on the effect of pollution from informal settlements in the Adentan Municipality. Over the years, the population of informal settlers within the municipality has grown exponentially and demolition attempts to curb the menace have failed. With the presence of characteristics mentioned above especially indiscriminate waste disposal as a main method for waste management, exploring strategies that can help improve living conditions in these settlements and protect the environment is significant. There is a dearth of information on software approaches such as behavioural strategies to reduce pollution behaviour in informal settlements (Mosler H.-J. , 2012), here in Ghana. It is against this backdrop that the aim of this

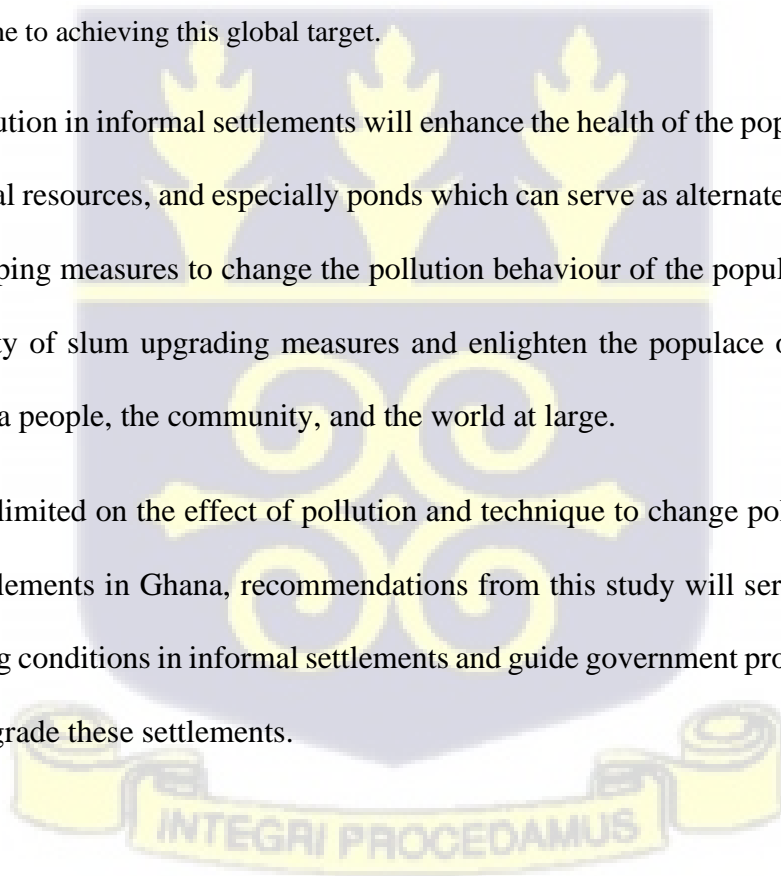
study is set. The study sought to identify the sources of pollution in informal settlements in the Adentan Municipality and determine a behaviour change technique to reduce pollution in terms of indiscriminate waste disposal behaviour in these settlements.

1.3 Justification

The rapid proliferation of informal settlements has been widely discussed in the literature as a significant concern in many countries (Danso-Wiredu & Midheme, 2017). Many studies have been done on informal settlements concerning their effects on the environment and other governance dimensions. The Adentan Municipality, although a planned area, faces challenges with the creation of new informal settlements that lack access to basic services such as waste disposal and toilet facilities. The informal dwellers engage in indiscriminate disposal and open defecation, which pollutes the environment. Thus, in the quest to achieve SDG Goal 11, Target 11.1 by 2030 in the municipality, this study is necessary as a stepping stone to achieving this global target.

Preventing pollution in informal settlements will enhance the health of the populace, protection of environmental resources, and especially ponds which can serve as alternate sources of water for use. Developing measures to change the pollution behaviour of the populace will enhance the sustainability of slum upgrading measures and enlighten the populace on how pollution affects them as a people, the community, and the world at large.

As literature is limited on the effect of pollution and technique to change pollution behaviour in informal settlements in Ghana, recommendations from this study will serve as a guide for improving living conditions in informal settlements and guide government projects on software measures to upgrade these settlements.



1.4 Research Questions

- What are the characteristics of informal settlements in the Municipality?
- What are the sources of pollution from informal settlements?
- How does indiscriminate disposal of waste affect the health of dwellers and the environs of informal settlements?
- Which behaviour change technique can change the pollution behaviour of the populace?

1.5 Objectives

The overall objective of the study is to identify behaviour change techniques to reduce pollution, in terms of indiscriminate waste disposal behaviour in informal settlements in the Adentan Municipality, Accra.

The specific objectives of the study include;

- Map out and characterise the attributes of the informal settlements in Adentan Municipality
- Identify the sources of pollution from informal settlements
- Evaluate the influence of indiscriminate waste disposal on the health of informal dwellers and the environment.
- Identify techniques to change indiscriminate waste disposal behaviour of informal dwellers

1.6 Study Proposition

Risks, attitudes, norms, ability, and self-regulatory factors influence indiscriminate waste disposal of the people.

1.7 Definition of terms

1.7.1 Informal Settlements

According to the United Nations Habitat (2015), informal settlements are residential areas where inhabitants lack security of tenure with regard to the land or dwellings they inhabit. The presence of general patterns or characteristics ranging from squatting to informal rental housing, lack of basic services and city infrastructure, and the housing may not comply with current planning and building regulations and is usually often situated in geographically and environmentally hazardous areas (UN-Habitat, 2016; Brown, 2015). In Ghana, three types of informal settlements have been identified in the literature. The first definition includes categories of old settlements, usually with family-owned houses which are unplanned and do not have development permits. These settlements predate the adoption of the first town and planning Ordinance (Cap 84) of 1945.

Secondly, the settlements where migrants officially buy lands from the owners and settle but lack development permission. The third type, known as squatter settlements, also includes settlements that evolve on the peripheries and unoccupied inlands of cities; this category usually does not have legal title to the land nor express permission from landowners, thus lack of developmental approval (Paller, 2015).

A critical view of all definitions includes the bit on land tenure. Thus, for the purpose of this study, the UN-Habitat, Brown, and the definition for the third type of informal settlements will be used in this study. Therefore, informal settlements are residential areas that develop on the peripheries and unoccupied inlands that lack security of tenure, with characteristics ranging from squatting to informal rental housing, lack of basic services and city infrastructure, and the housing may not comply with current planning and building regulations, and usually often situated in geographically and environmentally hazardous areas.

1.7.2 Lack of Basic Services

Basic services refer to access to toilet facilities, waste storage, and disposal facilities, electricity, and water (SERI, 2019). Also, basic services are defined as public service provision systems that meet basic human needs, including drinking water, sanitation, hygiene, energy, mobility, waste collection, health care, education, and information technologies. In achieving the objectives of the study, basic services will concentrate on sanitary facilities, water, and especially waste storage and disposal facilities. Thus, for this study, Lack of basic services is implied as the unavailability of enough and affordable services with regards to sanitation, water, and waste removal or collection.

1.7.3 Environmental Pollution

According to Landrigan et al., (2017) human activity that results in the degradation or depreciation of the quality of the natural environment is regarded as pollution. However, for the purpose of this study, pollution will be viewed in terms of land pollution, and this is defined as the contamination of the soil from indiscriminate disposal of domestic waste sources.

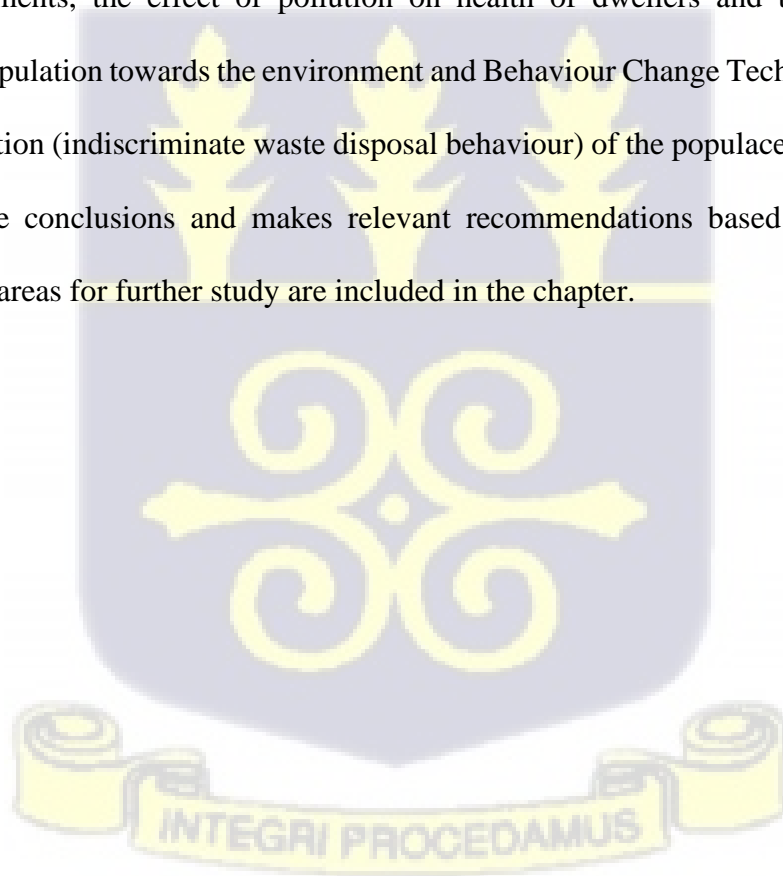
1.7.4 Behaviour Change Techniques

Behaviour Change Techniques are the component of an intervention strategy designed to change the processes that regulate behaviour. (Contzen & Mosler, 2012)



1.8 Organization of Thesis

The thesis comprised six chapters. Chapter one is basically made up of the introductory chapter which involves sections such as the background, problem statement, research questions, justification of the study, and the definition of concepts. Chapter two entails, the literature review, and the conceptual framework on informal settlements and behaviour change strategies. Chapter three is made up of the profile of the study area, sampling methods, tools for data collection and the data analysis method for the study. Chapter four presents the results from field research on the characteristics of informal settlements, sources of pollution, influence of indiscriminate waste disposal and behaviour change techniques identified. Chapter five provides the discussions of the results based on the objectives of the study. It discusses the characteristics of informal settlements in the Adentan Municipality the sources of pollution in informal settlements, the effect of pollution on health of dwellers and the environment, behaviour of population towards the environment and Behaviour Change Techniques identified to change pollution (indiscriminate waste disposal behaviour) of the populace. Finally, chapter six presents the conclusions and makes relevant recommendations based on the research findings. Also, areas for further study are included in the chapter.



CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Introduction

For the purpose of answering the research questions and achieving the objectives proposed by this study, there is the need to engage literature review to understand the topics suggested and perspectives proposed by other authors. This chapter reviews study on empirical studies done on issues related to informal settlements and behaviour change techniques.

2.1.1 Description of Informal Settlements

Informal settlements are residential areas that house millions of poor people in urban centres. This phenomenon exists globally as these settlements come in various forms, typologies, and dimensions and by a range of names, such as squatter settlements, slums, favelas, barrios, bajos and bidonvilles (Gilbert, 2007).

An ineffective planning system, the control of land development by the private sector or a single-party government, the establishment of grand and costly housing, and segregation controls that purposively excludes the poor propagates the existence of informal settlements (Pienaar, 2002). These settlements are mostly improvised homes for squatters who have no legal rights on the lands they reside on. Informal settlements grow through both urban migration from rural areas and through the displacement of people due to gentrification (Jiusto, 2012), development, or conservation.

Informal settlements are generally characterized by concerns involving inadequate sanitary facilities, lack of access to clean water, poor structural quality of housing, overcrowding, lack of social investment and infrastructure, insecure tenure, and illegal subdivisions (Jiusto, 2012).

Globally, the environmental challenges of informal settlements can be broadly outlined as:

Rapid rural-urban migration by the poor is characterized by settling in geographically marginalized and vulnerable areas (Arcidiacono et al., 2017).

Sanitation systems that exist in informal settlements are likely to be shared and substandard. Some identified obstacles to the improvement of sanitation systems in informal settlements are largely the unsuitability of land, high settlement densities, poor status of housing, and lack of proximity to existing sewage networks (Mels et al., 2009). For instance, In the Kambi Moto informal settlement in Nairobi, the river that runs directly through the settlement is so polluted that the water cannot be used for any other purpose since the use of the river is mainly as a sewage system.

A major concern in informal settlements includes domestic waste disposal and the lack of waste management services – domestic waste is dumped indiscriminately in drainage and along the roadsides of informal settlements. This is attributed to the absence of formalised waste management systems and infrastructure. The absence of well-planned drainage systems and poor conditions of drains that exist has implications such as erosion, run-off, and flooding in these settlements (Nixon, 2020).

2.1.2 Emergence of Informal Settlements

Precarious housing units have been in existence for as long as cities have existed. Nevertheless, it was only in contemporary times that informal settlements became a feature of urban structure. One of the major factors which influenced the mushrooming of informal settlements in the past was rapid urbanization as a result of the rise of industrialization in the mid-nineteenth century. Informal settlements were more prominent in Britain, France, America, and India and were named "slums" in that era (Davis, 2006). After a century, industrialization occurred in developing countries, which enhanced the shift in terms of the location of informal settlements from developed nations to developing nations. This was a result of the rapid increase of

migrants from the rural areas to cities in quest for jobs. Also, World War II, at some point in history, facilitated the widespread of informal settlements in Latin America and Asia. History also records that the formation of informal settlements can be ascribed to policies intended to divide the urban environment. An illustration of this is evident in the apartheid era, where the colonial government separated the white communities from the black communities, which engendered deficiencies in infrastructure and service deliveries in the black communities (Kironde, 2007; Smiley, 2009). Also, the inefficiencies of policy implementation also facilitate the suffusion of informal settlements in cities, as acquiring permits for land development is costly and cumbersome (Owusu-Ansah & Braimah, 2013).

Other causes of this phenomenon in the late 1970s were attributed to neoliberalism, and the neglect of these settlements by city authorities aided its flourishing. In contemporary times, still rapid population growth, rural-urban migration, and failure of urban governance are viewed as the key contributors to the increase of informal settlements. In the past, migrants had the opportunity to improve living conditions since they earned better incomes. However, this trend is no longer the case. Since the late 1980s, overurbanization rather increased poverty, inequality, and informal settlements. The impoverishment and living conditions in these settlements consequently have seen various approaches, including ignoring and demolition, and other approaches, such as securing land tenure and upgrading through the provision of standard housing infrastructure and basic public services (Jimenez-Huerta, 2019). The notion of upgrading, which started in the 1970s, was due to John Turner's strong advocate for 'slum' upgrading, which was mainly to improve the environment, especially in terms of sanitary, waste disposal, and water infrastructure. He further argued that if these things were provided, living conditions would be better in 'slums' as slum dwellers had organizational skills for land management. However, in the late 1980s, Werlin (1999) combated that these strategies were ephemeral as slum upgrading efforts appeared to be a myth.

In contemporary times, urbanization is still seen as the major factor in the enlargement and development of informal settlements. It is due to the cost and lack of housing stock to meet the needs of migrants that lead to the mushrooming of these settlements (Gaisie, Poku-Boansi, & Adarkwa, 2018).

2.1.3 Informal Settlements in the Global Context

Globally housing deficit is a challenge experienced in several countries in the world, including Peru, Brazil, and Nigeria (Libertun de Duren & Osorio, 2020; Ajayi, 2019; Brazil Capstone Team, 2016; World Bank, 2016). This challenge has birthed informal settlements, a problem that serves as a solution to the problem of housing challenges (Nassar & Elsayed, 2018; Jones, 2017). The proliferation of informal settlements globally has increased studies in this area which this section reveals with regards to studies from Asia, Latin America, and Africa.

In recent times, several studies on informal settlements have considered upgrading programs since the goal of pursuing sustainable growing cities, SDG 11; Target 11.1 is a major concern for the city and national authorities. An illustration of this in Asia was done in Bandung, Indonesia, where the study examined the challenges in relation to informal settlements and slums and understood their position in the policy context of urban plans and strategies using a case study approach. The study revealed that the approach the city authorities used, including restructuring and reshaping the lifestyle of informal settlers to fit into the formal context, was problematic and inappropriate for these communities. A call for greater leadership, political commitment, and recognition of contextual responses should be considered when embarking on slum upgrading policies in the urban context, which are labeled as sustainable, were recommendations of this study (Jones, 2017).

Similarly, a study in Alexandria, Egypt, examined the challenges in informal settlements to generate sustainable solutions based on the three pillars of sustainability. This study used the

case study approach, labeled as 'Hound 10', an approach that gives enlightenment as to how living conditions and socio-economic potentials can be improved in informal settlements. The study found that considering sustainability improves living conditions, and it is, therefore, important to consider the local needs of the people; that is, issues of social participation, local's empowerment, and voluntary organization work are essential to ensure sustainability in projects on informal settlements upgrading (Nassar & Elsayed, 2018).

However, due to the negative effect informal settlements has on the environment, government authorities are of the view that, for urban development, these settlements are of no good and must be demolished (Gupte et al., 2019; Danso-Wiredu & Midheme, 2017), against this backdrop are studies as evidence to this assertion.

China's approach has been to demolish existing structures and encourage private developers to build high-rise apartment blocks, and in the process, rental tenants are displaced, whereas property owners are enriched through market-rate compensation (Wang, Wang, & Wu, 2009; Wu, Zhang, & Webster, 2013). Also, in India, Ramanathan, 2005 has shown that big projects such as roads and railways require the relocation of slum dwellers to kick start such projects.

This relocation is usually achieved through forced eviction.

Demolition does not eradicate the problem of informal settlements since the causes of informal settlements still exist. The global up rise of informal settlements has mainly been attributed to rapid urbanization. The need to settle informally is attributed to the unavailability of affordable housing in urban areas and the lack of employment and educational opportunities in rural areas. The majority of people decide to live in informal settlements in urban areas in search of better living conditions such as employment, health, and educational facilities. They, therefore, have no option but to develop these settlements due to the lack of housing and the very high cost of housing that is available (Patel,2013).

2.1.4 Informal Settlements in the Local Context

Urban planning differs in context pertaining to countries; therefore, an informal settlement can only be regarded as informal with regards to legislations that are enforced in each context. In Ghana, the Local Governance Act, (Act 936) of 2016, the Land Use and Spatial Planning Act, (Act 925) of 2016, and the National Building Regulations (LI 1630) of 1996 regulate physical developments. Basically, these laws only recognize approved development projects by district planning authorities usually with keen interest in the legitimate title of the land (Gaisie, Poku-Boansi, & Adarkwa, 2018). Against this backdrop, informal settlements are housing infrastructures that lack legal approval and adherence to existing planning and building regulations (UN-Habitat 2003; Durand-Lasserve, 2006). Ghana as a country faces challenges with the existence of informal settlements, expansion, and creation of new ones. The country has about 58% of its urban dwellers living in informal settlements. Studies have shown demolition of informal settlements have failed the country and this has led to the problems of ‘reslumming’ and the creation of new slums. Evidently, the June 3rd Fire and Flood disaster which occurred at The Kwame Nkrumah Circle in Accra, displaced slum residents close to the area, and this resulted in the creation of new slums along the Tema Motorway (Good Governance Africa, 2018). The popularity of informal settlements in the global community resulted in studies that view informal settlements as a solution to urban housing problems and characteristics that can ensure sustainability of these settlements. A study done in the Abese quarter, an indigenous informal settlement in the La-Dadekotopon municipal which aimed at understanding human behaviour and social interactions.

The study revealed that, spatial dynamics of social interactions and human behaviour in informal settlements should not be viewed in a single perspective but should involve a wholistic approach which integrates both features during planning and designing developmental projects

in urban informal settlements. This will enable the introduction of appropriate interventions specifically tailored with respect to the identity of the people that will have the value of sustainability (Okyere, Diko, Hiraoka, & Kita, 2017).

Similarly, a study in Ayigya Zongo, Oforikrom which had the objective of re-examining slum upgrading interventions found nuances with regards to sustainability of slum upgrading interventions and recommended that slum upgrading interventions must involve the beneficiary households and must meet the priorities of the households (Doe, Pephrah, & Chidziwisano, 2020).

All these studies evidently reveal that, slum upgrading strategies and interventions is not new to Ghana as the country has been involved in such programs since 1982.

2.1.5 Mapping Informal Settlements

Informal settlements contribute to the development in cities; thus, their presence cannot be overlooked. Although the population in these settlements cannot be considered as insignificant, these settlements are usually marginalized spatially and invisible on official maps (Patel & Baptist, 2012; Robinson, 2002). Identifying and mapping these settlements is embedded in several of the United Nations Sustainable Development Goals. This is because the most vulnerable people socially and economically find home in these settlements thus, understanding the existence of these settlements is of paramount importance to governments (Helber, et al., 2019). The visibility of these settlements may either attract upgrading programs or ad hoc approaches which may cause destruction to slums.

In Contrast, these settlements often serve as embarrassment to governments as they signify poverty and lack of law and order, hence governments that can enforce eviction are applauded. Studies have shown that governments consciously erase the visibility of these settlements

during major tourist and political events. This is evident during APEC, 2003 in Bangkok where a welcome banner for international guests was used as a covering of these settlements to ensure invisibility, Also, in Delhi Bamboo sticks served as a covering at key access points to these settlements during the Commonwealth 2010 games, However, an informal settlement lining the airport freeway in Cape Town was demolished prior to the FIFA World Cup, 2010 (Mayne, 2017).

Also, the lack of accurate and complete data on informal settlements makes the mapping of this venture significant. Methods that have been used to bridge this gap have been classified into five including, community mapping, single case selection, national indexes, remote sensing, and urban morphologies. Each one of these methods has its virtues and challenges (Samper, Shelby, & Behary, 2020).

Community mapping is born out of the vacuum of information and the need for communities to create data to make the needs of their neighbourhoods visible. Since state agencies ignore the presence of informal settlements' living conditions, among the most effective systems to gather reliable data is self-mapping by communities (Archer, Luansang, & Boonmahathanakorn, 2012; Patel, Crooks, & Koizumi, 2012; Hasan, 2006). This self-mapping ensures accurate data on living conditions. Along with the mapping data, the isolation of communities also contributes to the accessibility of the information for groups or individuals not related to these mapping exercises.

Single case selection; these are the mappings by scholars, NGOs, and municipalities that concentrates on the neighbourhoods as a case (Kamalipour, 2016; Samper J. J., 2014 ; Hagen,2011). The output here, is more detailed, as new aerial photography and remote sensing data make the creation of highly detailed maps of neighbourhoods.

National indexes, mappings draw on the capacity of nations to collect demographic data based on variables of census tracts that is subsequently, compared at a global scale. The data collected at this scale are for international agencies such as the World Bank, United Nations/UN-Habitat, and the International Development Bank. However, the broad nature of national indexes is characterized by low-resolution data at the urban scale. Regardless, most of the scholarly understanding of the informal world at a global scale comes out of this type of data (Davis, 2006; Roy & AlSayyad, 2002). Remote sensing (RS) technologies bridge the gap between comparability and the level of detail necessary to create global analyses (Taubenböck & Kraff, 2014; Hofmann, 2001). The use of high-resolution satellite data permits researchers to visit multiple sites and apply variables to analyse the qualities of urban form (Angeles, et al., 2009; Stow et. al, 2007). The use of algorithms applied to this data, such as object-oriented, radial casting, and contour model (snakes), permits extraction and recognition of unique features of the landscape (Hofmann, 2001; Niebergall, Loew, & Mauser, 2018) These mapping projects use these algorithms alongside remote sensing imagery to collect, identify, and map informal settlements. GIS literature in remote sensing focuses on how to train algorithms to determine the location of informal settlements (Kuffer, Pfeffer, & Sliuzas., 2016; Huang, Lu, & Sellers, 2007) .

The RS method aids in identifying any unknown settlements, particularly when there is not enough information about the locations of these settlements. Today, there is an emergence of RS-based studies focused on exploring the morphological features of informal settlements to identify informal settlements. A lot of development has occurred in the automatic classification of locations from optical resources (Kuffer, Pfeffer, & Sliuzas, 2016). Other methods such as use of radar have also shown promise and success (Wurm, Taubenböck, Weigand, & Schmitt, 2017). Also, RS automated methods are employed to identify environmental risk in traditional unmapped areas such as in archaeology (Kennett & Kennett, 2009).Spatial-contextual

information can also be incorporated through Object Based Image Analysis (OBIA), which is also currently the most common strategy for the classification of informal settlement areas (Kuffer, Pfeffer, & Sliuzas, 2016; Fallatah, Jones, Mitchell, & Kohli, 2019). The use of Very High Resolution (VHR) with the help of the Level Co-occurrence Matrix (GLCM) has permitted the extraction of informal settlement, areas (Kuffer, Pfeffer, Sliuzas, & Baud, 2016).

Also, a study done in Ajmer, India which mapped informal settlements reported that, secondary data was used in identifying the informal settlements. Also, transect walks through informal settlements, focus group discussions, informal interviews, resource, and social mapping enabled the success of mapping out the 116 informal settlements (PRIA, n.d).

2.1.6 Characteristics of Informal Settlements

2.1.6.1 Housing Conditions

A critical view of housing conditions in informal settlements is very important in addressing vulnerability and exposure to extreme weather events, which serve as health risks to informal settlement dwellers. Informal settlements vary under different geographical locations, under different cultural, social, economic, and historical settings which influences its composition, typology, construction materials used and residents (Jean-Baptiste, Olivotto, Porio, Kombe, & Yulo-Loyzaga, 2018). A study done in Kisumu, the third biggest city in Kenya which has one of the largest informal settlements found that, numerous housing units were single rooms which constituted 77% of the total number of housing units. Roofs for these housing units were mainly iron roofing sheets, with a greater percentage having plastered walls (57%) and cemented floors (71%). Over half (57%) of the housing units did not have an electricity connection; and the average monthly rent was KES 1211 (Simiyu, Cairncross, & Swilling., 2019).

Another variation of housing conditions in informal settlements evident in Ajmer Municipal Council in India reported that, the type of structures in informal settlements were made of 63%

pucca which 16% semi-pucca and 22 % are kutcha. Over the years, there has been improvement in these informal settlements and people have constructed pucca houses (PRIA, n.d).

In Ghana, informal settlements are usually built with various materials including bamboo, mud and metal sheets, A study in Ayigya Zongo and Dakodwom revealed that, 90% of the walls of households surveyed in Dakodwom was made up of lancrete, mud, bamboo and 80% of the walls of Ayigya Zongo were majorly sand/cement blocks and partly made of other materials such as wood, aluminium /zinc sheets and bamboo. (Amoako & Boamah, 2017). A view at these informal settlements portrays a sense of permanency as a critical view of all three instances stated in this review shows majority of the settlements are built with permanent materials such as blocks, cement, and concrete. However, temporary materials including wood and metals sheets are also featured in these settlements.

2.1.6.2 Waste Storage and Disposal

Waste left to accumulate in ubiquitous and illegal dumps when generated is a common practice in most informal settlements. Waste is one of the many causes of environmental pollution in informal settlements due to the lack of waste collection services. Indiscriminate disposal of waste causes health hazards and environmental pollution which reduces the quality of the environment. A study in one of Kampala's informal settlements in Uganda revealed that informal settlements lack appropriate waste infrastructure because of environmental conditions such as flooding and social conditions which includes lack of land tenure security and high population densities. The study further described the methods of waste disposal in this settlement as burning and 'private dumping', a term used as a code term for open dumping. (Sanitation and Water Infrastructure, 2019; Omollo, 2019).

A Similar, study which examined the health implications of household and human waste disposal systems in Port Harcourt found open dumping of waste into creeks, roads, and drains as waste disposal methods (Wokekoro & Inyang, 2014).

Also, Simiyu, Cairncross, & Swilling, 2019 are of the view that informal settlements lack solid waste infrastructural services and recommend developmental approaches to provide these services. Using a transdisciplinary approach, a study done in Kisumu was of the view that due to the deplorable living conditions in informal settlements, access to waste collection services were poor. Thus, waste generated was heaped by the roadsides and in empty lots which affected the informal settlements and the city in general (Gutberlet, et al., 2016). Informal settlements have been identified as one of the major places with inadequate waste management services (AMA, 2006). A Study done in an informal urban settlement Sabon Zongo observed that rains served as an opportunity for dumping solid and liquid waste into gutters and open spaces (Owusu, 2010).

2.1.6.3 Sanitation

Access to safe sanitation in informal settlements is a heightened challenge as there is over 65% inadequate sanitation (UN-Habitat, 2014). Poor sanitation and unhygienic household practices are major causes of water contamination in the supply chain which contributes to 88% of the world's diarrhoea deaths (WHO/UNICEF, 2009).

Many residents of informal settlements rely on shared infrastructure including blocks of toilets, pit latrine and standpipe and these conditions may not be exclusive to all informal settlements but comes with its own repercussions (Corburn & Karanja, 2016). Some repercussions identified include stress and anxiety among women due to lack of security (Water and Sanitation for Urban Poor, 2018), and deleterious health outcomes compared to individual

household latrines (Heijnen, et al., 2014). Open defecation is common method for human waste disposal in informal settlements, however, where toilet facilities exist, there is usually no containment facility where excreta is separated from human contact.

A study done in 12 low- and middle-income cities found that; 98% of the households used toilet facilities, but only 29% of the faecal waste was safely managed (Peal, Evans, Blackett, Hawkins & Heymans, 2015). The study recorded that, pit-latrines are the most common form of sanitation in informal settlements. The prevalence of pit latrines was attributed to the limitation of space and the presence of other unfavourable factors in informal settlements. Therefore, emptying pit laterines safely and hygienically is not realised. However, the replacement of pit laterines is also far fetched. This therefore results in the unsafe management of effluent and pit-latrines which may cause pollution in the environment and enhance contamination spreading within settlements and to other far communities (Sinharoy, Pittluck, & Clasen, 2019).

Corburn et.al.'s (2017) research in an informal settlement in Mukuru, Nairobi, with a population of three hundred thousand (300,000) people, uncovered that, only 3.6% of households have access to adequate toilets.

The characteristic of inadequate toilet facilities in informal settlements gives the impression that, the presence of enough toilet facilities in these settlements will halt open defecation. However, the presence of more toilet facilities is not single-threaded to end open defecation. Evidently, a research in Mumbai, India, revealed that although toilet facilities were present in the squatter settlements in Mumbai 77% to 99% of the facilities were inadequate for use and open defecation still prevailed. The researcher suggests an integrated governance framework, coupled with capacity building to ensure open defecation is eradicated (Biswas, Arya, & Deshpande, 2020).

In contrast, other studies are of the view that, public toilets contribute to a reduction in open defecation since many people in informal settlements depend on public toilets for excreta disposal (Peprah, et al., 2015; Günther, et al., 2011).

2.1.6.4 Water Supply

Inadequate water supply is one of the key obstacles in informal settlements that hinders achievement of the Global Sustainable development Goal 6; that seeks to ensure availability and sustainable management of water and sanitation for all. Since informal settlements lack access to basic services including water supply, realizing the Goal 6; will be essential for the inclusion promise of target 6.2: achieve access to adequate and equitable sanitation and hygiene for all, thus various researchers have revealed different methods of bridging the gap to water supply in quest to achieve this global ambition.

Water supply in informal settlements is a gap left by government authorities which settlers themselves find ways to fill. A confirmation of this assertion is a study in the informal settlements in Alexandria which aimed at solving the deteriorated physical and non-physical conditions of slum areas found that, more than 20% of dwellers could not access water utilities. They bridged the gap of obtaining fresh water by fetching water with plastic containers for storage from open water channels and a public tap. The study recommends an installation of water purification systems to prevent water-borne diseases (Nassar & Elsayed, 2018).

Also, in São Paulo, 30% of the people in informal settlements lack access to water supply (Marques & Saraiva, 2017). A study which aimed at overcoming the legal barrier to services extension in informal settlements suggests that understanding informal institutions is very significant and can be used to the advantage of informal communities in the provision of services including water supply (Hylton & Charles, 2018).

Also, a study in Mukuru found that, only 29% of the total 300,000 population of the settlements had access to adequate water supply (Corburn et.al. 2017).

Similarly, a study by Friesen, Rausch, & Pelz, (2017) in support of providing access to water to informal settlements uses a multidisciplinary approach to design water supply networks in informal settlements.

Informal settlements as places tagged by lack of services such as adequate water supply is of keen interest to organisations.

A study with the objective to revitalising experiments a water- sensitive-cities, an approach to upgrade informal settlements in the environmental sustainability and social inclusiveness perspective by considering water cycle management has devised an approach which is being tested in twelve (12) informal settlements in both Indonesia and Fiji (Brown, et al., 2018).

In terms of water supply, informal settlements have experienced some improvements to that effect. A study in Kumasi affirms this assertion. The study discovered that, informal settlements have access to pipe-borne water and that the duration for water collection is not farfetched. The study showed that, 29.3% of responding households had facilities on their compounds. The remaining majority (70.7%) reported that they cover up to 750 m or walk for up to 10 min – averaging 225 m in distance or about 3 min in duration – to fetch water for domestic use. The study uncovers that the distance of settlements from good drinking water sources is not far. The relatively easy physical access to water sources minimizes the amount of time spent in search of water, thereby making it possible for children and women to spend adequate time on more productive activities (Gaisie, Poku-Boansi, & Adarkwa, 2018).

2.1.7 Informal Settlements and Pollution

Numerous studies are of the view that informal settlements pose threats to the environment in the form of water, air, and land pollution. (Abia, Ubomba-Jaswa, Schimdt, & Dippenaar, 2018; Msimang 2017; Gangoo, 2003) This view of informal settlements is usually attributed to the lack of basic services (Msimang;2017), including clean water, adequate sanitation, and safe disposal of municipal waste and greywater hence dwellers fall on other means such as open defecation, indiscriminate disposal and burning of solid waste in order manage their sanitary needs and waste disposal needs. A study Douala, Cameroun, revealed that high concentrations of organic faecal coliform and faecal streptococcus attributed to inadequate sanitation, beyond WHO acceptable limits were present in the samples taken from springs and bore holes, and recommended that groundwater needed to be chlorinated or boiled before used for drinking and other domestic purposes (Takem, Chandrasekharam, Ayonghe, & Thambidurai, 2009).

Other sources of pollution from informal settlements are attributed to unclean energy for cooking. Egondi,et.al.,(2016) reveals that, a study in two urban informal settlements in Nairobi have high particulate matter concentrations in the air, which was attributed to unclean cooking fuels, unsafe waste disposal and burning.

A study in Old Fadama, an informal settlement in Accra and its neighbouring town Agbogbloshie in Ghana, found that both areas experienced substantial land, water, and air pollution, poses risks not only to the immediate vicinity but to large parts of the rest of Accra as well. The main causes of pollution in these settlements are attributed to severe traffic congestion, widespread open sewers and untreated landfill, unregulated light industries, oil dumping by countless garages and workshops, and the burning of electronic waste, plastic, and rubber outer coatings of electric cables as Agbogbloshie has attracted global attention as an expansive toxic electronic waste dump (Stacey, 2018). These causes of pollution are caused by unsafe waste management practices.

2.1.8 Informal Settlements and Public Health

In Sub-Saharan Africa, dwellers in informal settlements are prone to various health risks daily attributed to the lack of clean water, adequate sanitation and overcrowding (Zerbo et al., 2020). As a result, communicable and non-communicable diseases such as diarrhoea, malaria, cholera and the novel COVID-19 are prevalent (Van Belle et al., 2020). Specifically, inadequate sanitation and the lack of potable water create conducive environments, for vector-borne diseases and water-borne diseases such as diarrhoea and worm infections. Also, the indiscriminate disposal of waste and the proximity of these settlements to open dumps serve as a risk to dengue fever, due to piles of waste serving as a favourable environment for breeding *Aedes Mosquitoes*.

Tuberculosis and outbreak of Ebola are also risks associated with overcrowding in these settlements (Zerbo et al., 2020). Also, Mental health is a health risk among informal settlers usually unsung. A study revealed that children in informal settlements face lots of behavioural and emotional problems (Ezeh, et al., 2017). Also, the stressful living conditions including poor housing facilities, poor environmental conditions such as inadequate sanitation and indiscriminate waste disposal and socio-economic factors including inadequate income, insecurity, and the constant threat of eviction in informal settlements has the tendency to cause psychosocial disorders among informal settlers as revealed by Satterthwaite, (1993). Also, the geographical location of informal settlements poses both housing and dwellers at risk since these housing structures and dwellers are not resilient to extreme weather conditions. The effects of these weather conditions which mount up to disasters usually results in injury, accidents, mental trauma, and sometimes death among dwellers.

Amankwaa (2013) showed further evidence on health risks in informal settlements. Most residents of Agbogbloshie an informal settlement in Ghana, engage in hazardous recycling of e-waste. the study revealed that respondents attributed some health effects experienced to

current practices in their environment. 30% of the respondents made a causal reference to breeding sites of mosquitoes and the prevalence of malaria in their environment. 40% of the respondents attributed health effects to accidents from the e-waste recycling process which included burns, cuts and other body injuries. Also, health records from the Usher Polyclinic and Children's hospital revealed that Acute Respiratory Infections was also prevalent in the area. Thus, health risks outlined in informal settlements are majorly attributed to environmental challenges in such settlements.

2.2 Conceptual Framework

Different theories underly the emergence of informal settlements, and they have been studied from various perspectives such as using their social characteristics. Informal settlements are mostly faced with the challenge of lack of basic services including safe waste management systems which lead to unacceptable behaviour practices such as open defecation and indiscriminate waste disposal. These activities pose health risks to informal dwellers and pollute the environment. Several theories have been suggested to explain the process of behaviour change in public health (Bunton, Murphy, & Bennett, 1991).

2.2.1 Behaviour Change

Behaviour change is defined as a psychological phenomenon where individuals, households or communities begin to act in some manner on specific aspects, on their own and do not depend on help from outside. Behaviour change is a complex process that could be a result of several factors like changing awareness, consciousness, knowledge, attitudes and practice, norms, and beliefs (Glanz & Bishop, 2010). (Mosler H. , 2012) conceptualises the driving factors into five main blocks: risk, attitudinal, normative, ability and self-regulation factors. . Glanz and Bishop (2010) found that social cognitive theory, health belief model, theory of planned behaviour and trans-theoretical model/stages of change are the most consulted theories with regards to

behaviour change. The theory of planned behaviour, which serves as an expansion of the theory of reasoned action, asserts that behaviour changes come as a result of attitude, subjective norms, and perceived control (Montano & Kasprzyk, 2008). The trans-theoretical model also proposes that people are at different stages of readiness to adopt healthful behaviours and combine the processes and principles from across major theories in a sequence of six steps for a successful behaviour change: pre-contemplation (no recognition of need for or interest in change), contemplation (thinking about changing), preparation (planning for a change), action (adopting new habits), maintenance (the ongoing practice of new, healthier behaviour) and termination (Prochaska & Velicer, 1997).

Three kinds of considerations guide human behaviour: beliefs about the likely outcomes of the behaviour, the normative expectations of others and motivation. The aggregate of these three considerations produces a favourable or unfavourable attitude to change one's behaviour that may eventually create demand for improvement (Ajzen, 2002, ;Ajzen, 2006). The trans-theoretical model for behaviour change and the household demand model for sanitation improvements are both complex change processes that involve multiple actions and adaptation along the sequential stages over time (Jenkins & Scott, 2007; Glanz & Bishop 2010). This implies that creating demand for improved sanitation through a planned behavioural change decision process is likely to yield better results than imposing some practices on individual households. However, many factors can either motivate or demotivate the individual's decisions and the overall demand. These factors can be categorised as demand motivators and barriers, respectively, and are either permanent or temporary (Jenkins & Scott 2007).

Sanitation is a crucial aspect of human health and development, However, in order to improve sanitation, providing hardware resources such as toilet facilities do not guarantee improved sanitation. Understanding preferences in the local context is essential. In their which reviewed approaches to change behaviour, Okurata et al (2014) concluded that a multidisciplinary

approach which must include all relevant stakeholders should be used to that effect behavioural change.

2.2.2 Application of Behaviour Change Strategies

The urgency of Water Sanitation and Hygiene (WASH) problems and the spread of specific behaviours as solutions to these problems reveals that, specific behaviour change interventions should have been the core of all WASH studies however it is rare to find these. However, most WASH interventions target beliefs, attitudes, self-efficacy variables and raising awareness. These variables usually do not define the specific target behaviour which needs to be changed. Recent systematic studies have shown that, the psychological factor is very significant in WASH interventions. Mosler (2018) for instance has noted that, 62% of safe drinking water practices were explained by socio-psychological factors. However, Ginja, Gallagher, & Keenan, (2019) are of the view that, a three-term contingency framework, a theoretical perspective that considers antecedents and consequences of a behaviour, is proposed as a sustainable means of changing and maintaining positive WASH behaviours.

A study which aimed at describing a psychological approach in designing a handwashing program using data collected from study participants, theory, and empirical evidence from the literature used the RANAS systematic approach to behaviour change to conduct interviews among 669 primary school children in Burundi and 524 in Zimbabwe (Seimetz, Slekiene, Friedrich, & Mosler, 2017). The results of the study revealed that, in both countries, a programme targeting social norms and self-efficacy would be most effective. The study recommended that in Burundi, raising the children's perceived severity of the consequences of contracting diarrhoea, and in Zimbabwe, increasing the children's health knowledge should be part of the handwashing intervention programme both in rural and urban Zimbabwe and Burundi

Other approaches used for behaviour change interventions include Community Led Total Sanitation which dwells on the use of shame, shock, and disgust to end open defecation. change behaviour. However, studies have shown that, this method does not apply in abrupt poverty settings, and it is often a harmful emotion to trigger. Evidently, this method failed in Cambodia since the coercive elements of shame was rejected (Bateman & Engel, To shame or not to shame—that is the sanitation question, 2017) . This explains why contextual factors and participatory approaches are necessary when introducing any sanitation behaviour change intervention.

2.2.3 The RANAS Model of Behaviour Change

To reduce activities (behaviours) that pollute the environment, The RANAS Model of Behaviour Change (Fig. 2.1) has been adopted in this study to evaluate behaviours that pollute the environment design strategies to reduce them. The model helped to identify psychological factors that need to be targeted in order to induce change. The letters in the acronym (RANAS) stand for Risks, Attitudes, Norms, Abilities and Self-Regulation. This model is based on behaviour change theories that have been fused into a model (Mosler H.-J. , 2012). These behaviour change theories include the health belief model, the health action process approach, and the theory of planned behaviour. The model also provides behaviour change techniques that targets each factor that must be changed. For an alteration in an old behaviour, The RANAS model incorporates five blocks of psychological factors that must be favourable: risk factors, attitudinal factors, normative factors, ability factors, and self-regulation factors. Risk factors represent a person's understanding and awareness of a health risk and the perceived consequences of a disease (Mosler H.-J. , 2012). Attitudinal factors are beliefs about the costs and benefits of a particular behaviour. Normative factors are certainties about the behaviour

performance of the social environment and what the social environment thinks about a certain behaviour. Ability factors include an individual's perspectives on their personal ability to execute the behaviour. Finally, self-regulation factors are those that are responsible for the continuation and maintenance of the behaviour. All these behavioural factors in the RANAS model will lead to particular behaviour change techniques that will target behavioural factors that influence behavioural factors. These behaviour change techniques will result in behaviour change and reduce pollution behaviour. In this study indiscriminate waste disposal behaviour was targeted and appropriate behaviour change techniques proposed.

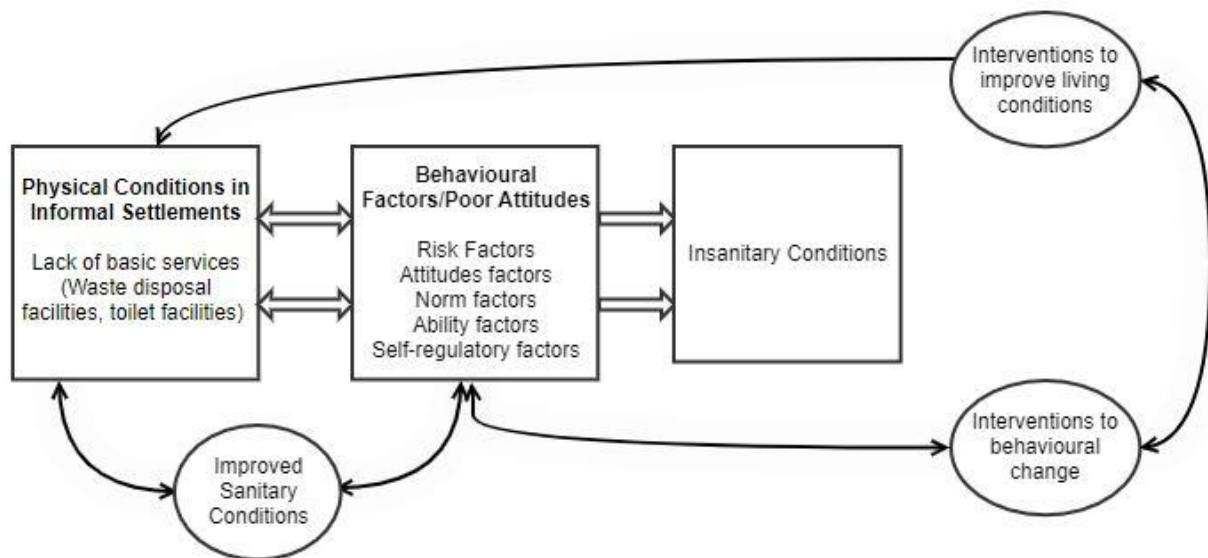
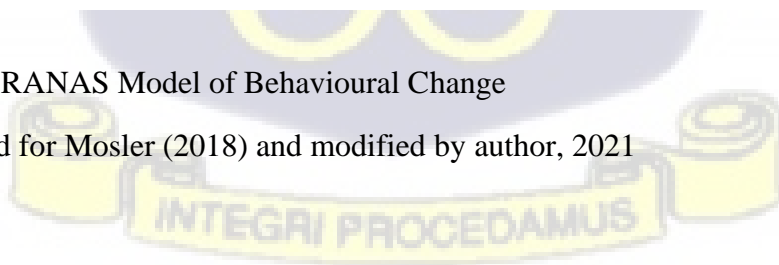


Figure 2.1: The RANAS Model of Behavioural Change

Source: Adopted for Mosler (2018) and modified by author, 2021



CHAPTER THREE

METHODOLOGY

This chapter unpacks the methodology used in the study. It describes the study area and discusses the research method used, which tools were used for data collection, how data was collected, the tools used for data analysis and how data was analysed. This section also reveals the limitations of this study.

3.1 Study Area

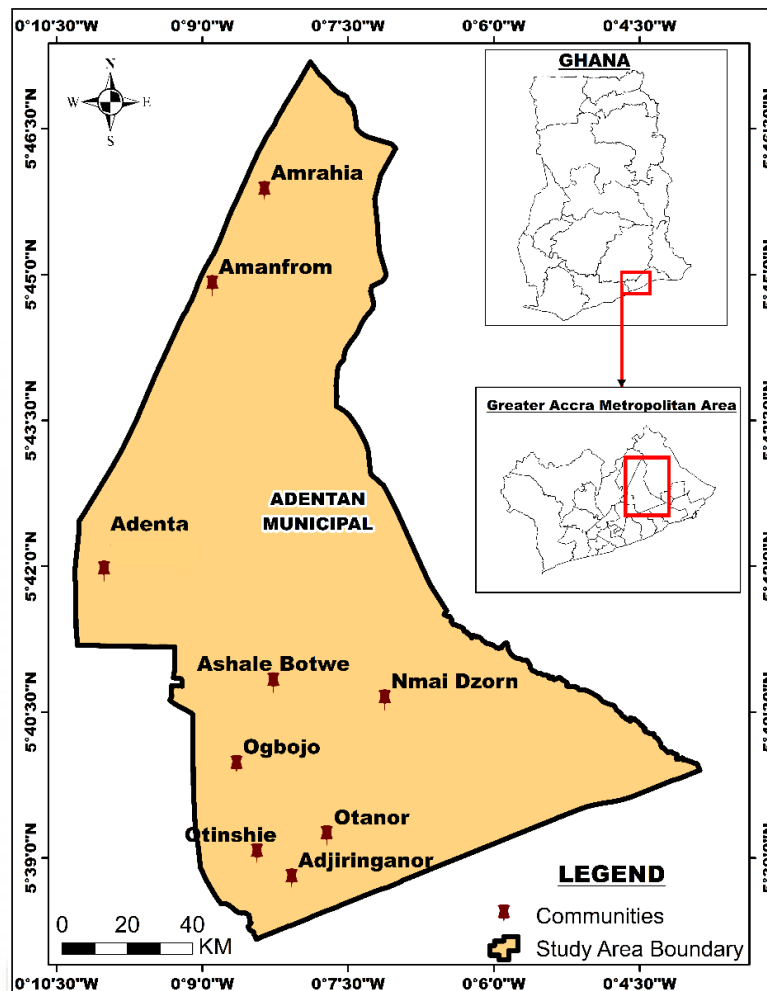


Figure 3.1: Map of Study Area

Source: Field data, 2021

The Adentan Municipality is the study area for this research. This Municipality was out of the Tema Metropolitan Assembly in February 2008 by LI 1888. The Adentan Municipal Assembly (with Adentan as its Central Business District) lies 10 kilometres to the Northeast of Accra, which is located explicitly on latitude 5' 43" north and longitude 0' 09" West. The Municipal has a land area of about 928.4 sq km. It shares boundaries with Ashaiman Municipal Assembly and Kpone Akatamanso District Assembly in the east and north, La Nkwantanang Municipal Assembly in the West and south in the north.

The Municipal has a population of about 78,215, with the age groups of 0-4, 25-29, 20-24 having the highest percentages of the population, respectively, indicating that the Adentan Municipality has a youthful population. Males dominate the sex construct of the Municipality. 39,336 forms (50.3%) of the total population are males, and the population of females is 38,849, representing 49.7% of the entire population.

A view of the Climatic conditions in the Municipality reveals that temperatures are generally high throughout the year. The area experiences two types of rainy seasons. The first and the major seasons start from April to July, while the second but minor season is from September to November. The bi-modal rainfall pattern provides a suitable environment for farming activities in most months (8 months) of the year, as residents can cultivate and harvest different types of crops within each season. The climatic condition and vegetative cover have contributed to the area's animal rearing and vegetable production. The soils are highly elastic when wet but become hard and compact when dry and then crack vertically from the surface. This condition renders the soil unsuitable for hand cultivation. The soil type is confined mainly to small amounts of subsistence cropping of cassava, okro, maize, and other vegetables.

The short type of grassland provides extensive grazing fields. Also, brownish grey, medium, or coarse sand is underlined by a hard porous gristly loam along the Frafraha area. The soils have low nutritional status and are quick to become parched after the end of the rainy season.

Adentan abounds in several natural resources; prominent among them are the Nugbete River in Nmai Djor and the Ogbojo stream. The Ogbojo stream tends to overflow its banks during the rainy season, making it difficult for residents to access.

Various individuals and institutions have constructed dams within the Adentan Municipality to facilitate farming and agricultural activities. The dams include; Japan Motors Tourist Resort, Faahe Dam at Nmai Djor, Tessa Dam at Adjiringanor, University Farms Dam, Water Body at Amrahia, and Water Bodies at Ashieye.

Water Bodies at Amrahia and Ashieye have seen little of the purpose for which it was constructed. Residents continue to use the facilities for domestic purposes. However, plans are advanced to develop the facility for Agric purposes properly.

The presence of natural and man-made water resources has not translated into total coverage of reliable water supply in the Municipality since 10,647 (52%) out of 20,478 (100%) Households rely on water tankers and vendors for water supply.

In terms of waste management, the Municipal generates an estimated 32,400.56 tons of waste, mainly from municipal sources. 72%, which translates to 23,328.40 tons, is collected, leaving 9,072.16 tons uncollected. A view of household waste management indicates that 41.1% out of 20,478 households have not registered for waste collection hence waste is either openly dumped, dumped indiscriminately, or burnt (Ghana Statistical Services, 2014).

These waste streams end up in drains, undeveloped plots, and water bodies and, as a result, serve as a breeding ground for bacteria and other harmful insects (mosquitoes, flees), which cause diseases among the population residing in such areas (Works and Planning Unit, n.d).

A view at the access to improved toilet facilities reveals that 23.5% of the total number of households which is 20,478 a significant number of households in informal settlements especially have no toilet facilities (Ghana Statistical Services, 2014).

With regards to housing, the Municipality has a housing stock of 13,699. Of which improvised homes, usually kiosks and containers, have an occupancy of 2844 households. These households lack basic services as the tenancy arrangement is usually squatters on privately owned or government land. These housing units threaten the Municipality's environment as these settlements have no access to municipal waste collection services, grey water disposal facilities, and toilet facilities. These people, therefore, engage in clandestine ways of disposing of their waste. Education and sensitization are required to change residents' mentality and behaviour, who believe waste collection and disposal should be done recklessly (Works and Planning Unit, n.d.).

3.2 Research Method

The mixed-method research approach was used in this study (Creswell & Creswell, 2017). Triangulating different methods enhanced the data collection and analysis quality as it draws on the complementary strengths of quantitative and qualitative approaches while limiting their weaknesses (Johnson et al., 2007). The concurrent embedded design of mixed methods was used to collect primary quantitative and secondary qualitative data that gave supportive information to the primary data simultaneously, saving time and cost (Creswell, 2010).

3.3 Primary Sources of Data

Regarding the Quantitative primary data, structured open and closed-ended questionnaires were self-administered by the researcher and research assistants to informal dwellers aged 18 and above. These questionnaires were administered to identify the sources of pollution from informal settlements, evaluate the effect of pollution from informal settlements on the

environment and dwellers, establish populations' behaviour towards the environment and identify potential behaviour change strategies for informal dwellers who dump waste indiscriminately. To acquire a high response from these dwellers, the local language of settlers was used in administering the questionnaires to enable clarity and appropriate response. The use of a local language was necessary due to the heterogeneity of ethnic groups living in informal settlements in the Adentan Municipality.

A structured interview guide was used in a face-to-face interview to collect data from municipal experts, including the Municipal Environmental Health Officer and the Municipal Works and Planning Officer. Data collected was on the sources of pollution and challenges faced in these settlements; also, the boundaries of the Municipality and the major towns, which included were identified with this tool respectively which aided in the mapping of informal settlements. Also, the informal settlements recognized by the Municipality were identified with this tool. These included Adenta Village, Ashaley Botwe Village, popularly known as Old Town, and the Adiringanor Village.

Geographic Positioning System (GPS) coordinates were used to identify the locations of all informal settlements in the Municipality. A structured listing form with specified standard characteristics of informal settlements was designed to identify the characteristics of these settlements (PRIA, n.d). The researcher also used direct Field Observations to identify characteristics, including the land mass occupied, the type of dwelling units, waste disposal, and sanitary facilities. Notes and pictures were also taken to enable cross-referencing during spatial analysis.



3.3 Secondary Sources of Data

The secondary data collection instruments used to achieve the study's objectives included a desktop review of existing scholarly works, including academic materials, articles from peer-reviewed journals, reports from recognized international bodies, and books on relevant topics. Also, maps and the Municipal profile provided by the Municipal Works and Planning Department were used as secondary data sources for this study.

3.4 Sampling Methods

Both probability and non-probability sampling methods were used due to the mixed approach of the study. Purposive sampling, a non-probability sampling method, was used to select experts for face-to-face interviews. The purposive sampling methods were used to select the Environmental Health Officer and The Municipal Works and Planning Officer for the expert interviews.

Simple random sampling was used to select four communities with pockets of informal settlements in each of the four zonal councils (Koose, Gbentanaa, Nii Ashale, and Sutrunna) in the Adentan Municipality. These communities include Amafrom in the Koose Zonal Council, Adenta in the Gbentanaa Zonal Council, Ogbojo in the Nii Ashale Zonal Council, and Adringanor in the Sutrunna Zonal Council.

In selecting households, simple random sampling was used on respondents who belonged to households in the informal settlements identified in the Municipality. This method gives every member of the whole population an equal chance of being selected for the questionnaire survey.

The sample size of 350 was calculated by using the formula below by Yamane (1967);

$$n = \frac{N}{1 + Ne^2}$$

Where n = is the sample size, N = population size of households living in informal settlements (2844 based on 2010 Population and Housing Census for the District), and e = level of precision (0.05).

3.5 Data Analysis

Field data was entered using the Statistical Package for Social Sciences (SPSS) version 20 for the questionnaire survey. ArcGIS version 10.4.1 was used to analyse data on the locations and characteristics of the informal settlements.

Descriptive and inferential statistics were used in analysing and interpreting quantitative data. Descriptive statistics provide procedures for summarizing a collection of data. These statistics convey data distribution, central tendency, and dispersion characteristics (Jaggi, 2003). Mean scores, percentages, ranges, and variance were used to evaluate the environmental effect of pollutants from informal settlements and identify the sources of pollution.

Pearson correlation tests were used to analyse dependent (health risks, environment) and independent variables (indiscriminate waste disposal) to establish significant relationships between sources of pollution and the health of dwellers and the polluted environment. Also, this test was used to establish the linear relationship between indiscriminate waste disposal and its influence on the environment and health. The results were presented as $r(df)$, p where r is the correlation coefficient at a given degree of freedom (df) and p is the significance level. The r value falls within the range of -1 to +1. Perfect correlations are exhibited by -1 and +1 values. r values between -1 and 0.5 indicate a strong negative correlation, while those between -0.5 and 0 show a weak negative correlation. A value of 0 indicates no correlation. A weak positive correlation is shown by values ranging between 0 and 0.5, while values between 0.5 and 1 exhibit a strong correlation. Though correlations only assess relationships, they were used as initial pointers to possible causation.

Regression analysis was used to describe the relationship between environmental challenges variables (land pollution, air pollution, water pollution) and informal settlement characteristics (lack of basic services resulting in unsafe waste management practice). This analysis assumed that the data is continuous, the variables being analysed have a linear relationship, no significant outliers, independence in observations, and normal distribution of errors (Chen, Wan, & Zhou, 2015)

SPSS Statistic was used to ensure conformity of data to this set criteria: Casewise diagnostic (outliers), Durbin-Watson (independence of observations), Model fit (normal distribution of errors), and Collinearity diagnostic (linear relationships). The output of the analysis is an F-test and regression function. The F test is presented as F , R -square where F is the Collinearity test, x and y are the degree of freedom, and R -square is the extent to which the linear regression explains variance in the data. The regression function is presented as, where a is an intercept term and b is a slope coefficient.

Also, a doer/non-doer analysis employed from the RANAS Model was used to establish people's behavior and determine the behaviour change technique relevant to the populace. This was calculated using means generated from each behavioural factor in the survey and scores from doers of the preferred behaviour (waste disposal into waste bins for collection) and non-doers of preferred behaviour (burning waste, dumping waste indiscriminately) to establish the critical behavioural change factors.

Also, qualitative data, the recorded interviews from the Municipal experts, was transcribed verbatim. Information on the sources of pollution, behaviour of informal settlers towards the environment, and environmental challenges caused by the existence of these settlements were sorted manually and coded according to the topics examined before they were categorized into various themes. The various themes included sources of pollution in informal settlements,

environmental challenges, and health risks obtained in the study. These findings supported quantitative findings.

3.6 Quality Control

First, a pre-test of the questionnaires for the study was conducted in April 2021, using 10 respondents to determine the reliability and validity of the data collection instrument. One interview and nine questionnaires were administered. This illuminated the structuring of the interview guide for Municipal officials and the open and close-ended questionnaire, respectively, to achieve the study's objectives and to ensure the quality of data collected.

Secondly, research assistants were given three days of rigorous training on administering the questionnaire and what the study aimed at achieving.

Also, the data collected was thoroughly cleaned by running preliminary frequencies to detect entry errors and remove inconsistencies before analysis.

Finally, Cronbach's Alpha test was used to determine the reliability level of this study. This reliability test was conducted on the all the variables used for the data analysis. Reliability test results (0.814) exceeded the acceptable rule of 0.6 to 0.7, indicating the acceptable reliability of the data collected.

3.7 Ethical Considerations

Ethical clearance was granted from the University of Ghana Ethics Committee of the College of Basic and Applied Sciences under the RAIN project since this study forms part of the project. Permission was sought from the Adentan Municipality for data collection. Steps were also taken to ensure the benchmark of ethics in research with participants. There was no coercion whatsoever for any respondent to participate in the study. Informed consent was read out to the participant and translated into the local language where necessary to enable understanding of

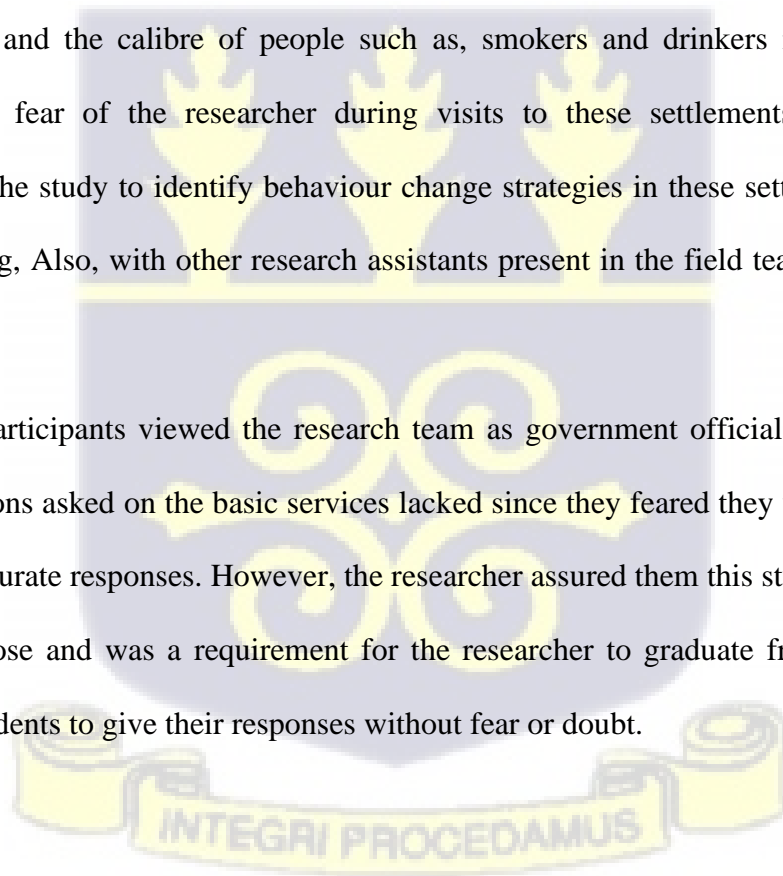
the study and freedom of choice in participation. The possibility of withdrawal when the participant was uncomfortable was also established. Questionnaires were therefore designed so that responses given did not allow tracing information to a specific person. Coding only served as markers of tracking only to facilitate analysis and cross-referencing.

3.8 Limitations to the Study

The study experienced several limitations. Resources in terms of time was the major limitation to the study. The research could have expanded to implement behaviour change techniques identified and measure the impact in the Adentan Municipality. However, due to time constrains this was not feasible. This is why the study recommends further studies in the Behavioural Change Techniques identified.

Also, information from the literature that describes informal settlements as places with high rates of social and the calibre of people such as, smokers and drinkers met on the field heightened the fear of the researcher during visits to these settlements. However, the importance of the study to identify behaviour change strategies in these settlements kept the researcher going, Also, with other research assistants present in the field team this challenge was resolved.

Again, some participants viewed the research team as government officials and sometimes diverted questions asked on the basic services lacked since they feared they will be penalized after giving accurate responses. However, the researcher assured them this study is strictly for academic purpose and was a requirement for the researcher to graduate from school. This allowed respondents to give their responses without fear or doubt.



CHAPTER FOUR

RESULTS

4.1 Introduction

This section presents the results of the data collected for this study. Thus, data collected was analysed to evaluate the environmental and health effects of pollutants (especially waste disposed off indiscriminately) from informal settlements. The analysis focused on characteristics of informal settlements, sources of pollution from informal settlements, effect of pollution from informal settlements, population behaviour towards the environment as well as strategies to change pollution behaviour. The findings of the study are presented using tables, charts, graphs, frequencies, percentages, mean, standard deviation, and relative importance index.

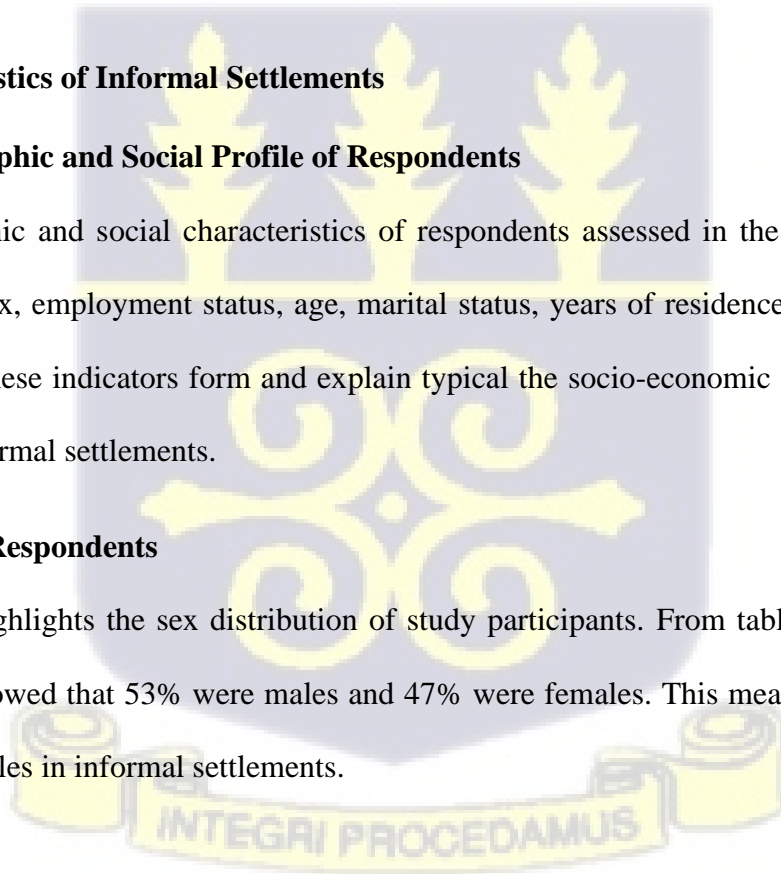
4.2 Characteristics of Informal Settlements

4.2.1 Demographic and Social Profile of Respondents

The demographic and social characteristics of respondents assessed in the study highlights indicators of sex, employment status, age, marital status, years of residence and educational background. These indicators form and explain typical the socio-economic characteristics of dwellers in informal settlements.

4.2.1.1 Sex of Respondents

This section highlights the sex distribution of study participants. From table 4.1, the sex of respondents showed that 53% were males and 47% were females. This means that males are more than females in informal settlements.



4.2.1.2 Employment Status of Respondents

The employment status of the informal settlement dwellers in Adentan Municipality was categorized into employment in formal sector, informal business (self-employed or employed by others) and unemployed. Table 4.1 depicts that, 3.90% were employed in the formal sector, 16.40% through informal business, 71.50% self-employed in informal and 8.20% unemployed. Most residents of informal settlements rely mostly on informal economy for subsistence. Occupations including hawking, petty trading, and artisanal trade and technicians in home industries are the most predominant in these settlements. However, those employed in the formal sector did menial jobs in industries as mostly artisans and cleaners. 8.20% were also unemployed they however, depended on their partners and friends for sustenance of livelihood while still searching for jobs. Also, some were nursing mothers, and this incapacitated them from working.

4.2.1.3 Marital Status

The marital status of the respondents showed that 49.7% were single, 34.2% were cohabiting/informal living together, 13.20% were married, 1.50% and 1.40% were separated and widowed respectively. Majority of the respondents were single. Secondly, 34.2% were couples living together without civil or traditional recognition. 13.20% were married under ordinance and customary rites, and 1.50% of the respondents who were initially had separated.

4.2.1.4 Level of Income

The results from table 4.1 reveal that majority of the informal settlement dwellers in the Adentan Municipality were low-income earners (86.70%). None of them belonged to the high-income earnings category while 7.90% and 5.40% were in the no income and middle-income level category, respectively. Informal settlements are characterized as low-income as majority of the dwellers earned less than GHC 200 monthly for the question asked on the monthly income.

4.2.1.5 Educational Level

The educational level among respondents reveals that 53.9% of participants had the basic junior high school education. Secondary level education was 34.5% while 2.1% had primary education and 1.8% had tertiary education. Also, 7.6% percent of the participants had no form of education. This indicates that most informal dwellers in the Municipality have some form of formal education. However, the study revealed that financial constraints was the main reason most dwellers decided not to pursue higher education.

One respondent mentioned that *'I couldn't continue my education because my parents didn't have money to push me. We are hustlers. I came to Accra to hustle to help my family in Takoradi'*

4.2.1.6 Age

Majority of the respondents 279 (70.60%) were between the 18 – 25 age categories, 16.10% of the respondents were within the age group 26-35, while 11.50% were within 46-55 and 1.80%, belonged to 56 and above age category. This implies majority of the participants belong to the active population.

4.2.1.7 Duration of Residence

Table 4.2 displays the number of years that respondents have lived in the informal settlements at Adentan Municipality. Accordingly, 39.1% of the respondents have spent within 1-5 years living within Adentan Municipality informal settlement. Also 41.42% had 6-10 years stay in the same settlement and 19.42% had lived below 1 year in the informal settlements. The results depict usual residency of informal dwellers since majority of the respondents have spent more than a year in the settlement. This shows the long-term existence of such settlements.

4.2.1.8 Land Tenure Arrangement

Most of the land tenure arrangement for informal settlement dwellers in the Adentan Municipality was squatting. The majority of informal dwellers 54.40% were squatting as they had no tenure arrangement with the owners of the land. This shows that most informal dwellers live on lands without the permission of owners which may be the reason for the constant threats of eviction. Also, renting recorded 31% as some dwellers responded that they pay between GHC 50-GHC 70 monthly for the lands that housed their homes (kiosks). Some (14%) also lived on lands without any monthly payment and 1% were caretakers.

4.2.9.1 Land Ownership

The ownership of the lands occupied by informal settlement dwellers in the Adentan Municipality is presented below in table 4.1. Majority of the lands occupied by informal dwellers in the Municipality are lands owned by private individuals. The results from the study unveiled that, 64.8% are for other private individuals while 35.2% is Public/Government ownership. This shows informal dwellers have no legal rights on the lands they occupy.

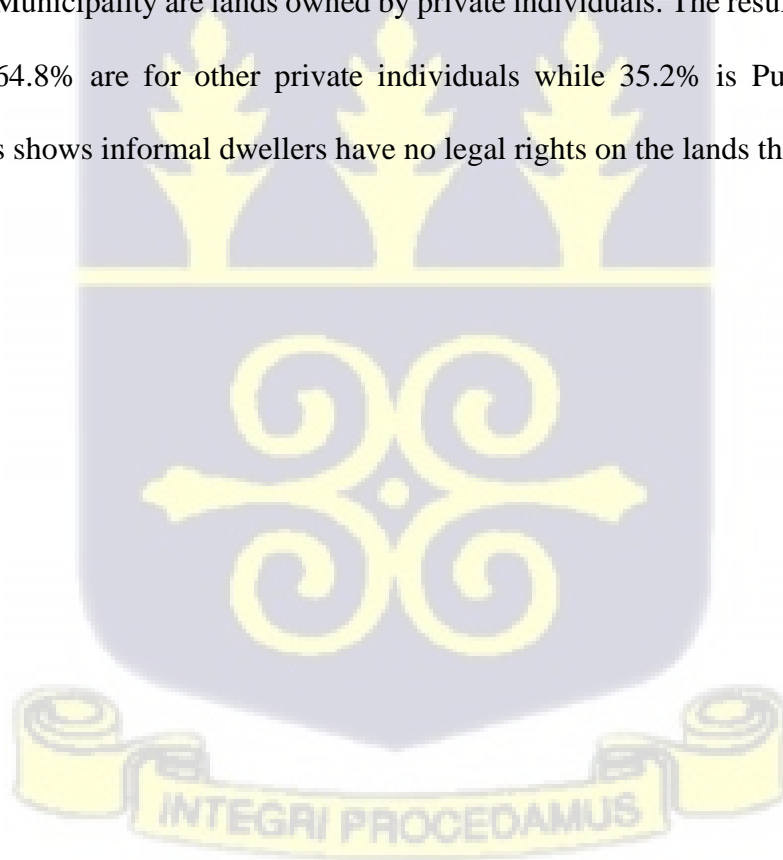
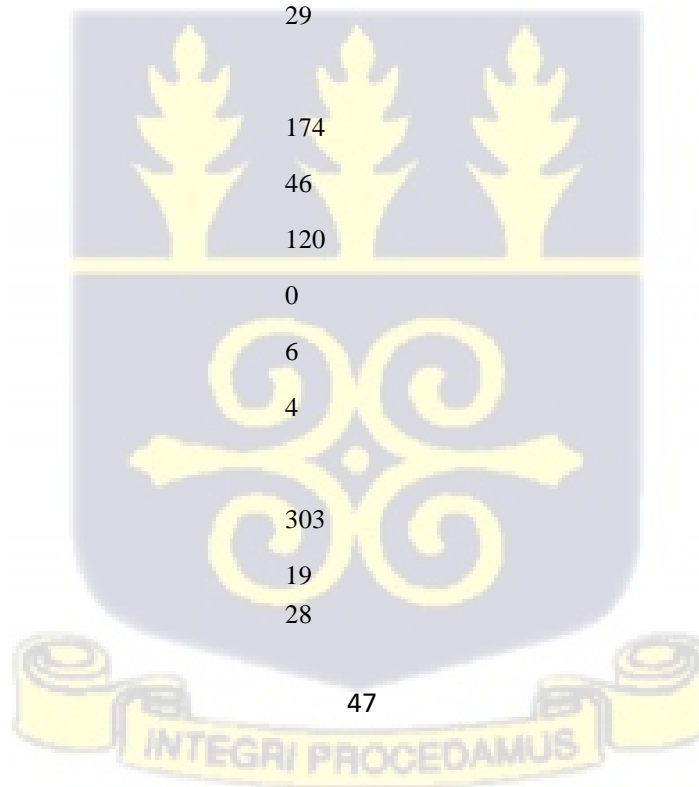


Table 4.1: Demographic and Social Profile of Respondents

Demographic Profile	Frequency	Percentage
Sex		
Male	186	53%
Female	164	47%
Employment Status		
Employed in formal sector	14	3.90%
Employed in informal business	57	16.40%
Self- employed in informal business	250	71.50%
Unemployed	29	8.20%
Current Marital Status		
Single	174	49.70%
Married	46	13.20%
Cohabiting/Informal Living Together	120	34.20%
Divorced	0	0.00%
Separated	6	1.50%
Widowed	4	1.40%
Level of Income		
Low	303	86.70%
Middle	19	5.40%
None	28	7.90%



Educational Level

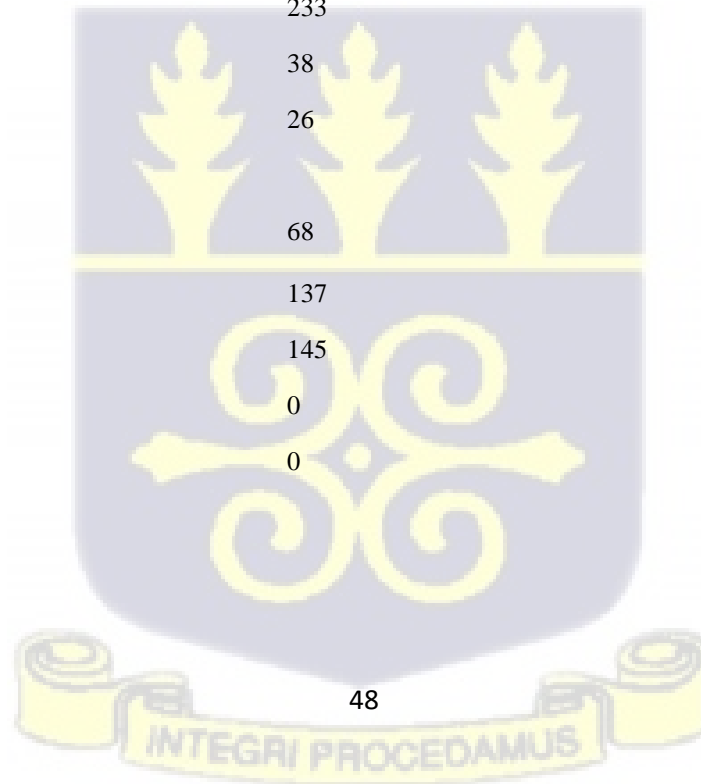
Primary	7	2.10%
Junior High	187	53.90%
Secondary	121	34.50%
Tertiary	6	1.80%
None	29	7.60%

Age

18-25	53	16.10%
26-35	233	70.60%
46-55	38	11.50%
56 and above	26	1.80%

Duration of Residence

Below 1 year	68	19.42%
1-5 years	137	39.14%
6-10 years	145	41.42%
11-20 years	0	0.00%
Above 20 years	0	0.00%



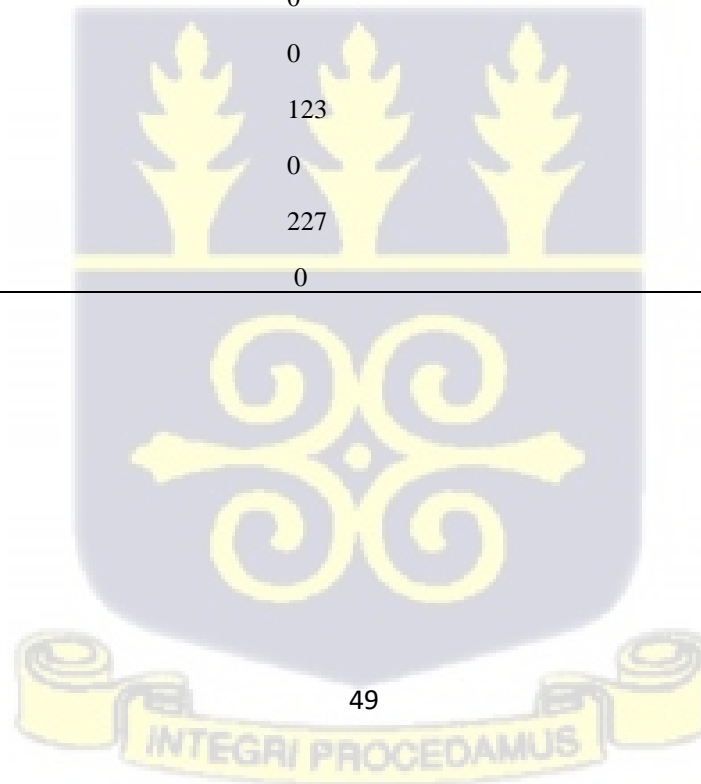
Land Tenure

Owner	0	0%
Renting	107	31%
Rent-free	50	14%
Perching	0	0%
Squatting	189	54.40%
Caretaker	4	1%

Land Ownership

Estate Developer	0	0
Family Property	0	0
Relative not household member	0	0
Private individual	123	35.20%
Private Employer	0	0
Public/Government	227	64.80%
Other	0	0

Source: Computation from field data, 2021



4.3.2 Physical Characteristics

4.3.2.1 Housing Conditions

Location

Informal Settlements were identified in 9 out of the 15 major communities in the Adentan Municipality. Field observations in the 9 communities where informal settlements identified revealed that informal settlements were scattered across both the peripheries and inlands of the Municipality. The informal settlements on the peripheries of the Municipality located in Adringanor were close to a major highway, the Tema Motorway. Informal settlements located in Tesa a suburb of Adringanor was also close to the Adringanor dam. Also, one of the settlements identified in Ogbojo was also close to a drainage and water body, Obgojo stream. Majority of the settlements identified were located on bare lands in the inlands of the Municipality in the following communities; Amanfrom Amrahia, Adenta, Nmai Dzorn, Ashaley Botwe, Otinshie and Otanor.

Estimated Household size

Through literature review, the population size of the informal settlements was determined. the population size was calculated using the number of inhabited structures in each informal settlements identified multiplied by the average household size, (3.6) in Ghana as stipulated by the 2021 Population and Housing Census. The number of structures (housing units) was a total of 2076 which accommodated 7473.6 people.

Size of Structures (Housing Units)

The average sizes of structures directly observed and compared to sizes found in literature was 9m².

Materials for Wall and Floor of Structures

This was also identified through direct field observations. Materials used for constructing the walls of the housing units was wood. It was only in Otanor that few housing units whose walls were made of mud and cement blocks. The floors of housing units in the informal settlements in the Adentan were also wood, a few with wooden walls had cement floors.

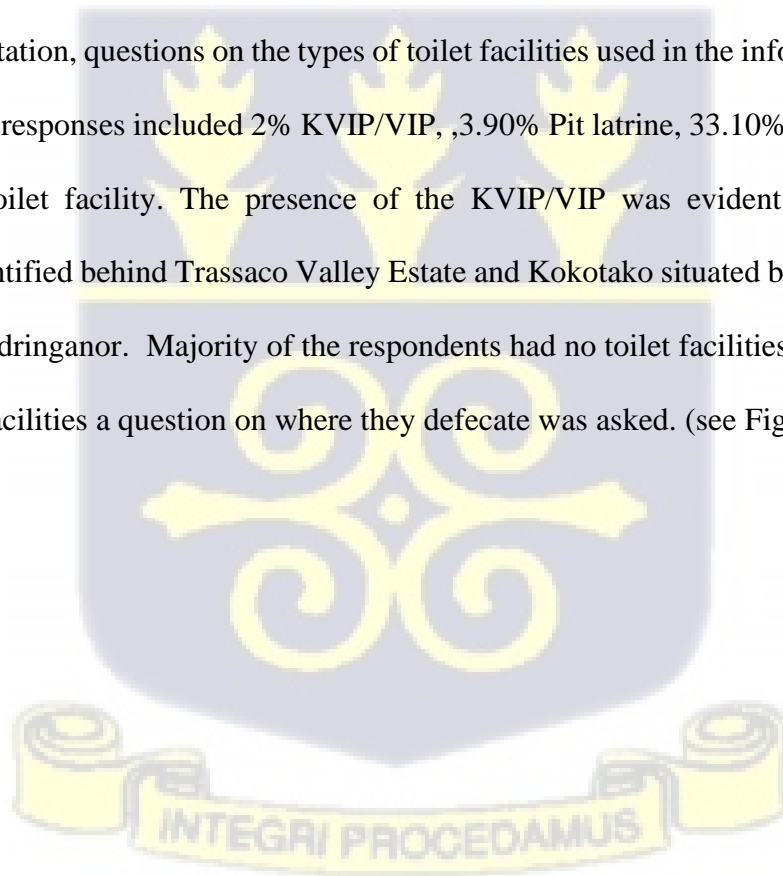
Type of Material for Roofing

Materials for roofing were metal sheets. 100% of the settlements identified had metal sheets as their roofing materials.

4.3.3 Access to Basic Services

Sanitation

In terms of sanitation, questions on the types of toilet facilities used in the informal settlements was asked. The responses included 2% KVIP/VIP, 3.90% Pit latrine, 33.10% Public toilet and 61% had no toilet facility. The presence of the KVIP/VIP was evident in the informal settlements identified behind Trassaco Valley Estate and Kokotako situated behind the Saleem estates, all in Adringanor. Majority of the respondents had no toilet facilities. Also, for those with no toilet facilities a question on where they defecate was asked. (see Figure 4.2)



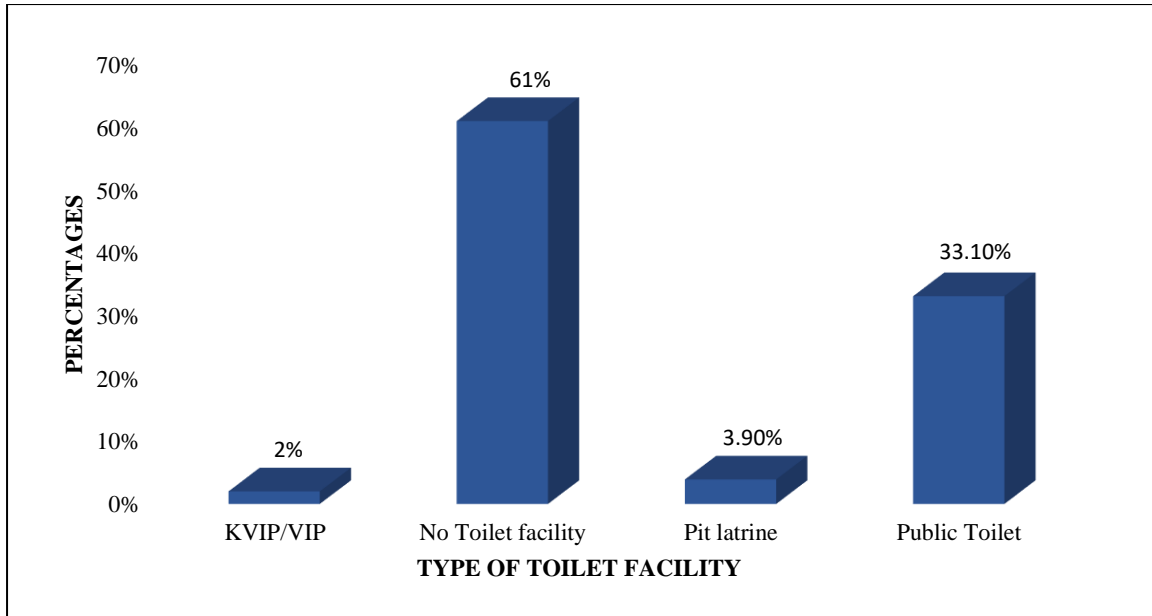


Figure 4.1: Type of Toilet Facilities

Source: Computation from Field Data, 2021

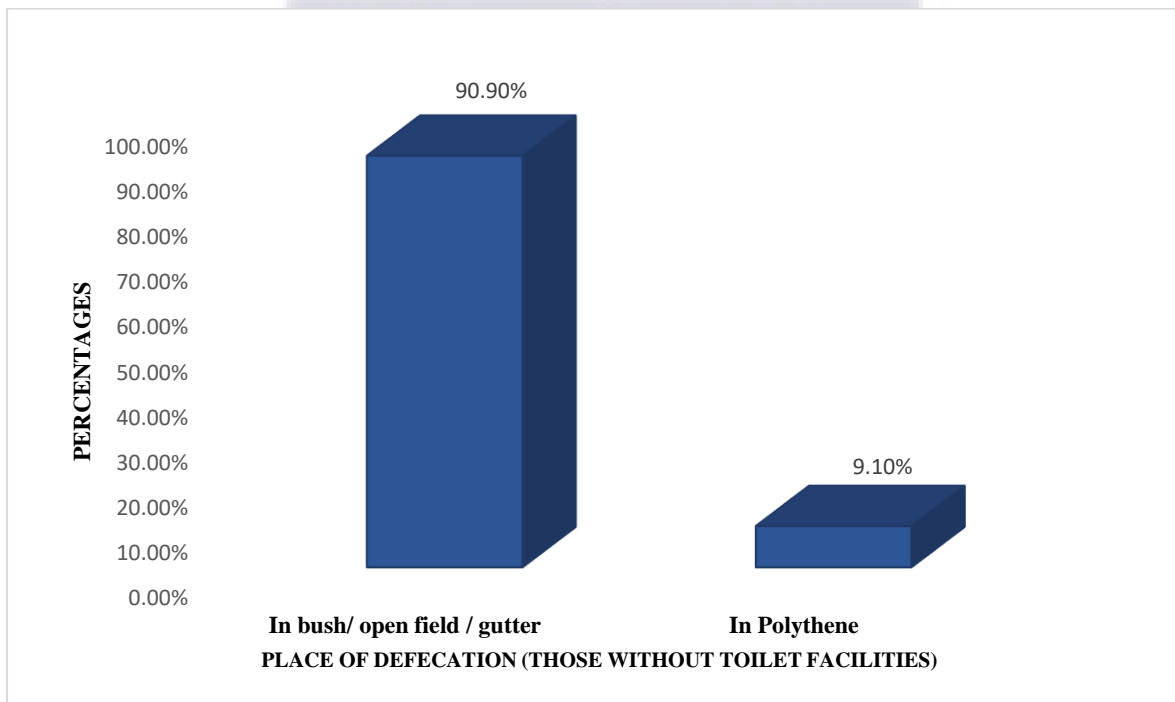


Figure 4.2: Place of Defecation for those without toilet facilities

Source: Computation from Field Data, 2021

Solid Waste Disposal

According to responses derived from the study; figure 4.3 reveal 45.40% of the respondents dumped waste indiscriminately, 30.9% Burnt their waste and 23.7% used tricycles also known as Borla taxis to dispose their waste. This highlights the fact that some informal dwellers in the Adentan Municipality had access to and used waste collection services. Informal settlements in Sychar, Obgojo and Adenta were those the ones who used tricycles. However, settlements identified on the Motorway, Adgringano and the peri-urban area Amanfrom dumped their waste indiscriminately on bare lands.

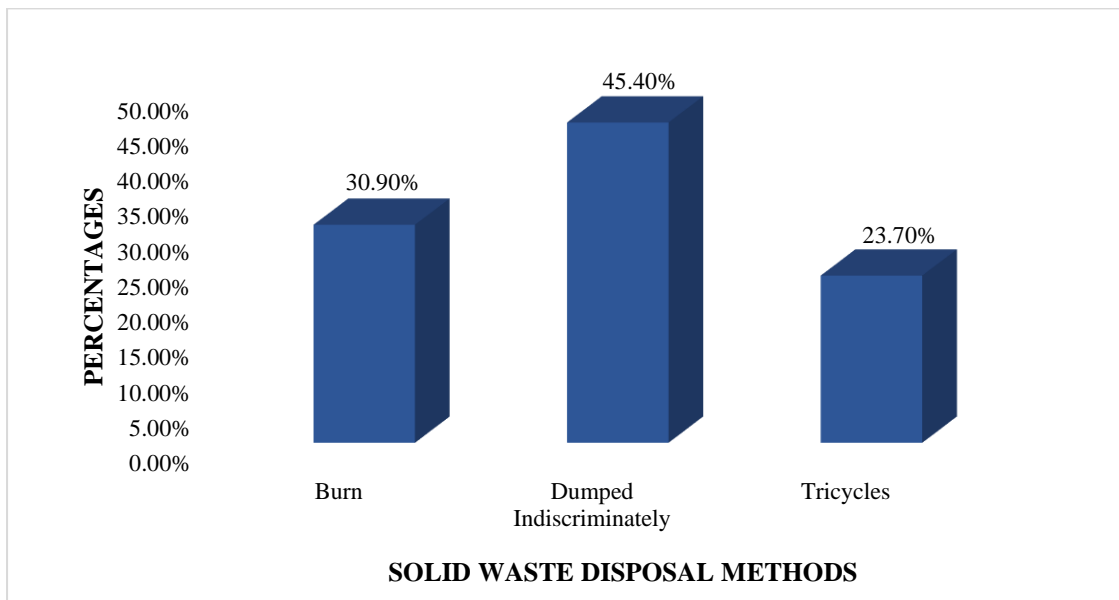


Figure 4.3: Solid Waste disposal Methods

Source: Computation from Field Data, 2021

Wastewater/ Greywater Disposal Methods

Responses in Figure 4.4 indicates that, wastewater that is thrown /flows onto grounds 74.90%, through a soakaway pit recorded 15.70%, Flows into drains or gutter recorded 9.40%. The informal settlements in the four communities which were studied including Adringanor, Amanfro, Obojo and Adenta had majority of respondents throwing wastewater from cooking,

bathing and laundry on the ground which has implications on the soil, ground water sources and breeding of disease vectors as well.

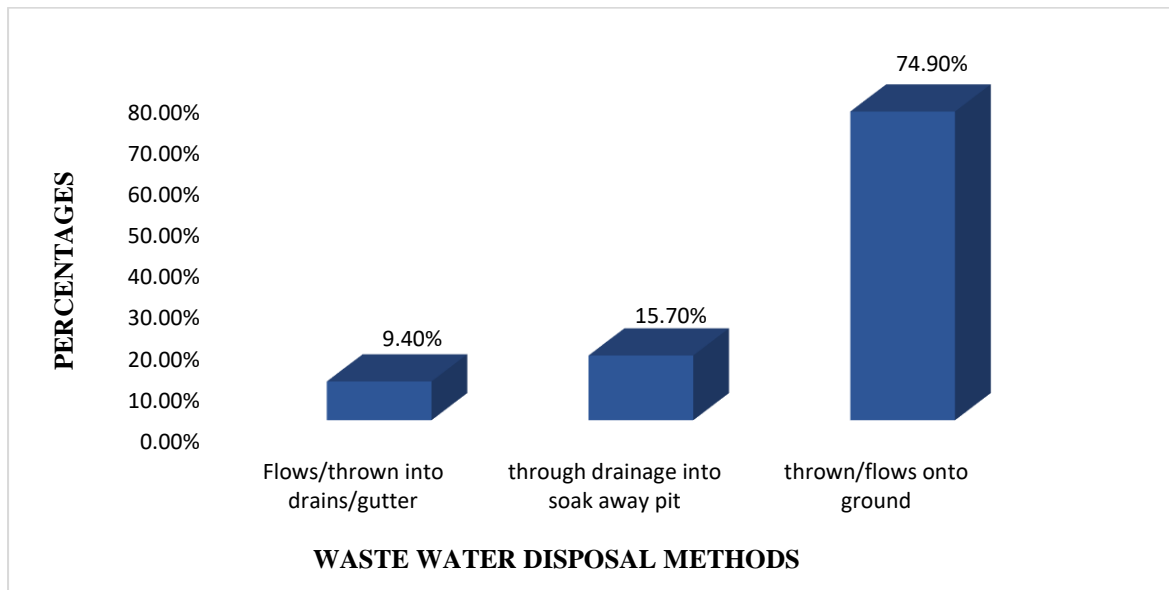


Figure 4.4: Wastewater Disposal

Source: Computation from Field Data, 2021

Water Supply

Figure 4.5 revealed that, 2% of the respondents had access to pipe borne water in the cluster they are located hence they didn't have to travel to fetch water for drinking. 1.70% of the respondents had access pipe-borne water on other compounds but the round time for in and out travel did not exceed fifteen minutes for most of the settlements identified who used this method. 62.9% of informal dwellers resorted to sachet water as their drinking source of water. Also, 33.4% of the respondents used Vendor/Tanker supplied water for drinking.



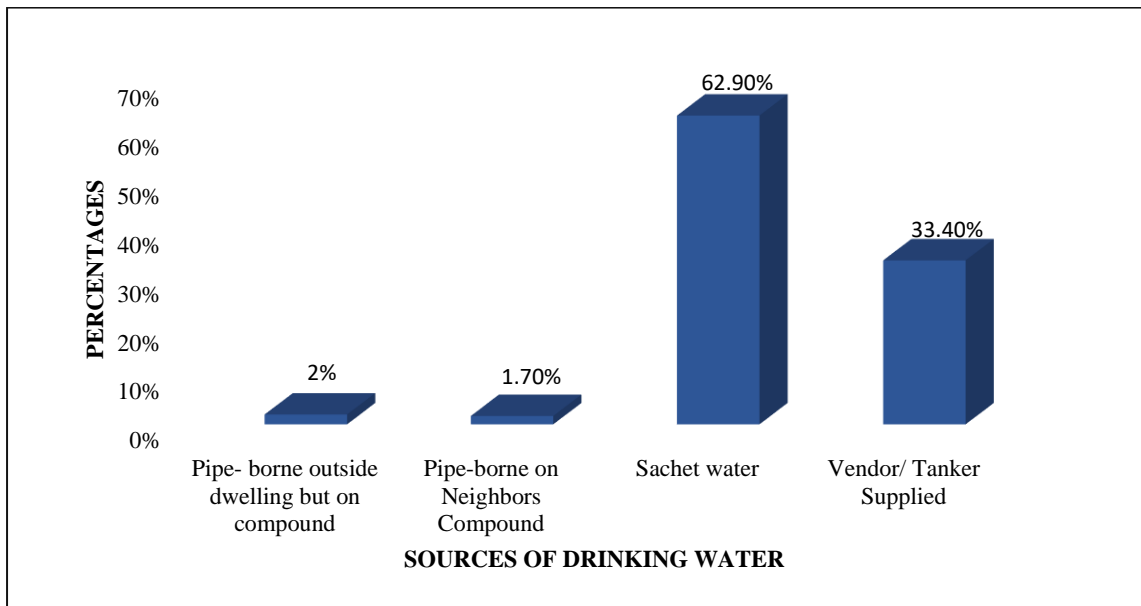


Figure 4.5: Sources of Drinking Water

Source: Computation from field data,2021

4.5 Sources of Pollution

Types of Environmental Challenges in Informal Settlements

The second objective in this study was to identify the sources of pollution from informal settlements in the Adentan Municipality. Thus, environmental challenges present in these settlements were identified and questions on the sources of these challenges which causes of pollution were identified.

Respondents were asked to identify the major source of pollution in their informal settlement on a scale 1 – 7. Whereby 1 depicts the major source and 7 the least. Figure 4.6 presents the sources of pollution identified in the informal settlements.

The study found that land pollution is the major environmental challenge within informal settlements. Thus, 61.40% respondents indicated land pollution as the major constituent of environmental problems in the informal settlement. Also, noise pollution (13.70%), flooding (13.40%), pest and flies (5.70%), water pollution (2%), fire hazards (2%), and air pollution

(1.70%) formed the other environmental challenges identified by dwellers in informal settlements. This was mostly in the case of informal settlements in Adringanor, along the Motorway and Ogbojo where informal dwellers dumped their domestic waste on bare lands close to their housing units (see Appendix C). Also, with regards to grey water disposal all settlements identified threw or connected water from laundry, bathing and cooking directly on the ground since these areas has no planned drainage systems installed. The informal dwellers in Obgojo among all the settlements identified were the only people who suffered the environmental challenge of flooding. This can be attributed to their proximity to the Obojo stream. Noise pollution was also rampant in informal settlements who were close to major roads. Informal settlements in Adringanor (from the Mannet stretch to Trassacco) located along the Tema Motorway, experienced this type of environmental challenge.

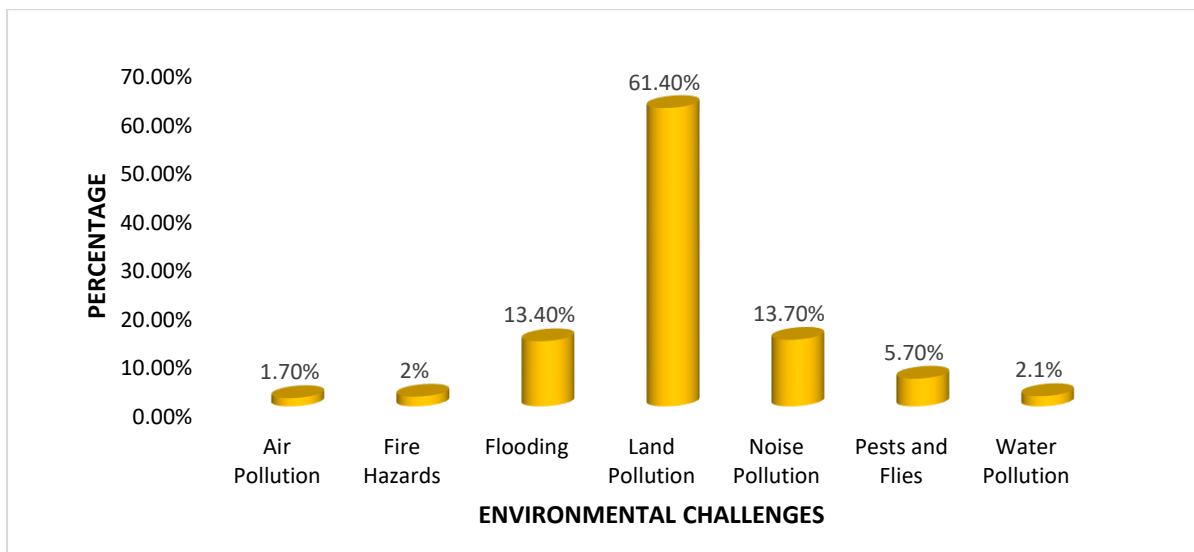
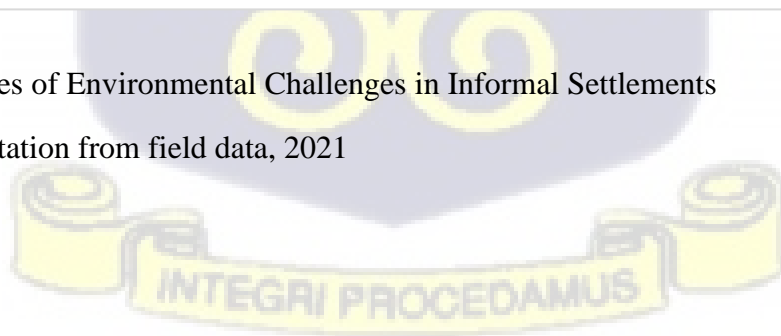


Figure 4.6: Types of Environmental Challenges in Informal Settlements

Source: Computation from field data, 2021



The Municipal planning officer's response to the environmental challenges these settlements pose and effect on health and the environment stated that:

'Land Pollution is one of the major challenges these settlements pose as they have no waste collection services and toilet facilities. I don't know where they even defecate. They are causing a lot of pollution on the Motorway. This poses risks to their own health and destroys the quality and aesthetics of the environment.'



Plate 4.1: Dump Site Close to Informal Settlements in Adringanor (Motorway)

Source: Photographed by Author during Field Survey, 2021



Plate 4.2: Greywater connection on bare ground in informal settlements, Ogbojo

Source: Photographed by Author during Field Survey, 2021

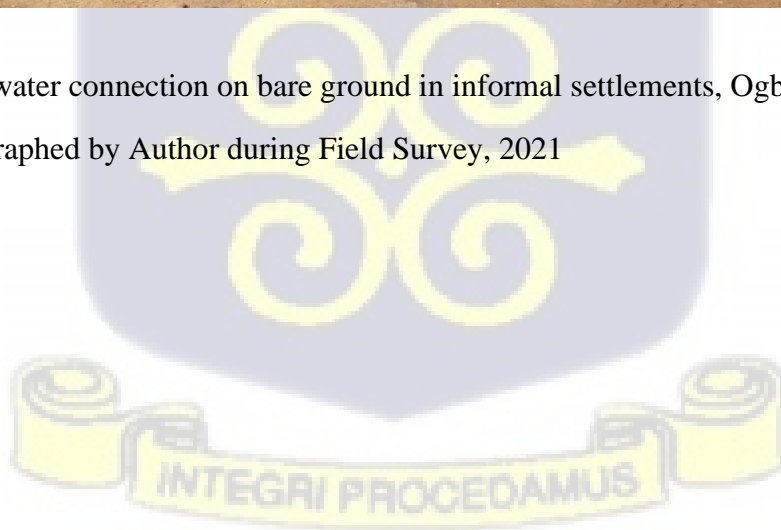




Plate 3: Greywater on bare ground, Adringano (Motorway)

Source: Photographed by author during Field Survey, 2021

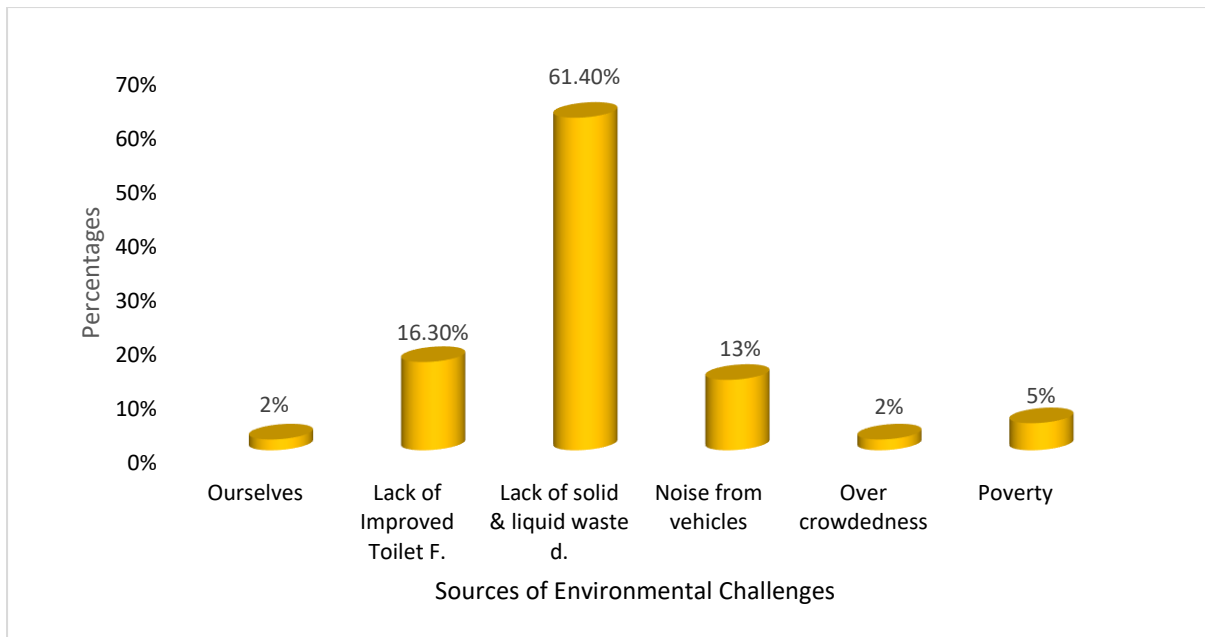


Figure 4.7: Sources of Environmental Challenges

Source: Computation from field data, 2021

The sources of environmental challenges in figure 4.7 were attributed to lack of solid waste and liquid waste disposal facilities which recorded 61.4%, the lack of improved toilet facilities recorded 16.3%, 13% was attributed to noise from vehicles due to proximity of the settlement to major roads was also recorded as a cause, 5% was attributed to poverty and 2% was attributed to over crowdedness and ourselves. These were the sources of pollution as the environmental challenges included land/soil pollution, air pollution, noise, and water pollution.

4.6 Influence of Indiscriminate Waste Disposal on the Health of Informal Dwellers and the Environment.

The relationship and effect of indiscriminate waste disposal on the health of informal dwellers and the environment was investigated in this section. Pearson correlation and multiple regression analysis is used to ascertain the relation between the variables and influence the variables indiscriminate waste disposal, health of informal dwellers, source of pollution has on each other.

4.6.1 Pearson Correlation

Pearson’s coefficient of correlation (r) is used to establish the relationship between the variables under studied. It also indicates the direction and how much relationship exist between the variables. The value of correlation lies between positive one to negative one.

Table 4.2: Correlation Coefficient

Correlations		EC	HR	IWD
Environmental Challenges (EC)	Pearson Correlation	1	0.590	0.718
	Sig. (2-tailed)		0.849	0.476
	N	350	350	350
Health Risk (HR)	Pearson Correlation	0.590	1	0.393
	Sig. (2-tailed)	0.849		0.00**
	N	350	350	350
Indiscriminate Waste Disposal (IWD)	Pearson Correlation	0.718	0.393	1
	Sig. (2-tailed)	0.476	0.00**	
	N	350	350	350

** Correlation is significant at the 0.05 level (2 tailed).

Table 4.2 indicates the correlation between the variables Environmental Challenges (EC), Health Risk (HR) and Indiscriminate Waste Disposal (IWD). The result in Table 4.3 reveals positive relationship between EC and HR with correlation coefficient (ρ) 0.590. Thus, a strong relation exists between EC and HR. Meanwhile, there was a weak positive relationship between HR and IWD at a correlation coefficient (ρ) 0.393. The relationship between both pair (EC and IWD) as well as (HR and IWD) is insignificant at 5% level. In summary, Table 4.3 shows the existence of relationship between the variables EI, HR and IWD.

4.5.2 Effect of Indiscriminate Waste Disposal on the Health of Informal Dwellers and the Environment.

Multiple Linear Regression was used to investigate the effect of indiscriminate waste disposal on the health of dwellers informal and the environment.

4.5.2.1 Model Specification

The following regression model(s) is used to establish the relationship between dependent and independent variables:

$$Y_1 = \alpha_0 + \delta_1 X_1 + \delta_2 X_2 + \delta_3 X_3 + \varepsilon \text{ --- } equa(1)$$

$$Y_2 = \beta_0 + \gamma_1 X_1 + \gamma_2 X_2 + \gamma_3 X_3 + \varepsilon \text{ --- } equa(2)$$

Environmental effect as a dependent variable which is measure of environmental challenges within the informal settlement is predicted using the independent variables which is a measure of indiscriminate waste disposal using equation (1).

On the other hand, equation (2) examines the influence indiscriminate waste disposal on the health risk of Adentan Municipal informal settlers. Health Risk (HR) is employed as the dependent variable while indiscriminate waste disposal characteristics are adopted as independent variables.

The variables in the regression model(s) are defined as follows.

α_0, β_0 = Intercept

δ_i, γ_i = Constant coefficient

Y_1 = Environmental Challenge

$Y_2 =$ Health Risk

$X_1 =$ Place of Defecation

$X_2 =$ Wastewater Disposal

$X_3 =$ Disposal of Solid Waste

$\varepsilon =$ Error term

The error term of the regression model(s) indicates all the variation in the dependent variables not explained by the weighted independent variable.

4.5.2.2 Multicollinearity Test

Severity of multicollinearity test among the variables were conducted using the Variance Inflation Factor (VIF). Table 4.3 present the VIF values of the variables adopted in this study.

Table 4.3: Multicollinearity Test

	EC	HR
Variables	VIF	VIF
Place of Defecation	1.005	1.007
Wastewater Disposal	1.049	1.069
Disposal of Solid Waste	1.032	1.602

Table 4.3 shows that none of the VIF values was above the 10.0 threshold. The VIF 10.0 threshold was chosen since VIF values greater than or equal to 10.0 are commonly used to determine if collinearity is strong enough (Craney & Surles , 2002). This means that collinearity is not a problem in this model estimation of the factors that influence health risk and environmental pollution.

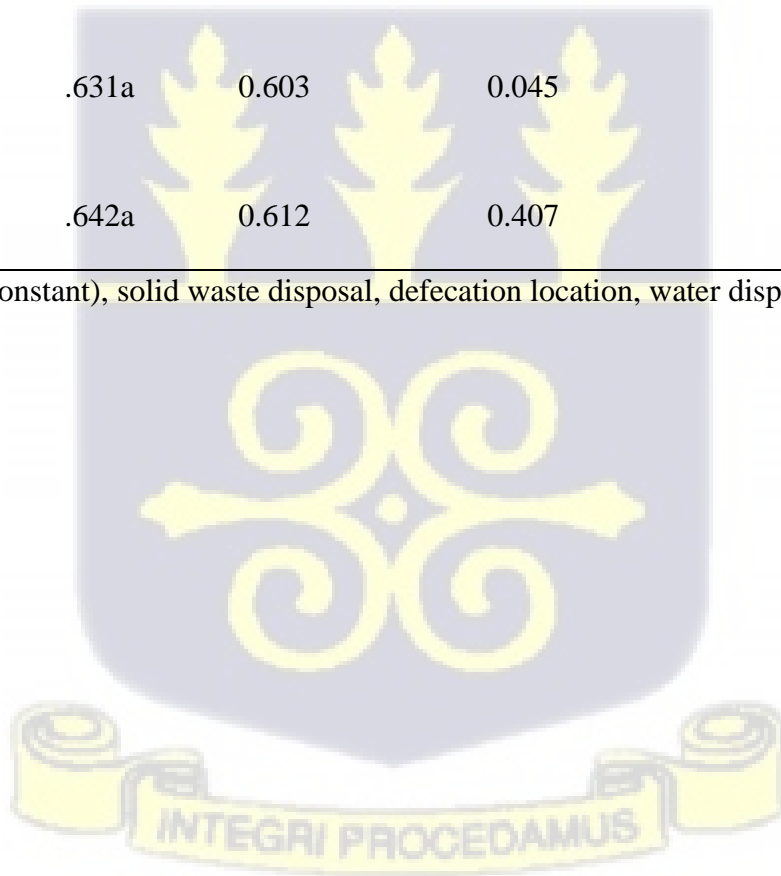
4.5.2.3 Coefficient of Determination

Table 4.4 indicate the coefficient of determination value of (0.631) and (0.642) for environmental challenges and health risk respectively, which implies there is a positive relationship between the variables under studied. The R square (R^2) is the explanatory power which shows that (0.603) and (0.612) of EC and HR is explained by the predictors. This implies that, the independent variables under study that is Place of Defecation, Wastewater disposal, Disposal of Solid waste predicts the dependent variables Environmental Challenge and Health risks. By 60.3% and 61.2% respectively.

Table 4.4: Coefficient of Determination

Model Summary				
	R	R Square	Adjusted R Square	Std. Error of the Estimate
Model Summary 1	.631a	0.603	0.405	1.832
Model Summary 2	.642a	0.612	0.407	0.293

a Predictors: (Constant), solid waste disposal, defecation location, water disposal



4.5.2.4 Analysis of Variance (ANOVA)

The study used ANOVA to establish the level of significance of the regression with f statistic value of p less than 0.05 with confidence level above 95%. Table 4.5 shows the ANOVA

Table 4.5: ANOVA Summary

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Model 1	Regression	65.658	3	21.886	6.519	.000b
	Residual	1161.659	346	3.357		
	Total	1227.317	349			
Model 2	Regression	20.758	3	6.919	80.854	.000b
	Residual	29.61	346	0.086		
	Total	50.369	349			

a. Dependent Variable: EC, HR

Also, the analysis of variance (ANOVA) results in Table 4.5 shows that the F-value for the model(s) are significant having a p-value of 0.000 which is less than 0.05. This implies that the combination of the independent variables can significantly predict the dependent variable. The independent variables under study namely, place of defecation, wastewater disposal,

disposal of solid waste influences the environmental challenges as well as health risks in the Municipality.

4.5.3. Multiple Regression Results

The multiple regression analysis results showed that all the three independent variables, thus, solid waste disposal, defecation location, and waste water disposal was found to be significant. The three predictors were found to influence environmental pollution and health risk. The multiple regression result is presented in Table 4.6.

Table 4.6: Multiple Regression Summary

Coefficients		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
Model 1	(Constant)	2.284	0.556		4.108	0
	defecation location	-0.424	0.341	-0.065	-1.243	0.001
	wastewater disposal	0.523	0.136	0.208	3.848	0
	solid waste disposal	0.164	0.069	0.129	2.391	0.003
a Dependent Variable: environmental challenges						
		Unstandardized Coefficients	Std. Error	Standardized Coefficients	t	Sig.
		B		Beta		
Model 2	(Constant)	1.258	0.089		14.173	0
	defecation location	-0.14	0.054	-0.106	-2.568	0.002
	water disposal	0.256	0.022	0.502	11.787	0
	solid waste disposal	-0.07	0.011	-0.272	-6.41	0
a Dependent Variable: health risk						

Table 4.7: Mean Score of Each Behavioural Factor for Doers and Non-Doers

Factor Group	Contextual Factors	Score in Behaviour / Health Knowledge	
		Doer (90% or more_	Non-Doer (Less than 90%) Mean
Context	Age	12.5	10
	Income	0.8	0.53
	Sex	0.8	1.2
Risk Factors	Vulnerability	1.47	1
	Severity	2.43	2.03
	Health Knowledge	6.11	3.13
Attitude Factors	Belief (Effort)	5.25	3.14
	Belief (Health)	4.33	2.16
	Belief (Time)	4.81	2.12
Norm Factors	Feelings (Behaviour)	6.35	2.45
	Others' Behaviour	3.21	5.34
	Others' Dis/approval	4.23	6.23
Ability Factors	Personal Importance	5.14	2.37
	Action Knowledge	7.23	3.44
	Confidence in Performance	8.2	2.8
Self-Regulation Factors	Confidence in Continuation	9.1	1.8
	Confidence in Recovering	8.41	2.66
	Action Planning	7.25	4.21
	Action Control	6.5	3.49
	Barrier Planning	7.3	3.23
	Remembering / Forgetting	6.33	3.22
	Commitment	8.67	2.55

Establishing Critical Behavioural Factors and Identifying Behavioural Change Techniques

Techniques

Critical Behavioural factors were identified by using significant mean difference scores between doers and non-doers. The results are presented below:

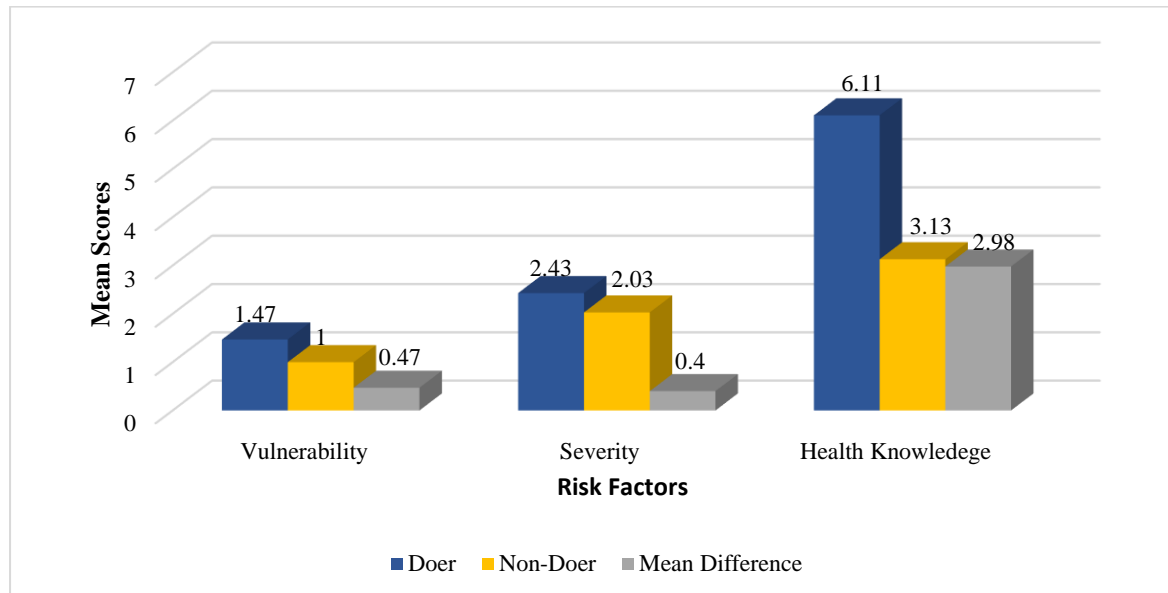


Figure 4.8: Doer and Non-Doer Risk Factors of Indiscriminate waste disposal

Source: Computation from Field Survey, 2021

A look at the risk factors as a behavioural change factor reveals that, health knowledge had the largest difference between the doers and non-doers. Health knowledge recorded a difference of (2.98) which is very significant, also, vulnerability presents the lowest mean difference (0.47) between doers and non-doers. This postulates that, behaviour change techniques that should be targeted majorly at the health knowledge aspect of the risks factor. The recommended behaviour change technique is The Information Behaviour Change Technique. With this technique, facts about indiscriminate waste disposal and possibilities of contracting diseases will be presented. Also, scenarios on indiscriminate waste disposal will be presented on how it leads to diseases.

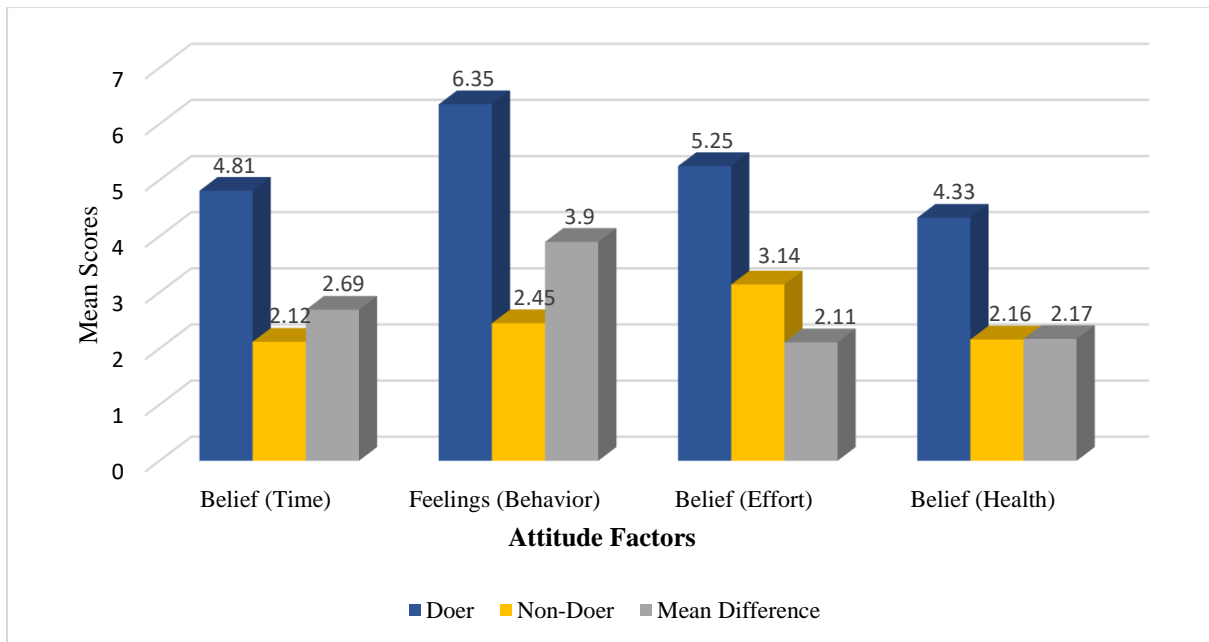


Figure 4.9: Doer and Non-Doer Attitude factors for Indiscriminate Waste disposal

Source: Computation from field data, 2021

Figure 4.9 stipulates that a Persuasive Behaviour Change Technique should be used under the behavioural factor, attitude factors, the beliefs about feelings should be major target under this behavioural factor to initiate behaviour change as the mean difference between the doers and non-doers is (3.9), A vivid description about performing the behaviour (indiscriminate waste disposal) and about the consequences of the behaviour. The second, beliefs about costs and benefits (time) should be targeted with information on the costs and benefits of disposing waste safely into bins for collection and indiscriminate waste disposal. A cost benefit analysis should also be conducted on the two behaviours for informal dwellers to understand the costs and benefits of both behaviours.

Beliefs about costs and benefits (health) participants should be prompted to talk to others about safe waste disposal for collection.

Also, with regards to beliefs about costs and benefits (effort), each time she/he has performed the desired behaviour, there should be a reward.

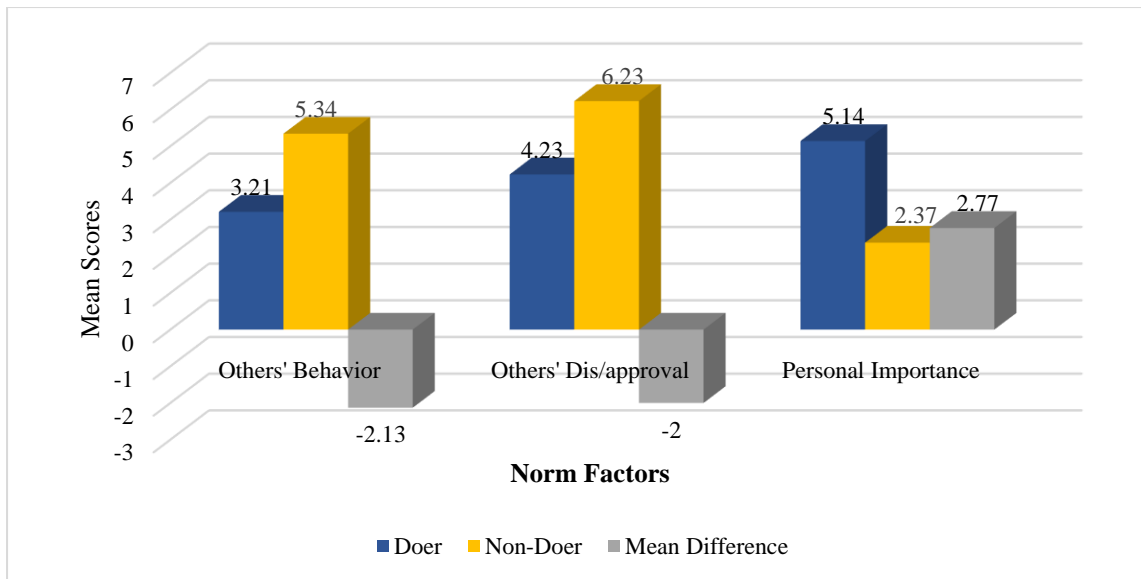


Figure 4.10: Doer and Non-Doer Analysis for Norm factors of Indiscriminate waste disposal
 Source: Computation from field data, 2021

Figure 4.10 presents the means of Norm factors, the results from the study postulates that, personal importance which records a mean difference of 2.77 is significant and must be majorly targeted during safe waste management interventions in the Municipality. Others' Behaviour saw the least mean difference (-2.13). In relation to Personal Importance, Behaviour change should be targeted at prompting anticipated regret with regards to making them imagine the regret after dumping waste indiscriminately. Secondly, describe people who manage waste safely in an attractive manner that safe waste disposal for collection will be increased. Finally, also prompt identification as a role model. This means to encourage participants to set good examples for children this will help to influence others to manage waste safely through the participants' behaviour.



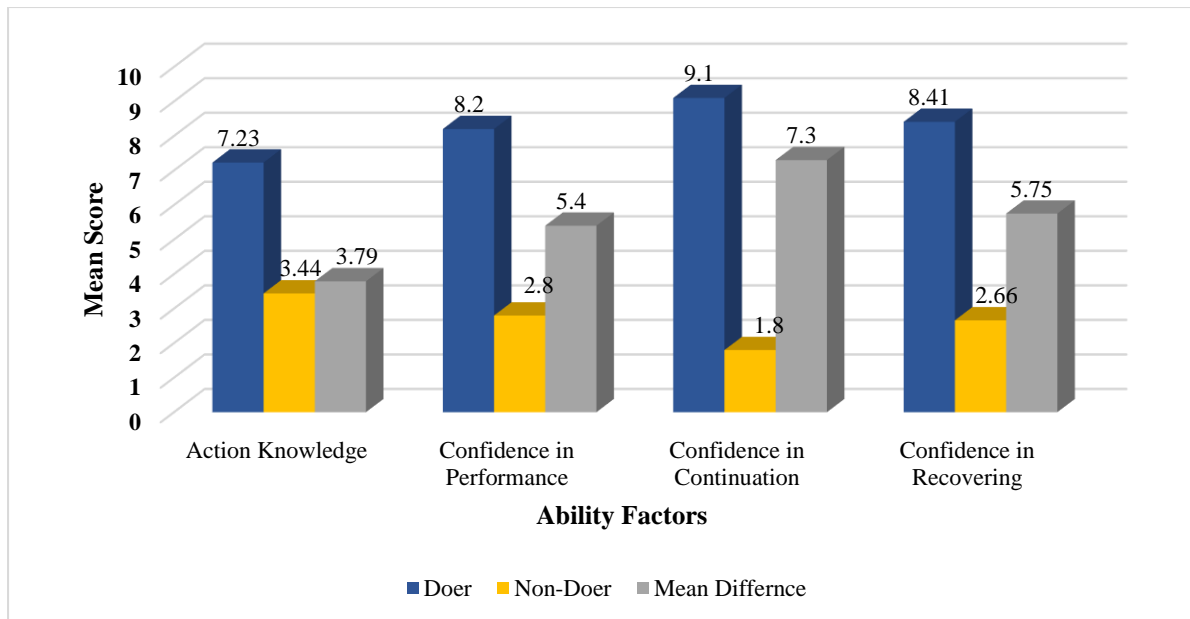


Figure 4.11: Doer and Non-Doer Analysis of Ability factors

Source: Computation from field data, 2021

Figure 4.11 shows the doer and non-doer analysis of the Ability factor in the RANAS model. This Behavioural factor requires the Infrastructural, skill and ability Behaviour Change Techniques. The Behavioural factor with the highest mean difference is Confidence in Continuation which has a mean difference of 7.3. the corresponding BCT for this Behavioural factor is the reattribution of past successes and failures. In this technique participants are prompted that their failures of practicing the behaviour is due to adverse circumstances. However, successes are attributed to participants' personal achievement.

In addition, for Behavioural factors under Confidence in Recovering which recorded a mean difference of 5.75. should be targeted to change indiscriminate waste disposal behaviour of informal dwellers. Specifically, Participants should be prompted that lapses are part of adopting the new behaviour (safe waste disposal into bins for collection) although it may be disappointing, it is not a sign of failure.

Again, the behaviour change technique towards Confidence in performance. Provide infrastructure for waste management and disposal.

Demonstrate and prompt participants to pay attention to others' performing their behaviour and its consequences in their everyday life.

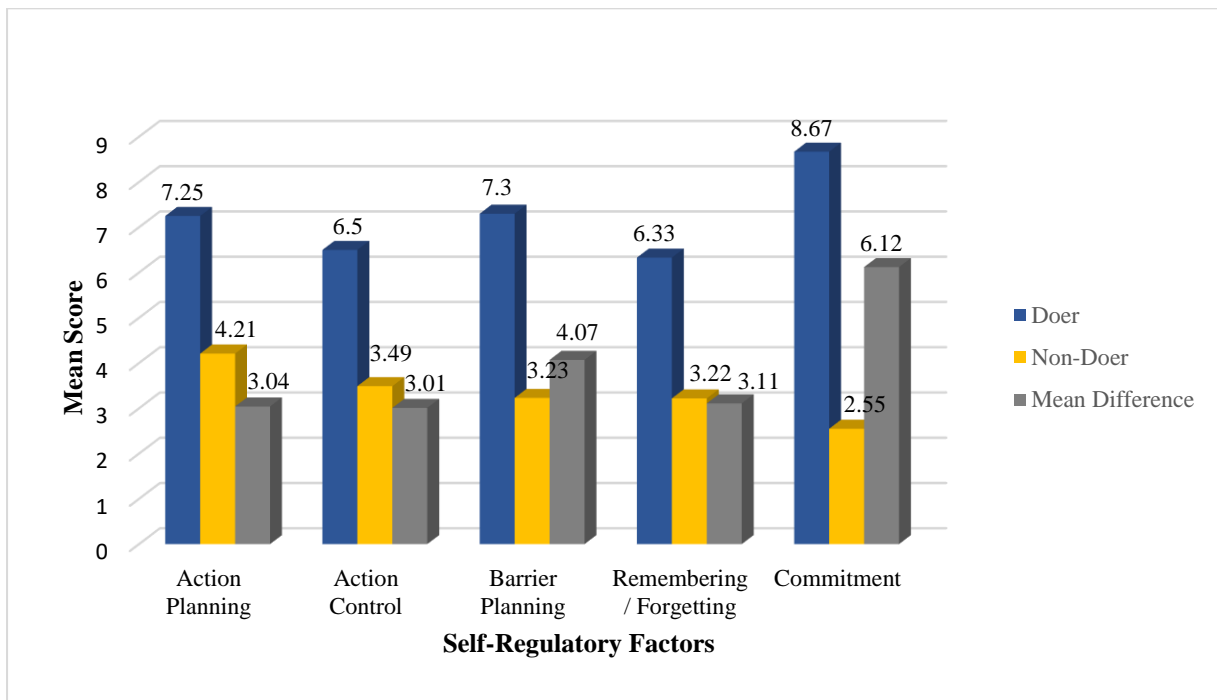


Figure 4.12: Doer and Non-Doer Analysis of Self-Regulatory factors.

Source: Computation from Field Survey, 2021

This figure 4.12 shows self-regulation factors, The chart shows significant differences between the doers and the non-doers of the behaviour, disposing waste into bins for collection. Behaviour change technique to target these factors include Planning and Relapse prevention behaviour change techniques.

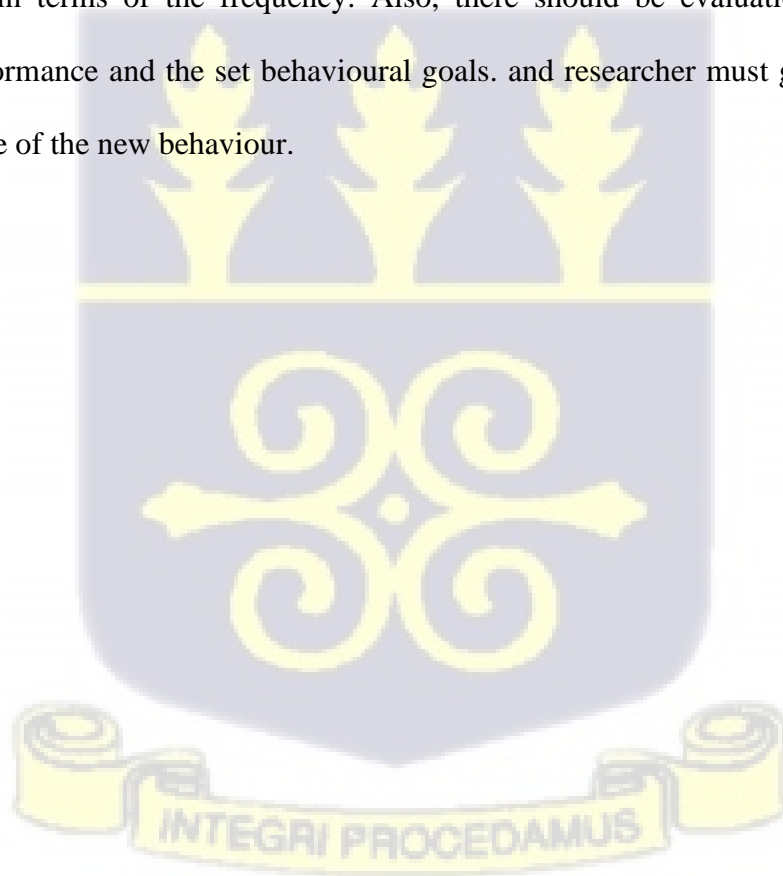
Commitment has the highest mean difference (6.12) between the doers and the non-doers. This behavioural factor is tackled with Planning and relapse prevention BCTs. Participant should be invited to formulate a goal or intention, and also to agree on a behavioural contract to settle his /her commitment in achieving the goals (dumping waste into bins for Collection).

The next significant behavioural factor that needs a target behavioural change technique is barrier planning. Participants should be stimulated on how, when where and how he/she intends to achieve safe waste management, by disposing waste into bins for collection. Thirdly,

Remembering/Forgetting behavioural factor also needs a target Behaviour change technique to enable safe waste management. Participant must be prompted to use memory aids or environmental to help to remember the new behaviour (disposing waste into bins for collection) so as to trigger the preferred situation (safe waste management).

Fourthly, behaviour change techniques for the behavioural factor barrier planning is prompting participants to identify barriers to the new preferred behaviour (disposing waste into bins for collection) and plan solutions. Restructure the social and physical environment so they do not interrupt habitual procedures to disposing waste safely. Participant must be prepared for negative comments from others' for managing their waste safely and pressures towards indiscriminate waste disposal.

Finally, with regards to the behavioural factor Action Control, participants must self-monitor the behaviour in terms of the frequency. Also, there should be evaluation of the actual behaviour performance and the set behavioural goals. and researcher must give feedback on the performance of the new behaviour.



CHAPTER FIVE

DISCUSSION

5.1 Maps and Characteristics of Informal Settlements

Helbert et.al 2019 postulates that identifying informal settlements is critical to achieve the United Nations SDGs. This is so because most of the vulnerable and socially excluded urban poor live in such places. Thus, it is necessary to identify them to achieve global targets such as the SDG goal 3,6 and 11; identifying these settlements brings them to the spotlight which may improve living conditions as a result. However, ad hoc approaches such as demolition sometimes are targeted towards these settlements after their identification.

In the case of the Adentan Municipality, adhoc approaches as demolishing is targeted at these pockets of informal settlements and it is considered as the only development measure towards such settlements. However, it was confirmed that, creation of awareness in these settlements was done periodically to improve sanitary conditions in such areas, although they had been earmarked for demolition.

The UN- Habitat (2016) definition of informal settlements as residential areas characterized by the lack of basic services, infrastructure, insecurity of land tenure and housing may not comply with housing regulations and standards. As these settlements are recognized as settlements that lack certain amenities including toilet facilities and waste collection services it is important to look at these salient characteristics.

Socio-demographic characteristics that aided profiling of these settlements included sex, age, employment status, marital status, level of income, educational level, residence duration, tenure arrangement and land ownership. Some significant characteristics in the UN-Habitat definition of informal settlements that syncs with the profiling characteristics for the study includes, tenure arrangement, level of income and educational level.

5.1.1 Socio Demographics and Social Information

5.1.1.1 Sex

The sex of respondents is important in demographic profiling. The Adentan Municipality sex structure is one that males dominate recording 39,366 (50.3%) and females 38,849 (49.7%) (GSS,2014.). The result from the study also reveals a similar structure (males 53% and Females 47%) with males dominating the population in informal settlements. This indicates that, the historical trend of only men migrating to find greener pastures is changing. An estimation can be made from the results that the number of women who migrate to cities is increasing. However, as a result of the unavailability of affordable housing, women who find themselves in urban centres with low- income jobs put up make-shift wooden structures as shelter (Tufour, 2009).The findings from the study confirms this, as well.

5.1.1.2 Employment Status and Level of Income

Informal dwellers are mostly engaged in the informal economic sector. A study in Port Harcourt revealed that, informal dwellers engaged in elementary trades (Deeyah, Ohochuku, & Eke, 2021). Similar to the informal dwellers in Adentan Municipality who engaged in their own informal business and were sometimes employed still in informal business which included were mostly elementary trades. artisanal occupations such as pot makers, electricians, masons, also, petty trading and hair dressing. An additional occupation which was agricultural was identified in these settlements as some dwellers were vegetable farmers. Economic activities in these settlements demonstrates low-income earnings as the results from the study reveals that 87.6% of the respondents in informal settlements in the Adentan Municipality were low-income earners. This finding confirms a similar study in Ayiya Zongo, recorded majority of dwellers as low income-earners as majority earned an average of GHC526 (Doe & Aboagye,

2020). which is below the national average of GHC 1387.05 (Ghana Statistical Services, 2014). The level of income recorded in these settlements contributes to the nature of economic hardships in these settlements. This serves as barriers to access basic services such a waste collection services in in informal settlements.

5.1.1.3 Residence Duration

The Ghana Statistical services indicate that an individual's usual place of residency is if an individual has lived at a particular place continuously for one year (GSS, 2021). The number of years of residence duration recorded postulates that most residents of informal settlements in the area are usually residents since the duration range, 1-5 years, recorded the most. This indicates that informal settlements are in long-term existence, and ad-hoc approaches such as demolishing these settlements do solve the problems in these settlements (Tufour, 2009). Therefore, governments should take a second look at the slum upgrading section in the Ministry of Works and Housing Policy to achieve SDG 11, target 11.1.

5.1.1.4 Land Tenure Arrangement and Land Ownership

Land tenure is very critical when upgrading measures are being put in place. It has been established in the literature that informal settlements lack security of tenure. To confirm this, a question on the land tenure arrangement of respondents was asked. The response that dominated was squatting. Squatting refers to a situation where the household occupies a place without permission from the owner (GSS, 2021). Lands occupied in informal settlements were mainly owned by private individuals and the government. Due to this characteristic in informal settlements, the residents faced constant threats of eviction which the literature has proved affects the mental health of informal dwellers.

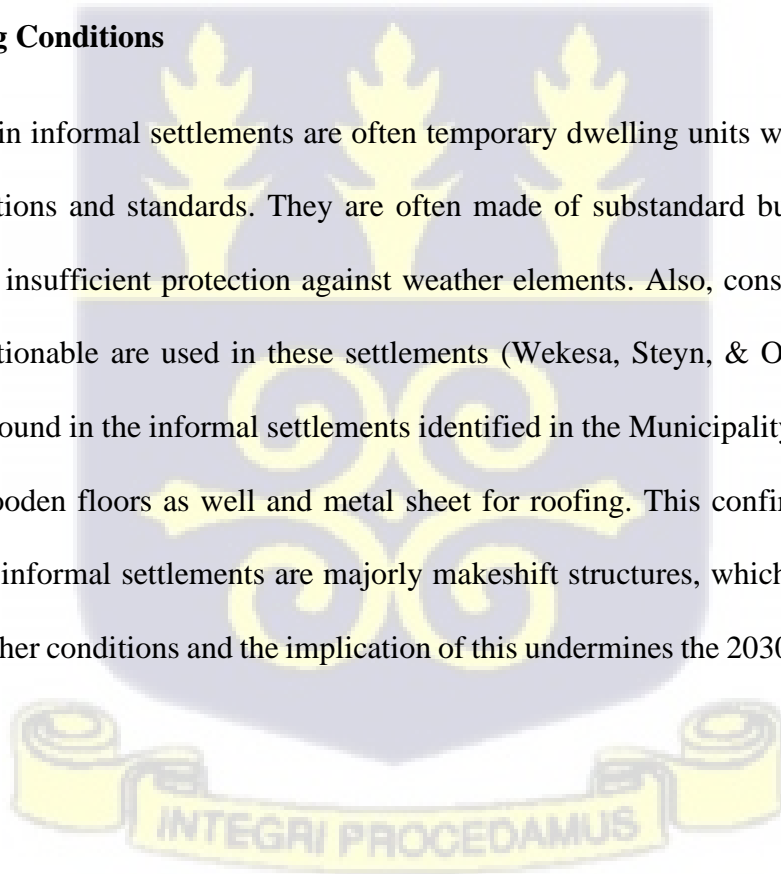
5.1.2 Physical Characteristics

5.1.2.1 Location

Informal settlements identified in the Municipality were located in 9 out of the 15 communities in the Municipality. These communities included Amrahia, Amanfrom, Adenta, Ashale Botwe, Obojo, Nmai Dzorn, Otanor, Otinshie and Adringanor. These settlements are usually found in places of low environmental quality (Wekesa, Steyn, & Otieno, 2011). In relation to hazardous locations, some settlements in Adringanor, were along the Tema Motorway, a major high road and, dumpsite which they had created (Plate 1). Those informal settlements in Obojo were also close to a dumpsite and a contaminated water body. The locations of some of the settlements identified exposed dwellers to health hazards and the environmental quality in some of these settlements is reduced. This confirms (Wekesa, Steyn & Otieno, 2011)'s study.

5.1.2.2 Housing Conditions

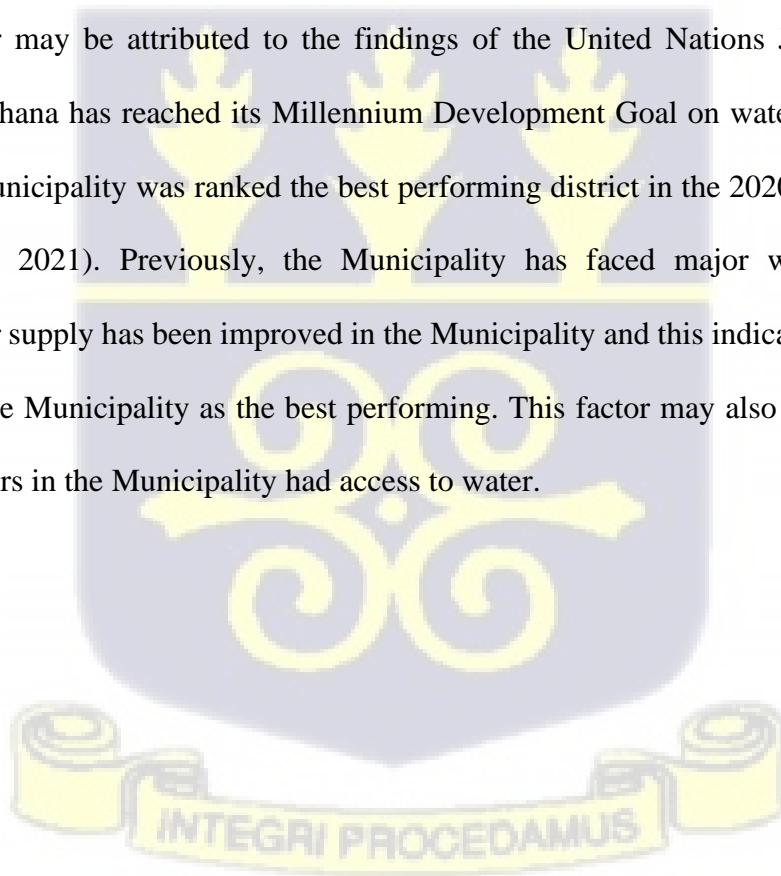
Dwelling units in informal settlements are often temporary dwelling units which do not meet building regulations and standards. They are often made of substandard building materials, which provides insufficient protection against weather elements. Also, construction methods which are questionable are used in these settlements (Wekesa, Steyn, & Otieno, 2011). The dwelling units found in the informal settlements identified in the Municipality had walls made of plywood, wooden floors as well as metal sheet for roofing. This confirms the fact that, dwelling units' informal settlements are majorly makeshift structures, which are not resilient to climatic weather conditions and the implication of this undermines the 2030 Agenda of SDG Goal 11.



5.1.2.3 Access to basic services

Informal settlements are usually characterized as areas which lack basic services such as potable water, storm drainage, sewerage systems, sanitation, waste collection services (UN-Habitat, 2014). In the Adentan Municipality, some informal settlements had waste collection from the informal waste collection services such as the tricycles or *borla taxis*, However, a significant percentage of the respondents practiced burning and dumping waste indiscriminately. This may be attributed to the low-income levels and risk behavioural factor, where knowledge on the direct health implications of the practice is unknown.

However, regarding access to water, majority of informal settlements had access to potable water. The acquired water supply from both vendors onsite and offsite their areas of abode. Vendor supply recorded about as 25 litres of water went for about GHC 1. The record of major access to water may be attributed to the findings of the United Nations Joint Monitoring Program that Ghana has reached its Millennium Development Goal on water. Also, recently the Adentan Municipality was ranked the best performing district in the 2020 District League Table (Odame, 2021). Previously, the Municipality has faced major water challenges. However, water supply has been improved in the Municipality and this indicator was included in measuring the Municipality as the best performing. This factor may also be a reason why informal dwellers in the Municipality had access to water.



5.2 Sources of Pollution

Environmental Pollution is a major issue globally, especially in developing nations. There is broad knowledge on the issue of pollution. Studies on pollution reveal the main types of pollution which are found in the immediate environment include soil/land pollution, air pollution, water pollution and noise pollution. The results of the study revealed all these types of pollution are present in the informal settlements in the Adentan Municipality. The study revealed land pollution as a major type of pollution in informal settlements in the Municipality. Contrary these findings, a study in Dhaka which found that air pollution was the largest form of Pollution attributed to automobiles and industries (Nahar, Mahiuddin, & Hossain, 2021). Land pollution was the largest in the informal settlements in the Municipality followed by air pollution, noise, and water as the least. The sources of pollution found in the Adentan Municipality was due to the lack of municipal waste and wastewater disposal facilities similar to the causes of land pollution in Dhaka.

5.3 Indiscriminate Waste Disposal on Health and The Environment

There was a significant difference between the health and indiscriminate waste disposal informal dwellers practiced. The environmental challenges which included land pollution and air pollution mentioned by dwellers which was due to the burning of refuse and the indiscriminate dumping of refuse. This in turn affects the health of dwellers as waste disposed serve as breeding grounds for vectors that transmit diseases. The multiple regression model used in the study (table 4.6) shows the variables solid waste disposal, defecation location and waste water disposal influence environmental pollution and health risks present in informal settlements. Mosquitoes were identified as the vectors most informal dwellers were exposed to. Houseflies and pests bred from indiscriminate dumping were also observed as potential

health risks to the dwellers of these settlements. This is in line with the findings as the study shows a link between refuse collection and its effect on health. (Corburn & Sverdlik, 2018) The most prevalent health risks identified in informal settlements in the Adentan Municipality included Malaria and Respiratory infections which are as a result of Indiscriminate waste disposal.

5.4 Behaviour Change Techniques

In order to change unaccepted behaviours to preferred behaviours, behavioural factors are key to establish critical behaviours. In this study, all behavioural factors including risks, attitudes, norms, ability and self-regulatory factors were important in identifying behavioural change techniques that can change indiscriminate waste disposal behaviour of informal dwellers in the Adentan Municipality. Behaviour Change Techniques identified included Information BCTs, Persuasive BCTs, Norm BCTs, Infrastructural, Skill and Ability BCTs and Planning and Relapse BCTs contrary to Huber, Tobias, & Mosler (2014) who identified only Persuasive BCTs for behavioral change campaign on using filtered water in Ethiopia to prevent fluorosis. In this study, the most critical behavioural factors that influenced indiscriminate waste disposal was health knowledge under the risk behavioural factors. This implies that, most dwellers in informal settlements do not realise any direct linkages of practicing indiscriminate waste disposal and the health. This may be one of the reasons why they still dump waste haphazardly instead of resulting to borla taxis available for waste collection. Thus awareness creation of such linkages should be included in behavioural change strategies.

To enlighten dwellers on health implications of a behaviour. Awareness is usually the first step taken. the severity of a disease and a person's vulnerability are usually the major components of awareness creation as indicated by this study. However (Huber, Tobias, & Mosler, 2014) is

of the view that, risk perceptions, which includes perceived severity and perceived vulnerability, may seldomly be the major factors that affect executing a new behavior.

Also, as critical behavioural factors differ from each geographical setting, interventions should be develop in reference to the baseline data gathered to increase the effectiveness of behaviour change techniques identified.



CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusions

The study provided theory-based evidence on informal settlements, sources of pollution, and techniques to change indiscriminate waste disposal behaviour using the RANAS Model. The prominent characteristics in informal settlements were the lack of basic services. The lack of these services especially waste disposal facilities and grey water containment facilities, were the major sources of environmental challenges (pollution). The study was conducted in the Adentan Municipality. All subjects of the study were dwellers of informal settlements.

In summary, the study points to the following salient findings;

Informal settlements identified in the Municipality were located in 9 of the 15 communities. These settlements were clustered wooded housing units, which explains the term used to address such settlements in the Municipality as *kiosk estates*. The total number of housing units identified numbered 2038, with an estimated population of 7498.8. The communities with the highest clusters of informal housing units were Adringanor and Obgojo, respectively. Most of these clusters were situated along the Tema Motorway, under high tension and close to a water body, which posed health hazards to dwellers.

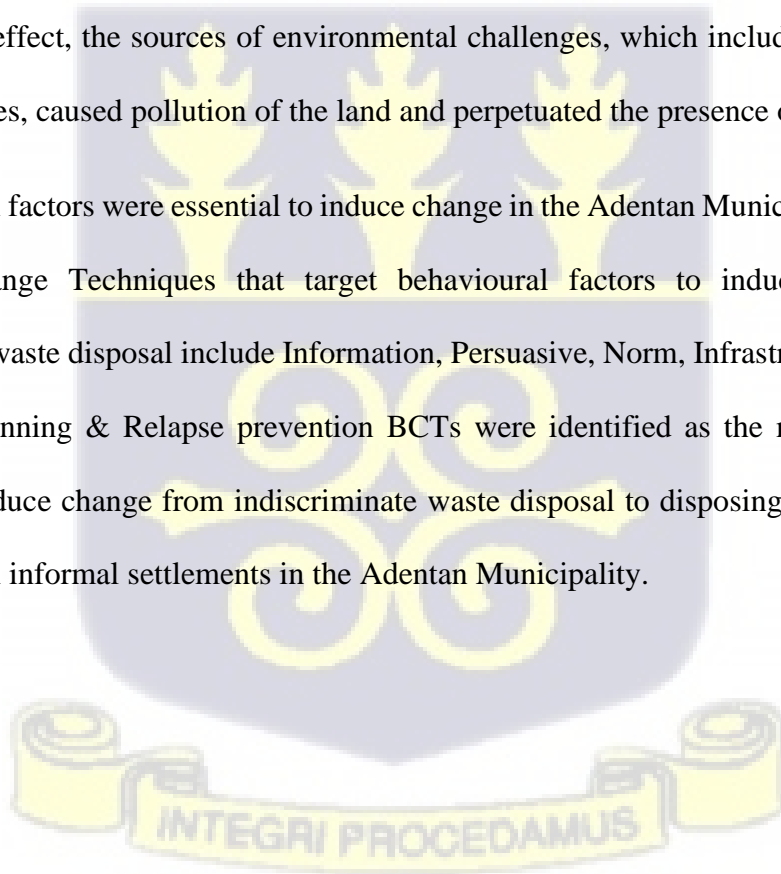
Regarding access to basic services, most of the clusters identified lacked access to toilet facilities. Those with toilet facilities were usually shared at an estimated average ratio of 1 toilet: 50 households, which is way below the specified standards of shared toilet facilities. Also, most of the clusters lacked access to waste disposal facilities and collection services, which had implications as most of the dwellers resorted to indiscriminate dumping and burning, which had implications for the environment and the health of dwellers. However, regarding water supply, most of these clusters had access to pipe-borne water but came at a fee for

fetching, which settlers complained was expensive. Greywater containment was also a major lacking facility in almost all of these settlements.

The demographic and the social profile of participants of the study revealed that the informal dwellers are a youthful population, as the age range of 26-35 recorded the highest number of respondents. Also, most of the respondents were squatters which shows a lack of security of tenure that explained the constant threats of eviction. Most dwellers had basic formal education in terms of education and economic activities. However, the majority of them were low-income earners, which explained their living conditions.

The effect of indiscriminate waste disposal on the health of dwellers and the environment was established as a positive relationship was established between the two. Health risks dwellers mentioned included exposure to malaria and respiratory infections. Regarding the environmental effect, the sources of environmental challenges, which included lack of waste disposal facilities, caused pollution of the land and perpetuated the presence of pests and flies.

All Behavioural factors were essential to induce change in the Adentan Municipality. Thus, the Behaviour Change Techniques that target behavioural factors to induce change from indiscriminate waste disposal include Information, Persuasive, Norm, Infrastructural, skill and ability, and Planning & Relapse prevention BCTs were identified as the major techniques which could induce change from indiscriminate waste disposal to disposing of waste in bins for collection in informal settlements in the Adentan Municipality.



6.2 Recommendations

Based on the findings of the study, the following recommendations are made;

Firstly, Informal settlements are alternative sources of housing for the urban poor and hence must be recognized as a reality caused by rapid urbanization. The Municipal Assembly should therefore recognize these settlements in terms of provision of sanitary and waste disposal facilities and collection services. Also, engaging dwellers in capacity-building programs such as behavioural change sensitization to curb the menace of indiscriminate waste disposal significantly.

Secondly, Monitoring and Evaluation is a crucial activity the municipality must conduct in all communities to curb the proliferation of these settlements. Also, since these settlements already exist, M&E visits to these sites is vital to measure the impact of sensitization programs.

Thirdly, although these informal dwellers lack security of tenure, demolition is not a sustainable solution to eliminate the presence of these settlements as employed by the Municipal Assembly. Transdisciplinary stakeholder engagement should be considered as the presence and conditions of the settlements is critical in attaining the SDG Goal 11 and other goals such as Goal 6.

Again, Interventions in informal settlements should not include the hardware provision software approaches such as behavioural factors should be considered in interventions as these result in sustainable solutions.

Finally, as informal settlements lack access to basic services (waste disposal facilities, toilet facilities, and grey water containment), which are key determinants of health, official data collection(census) in these settlements must be improved. This will help in easily identifying health risks in informal settlements.

6.3 Areas for Further Study

In the course of the study, three major old towns identified in the Municipality were also classified as informal settlements but did not fall within the scope of this study. However, these settlements had access to basic services; further study is recommended on whether/ not these services are utilized.

Secondly, the study recommends further long-term studies on implementing the behaviour change techniques identified can be done to evaluate the effectiveness of these techniques. This study's findings provide a key foundation for further theory and evidence-based intervention research on eliminating indiscriminate waste disposal behaviour in informal settlements.



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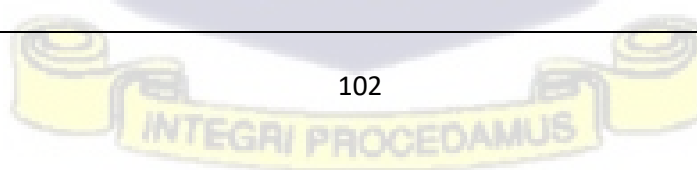
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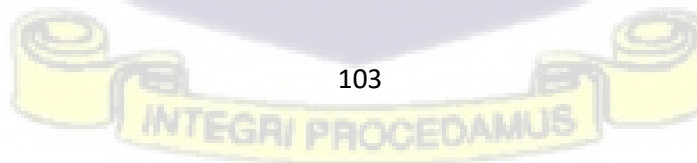
APPENDICES

APPENDIX A: QUESTIONNAIRE

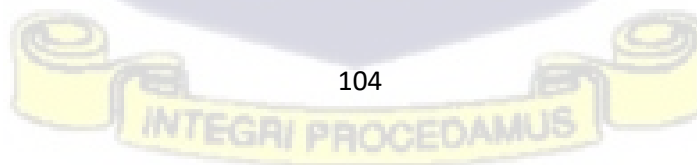
INFORMAL SETTLEMENTS AND POLLUTION BEHAVIOUR IN THE ADENTAN MUNICIPALITY, ACCRA					
<p>This questionnaire is designed for informal dwellers in the Adentan Municipality to assess the sources of pollution, the effect of pollution on the environment and on dwellers themselves. The questionnaire is divided into two sections. Section A is made up the demographics of informal dwellers and questions to establish the sources of pollution, impact of sources of pollution on the health of dwellers and the environment (land/water sources). The second part which is the Section B establishes and measures the Behaviour of the informal dwellers towards the environment and to identify behaviour change strategies particularly for these settlements.</p>					
Section A					
Demographic Information					
1) Sex					
1. Male <input type="checkbox"/>	2. Female <input type="checkbox"/>				
2) Employment Status					
1. Employed in formal sector <input type="checkbox"/>	2. Self-employed in informal sector <input type="checkbox"/>	3. Employed in informal business <input type="checkbox"/>	4. Unemployed <input type="checkbox"/>		
3) Marital Status					
1. Single <input type="checkbox"/>	2. Married <input type="checkbox"/>	3. Cohabiting/Living Together <input type="checkbox"/>	4. Divorced <input type="checkbox"/>	5. Separated <input type="checkbox"/>	6. Widowed <input type="checkbox"/>
4) Level of Income (What is the average amount you earn monthly?)					
1. High. 1500 and above <input type="checkbox"/>	2. Middle 500-1000 <input type="checkbox"/>	3. Low. less than 200 <input type="checkbox"/>	4. None <input type="checkbox"/>		
5) Educational Level					



1.Primary	2. Junior High <input type="checkbox"/>	3.Secondary <input type="checkbox"/>	4. Tertiary <input type="checkbox"/>	5. None <input type="checkbox"/>		
6) Age						
1. 18-25 <input type="checkbox"/>	2. 26-25 <input type="checkbox"/>	3. 35-45 <input type="checkbox"/>	4. 36-45 <input type="checkbox"/>	5.46 and above <input type="checkbox"/>		
7) Community of Study?						
8) How long have you lived here?						
1. Less than a year <input type="checkbox"/>	2. 1-5 <input type="checkbox"/>	2. 6-10 <input type="checkbox"/>	3. 11-20 <input type="checkbox"/>	4. Above 20 years <input type="checkbox"/>		
9) What is the tenure arrangement of this land your dwelling unit is situated on?						
1.Owner <input type="checkbox"/>	2. Renting <input type="checkbox"/>	3.Rent-free <input type="checkbox"/>	4.Perching <input type="checkbox"/>	5.Squatting <input type="checkbox"/>	6.Caretaker <input type="checkbox"/>	
10) Who owns this land?						
1.Estate Developer <input type="checkbox"/>	2.Family Property <input type="checkbox"/>	3.Private individual <input type="checkbox"/>	4.Private Employer <input type="checkbox"/>	5.Public/Government <input type="checkbox"/>	6.Other <input type="checkbox"/>	
Sources of Pollution						
11) What has your experience been like living in this informal settlement, especially with the lack of services (waste disposal facilities and waste collection, toilet facilities, wastewater containment)?						
1.Very Bad <input type="checkbox"/>	2.Bad <input type="checkbox"/>	3.Neither good nor bad <input type="checkbox"/>	4. Good <input type="checkbox"/>	5.Very Good <input type="checkbox"/>		
12) Which of the following constitute the basic services, this particular settlement lacks? Rank using a scale from 1-5, whereby 1 depicts the most lacked basic service and 5 the least.						
1.Clean Drinking water sources <input type="checkbox"/>	2. Waste disposal Facilities <input type="checkbox"/>	3. Toilet Facilities <input type="checkbox"/>	4.Grey water containment <input type="checkbox"/>	5.None <input type="checkbox"/>		
13) Do you think that this area is suitable for residential purposes, considering the lack of basic facilities? If No give your reasons in the space provided.						
1. Yes <input type="checkbox"/>	2. No <input type="checkbox"/>					



14) Which of the following constitute the major environmental problems experienced in this area? Rank using a scale 1-7, where 1 depicts the major problem and 7-the least.						
1. Water Pollution <input type="checkbox"/>	2. Air Pollution <input type="checkbox"/>	3. Land Pollution <input type="checkbox"/>	4. Noise Pollution <input type="checkbox"/>	5. Pests and Flies <input type="checkbox"/>	6. Fire Hazards <input type="checkbox"/>	7. Flooding <input type="checkbox"/>
15) What are the major causes / sources of the environmental challenges experienced in this settlement? (Rank 1-7) depicts major source and 7-least source						1
1. Lack of improved toilet facilities <input type="checkbox"/>	2. Lack of solid waste and liquid waste disposal facilities <input type="checkbox"/>	3. Noise due to proximity of vehicles to major road <input type="checkbox"/>	4. Over crowdedness <input type="checkbox"/>	5. Poverty <input type="checkbox"/>	6. Ourselves <input type="checkbox"/>	7. Other <input type="checkbox"/>
16) Who is responsible in your area for addressing these environmental problems? Answer in the space provided						
17) Are there any health risks associated with the environmental challenges and sources of environmental challenges present in this settlement?						
1. Strongly Agree <input type="checkbox"/>	2. Agree <input type="checkbox"/>	3. Neither Agree nor Disagree <input type="checkbox"/>	4. Disagree <input type="checkbox"/>	5. Strongly Disagree <input type="checkbox"/>		
18) What cooking fuel do you use in this household						
1. Wood <input type="checkbox"/>	2. LPG <input type="checkbox"/>	3. Charcoal <input type="checkbox"/>	4. Electricity <input type="checkbox"/>	5. Other <input type="checkbox"/>		
19) What refuse receptacle is mainly used to store rubbish?						
1. Covered Standard Waste Bin <input type="checkbox"/>	2. Container with cover <input type="checkbox"/>	3. Sack <input type="checkbox"/>	4. Uncovered Container <input type="checkbox"/>	5. Other <input type="checkbox"/>	5. No Receptacle <input type="checkbox"/>	
20) How do you dispose of rubbish?						
1. Compaction Truck <input type="checkbox"/>	2. Tricycles <input type="checkbox"/>	3. Central Container/Skip <input type="checkbox"/>	4. Burn <input type="checkbox"/>	5. Bury <input type="checkbox"/>	6. Dumped Indiscriminately <input type="checkbox"/>	
21) How frequent is waste collected in your area? (Those who use tricycles/ compaction truck)						

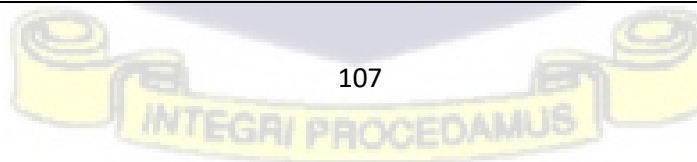


1. Daily <input type="checkbox"/>	2. Weekly <input type="checkbox"/>	3. Monthly <input type="checkbox"/>	4. Not Collected <input type="checkbox"/>	5. Other <input type="checkbox"/>		
22) How can waste be minimized in this area?						
1. Composting <input type="checkbox"/>	2. Reusing <input type="checkbox"/>	3. Recycling <input type="checkbox"/>	4. Source Separation <input type="checkbox"/>			
23) What type of toilet facility is mainly used by your household?						
1. Pit laterine <input type="checkbox"/>	2. KVIP/VIP <input type="checkbox"/>	3. Public Toilet <input type="checkbox"/>	4. No Toilet Facility <input type="checkbox"/>			
24) Where do you defecate (for those with no toilet facility).						
1. In Chamber pot <input type="checkbox"/>	2. In polythene Bag <input type="checkbox"/>	3. In bush/open field/gutter <input type="checkbox"/>				
25) How is wastewater (water from bathing, kitchen, laundry) disposed of?						
1. Flows/ Thrown into drains <input type="checkbox"/>	through drainage into pit (soakaway) <input type="checkbox"/>	thrown/flows onto ground <input type="checkbox"/>	4. through sewerage systems <input type="checkbox"/>	5. Other <input type="checkbox"/>		
26) What is your main source of drinking water?						
1. Sachet Water <input type="checkbox"/>	2. Pipe-Borne on Neighbour's compound <input type="checkbox"/>	3. Pipe-borne outside dwelling but on compound <input type="checkbox"/>	4. Public Standpipe <input type="checkbox"/>	5. Vendor/ Tanker Supplied <input type="checkbox"/>	6. Other <input type="checkbox"/>	
27) What is your main source of water for domestic activities (cooking, washing, bathing)?						
1. Pipe-Borne on Neighbour's compound <input type="checkbox"/>	2. Pipe-borne outside dwelling but on compound <input type="checkbox"/>	3. Public Standpipe <input type="checkbox"/>	4. Vendor/ Tanker Supplied <input type="checkbox"/>	5. Other <input type="checkbox"/>		
28) What is the community's attitude towards environmental conservation? (Things done by the community to avoid pollution and keep the environment clean)						

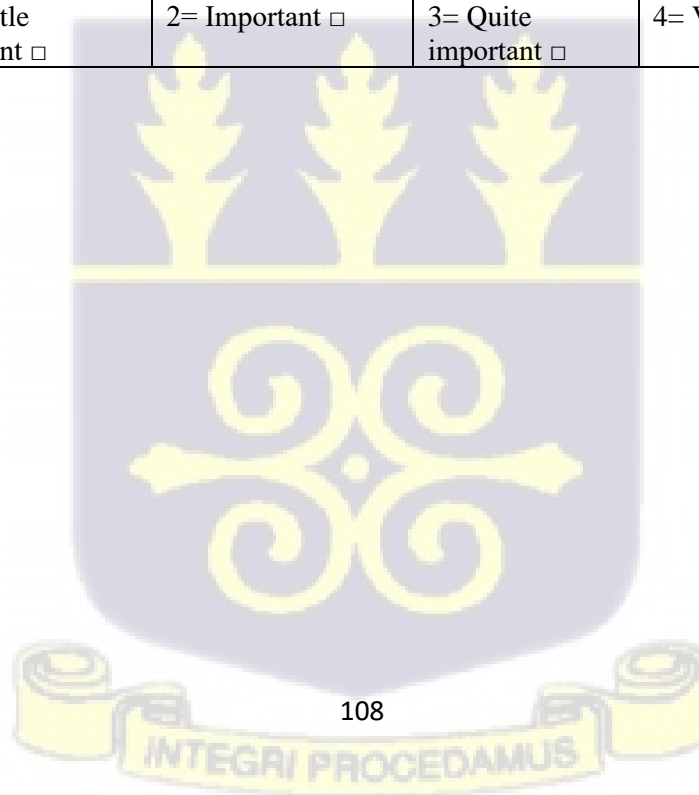
1. Positive <input type="checkbox"/>	2. Negative <input type="checkbox"/>					
29) Is there any need to protect the environment from pollution?						
1. Yes <input type="checkbox"/>	2. No <input type="checkbox"/>					
30) How best do you think this could be done?						
31) What do you think the community should do about it?						
Section B: This Section Measures Behavioural Factors that Influences indiscriminate waste disposal						
32) How much of your household waste generated is stored in a receptacle (Bin, sack, container) for collection?						
0=None <input type="checkbox"/>	1=Less than half <input type="checkbox"/>	2=About half <input type="checkbox"/>	3=More than half <input type="checkbox"/>	4= All <input type="checkbox"/>		
33) How strongly do you intend to dispose waste in a standard container for collection						
0=Not strongly <input type="checkbox"/>	1=A little strongly <input type="checkbox"/>	2=Strongly <input type="checkbox"/>	3= Quite Strongly <input type="checkbox"/>	4= Very Strongly <input type="checkbox"/>		
34) How much do you feel that you dispose your household waste in a (bin, sack, container) for collection automatically?						
0= Not automatically <input type="checkbox"/>	1= A little automatically <input type="checkbox"/>	2=Automatically <input type="checkbox"/>	3= Quite Automatically <input type="checkbox"/>	4= Very Automatically <input type="checkbox"/>		
35) Could you please tell me if these activities can cause diseases						
1. Open Defecation <input type="checkbox"/>	2. Indiscriminate Solid Waste Disposal <input type="checkbox"/>	3. Indiscriminate Wastewater disposal <input type="checkbox"/>	4. Burning solid waste <input type="checkbox"/>			
36) Do you know if indiscriminate waste disposal pollutes the environment?						
1. Yes <input type="checkbox"/>	2. No <input type="checkbox"/>					
37) How high do you feel at risk that you can contract malaria from indiscriminate waste disposal?						
0=No risk	1= At little risk	2= At risk	3= Quite risk	4= A high risk		
38) In case you contract Malaria, how damaging will the impact be on your daily life?						
0= Not severe	1= A little severe	2= Severe	3= Quite Severe	4= Very severe		



39) Do you think disposing waste into either bins, containers, sack for collection requires much effort?						
0= Not much effort	1= A little effort	2= effort	3=Some effort	4= Much effort		
40) Do you think disposing waste into either bins, containers, ack for collection is time consuming?						
0= Not time consuming <input type="checkbox"/>	1=A little time consuming <input type="checkbox"/>	2= Time consuming <input type="checkbox"/>	3= Quite time consuming <input type="checkbox"/>	4= Very time consuming <input type="checkbox"/>		
41)How certain are you storing waste in bins, sack, containers prevent you from getting malaria?						
0=Not certain <input type="checkbox"/>	1= A little certain <input type="checkbox"/>	2= Certain	3= Quite Certain	4= Very certain		
42) Do you like to dispose your household waste safely into bins/sacks/containers for collection?						
0=Don't like it <input type="checkbox"/>	1= Like it a little <input type="checkbox"/>	2= Like it <input type="checkbox"/>	3= Quite like it <input type="checkbox"/>	4= Like it a lot <input type="checkbox"/>		
43) How many people in your community dispose their waste safely into bins/sacks/containers for collection?						
0= Nobody <input type="checkbox"/>	1= Some of them <input type="checkbox"/>	2= Half of them <input type="checkbox"/>	3= Most of them <input type="checkbox"/>	4= All of them <input type="checkbox"/>		
44) Do important people to you approve/ disapprove bins/ sacks/ containers as a final place for waste storage before collection?						
0= Disapprove a lot <input type="checkbox"/>	1= Disapprove <input type="checkbox"/>	2= Neither approve nor disapprove <input type="checkbox"/>	3. Approve <input type="checkbox"/>	4. Approve a lot <input type="checkbox"/>		
45) How strongly do you feel an obligation to dispose your household waste safely into waste bins for collection?						
0=Not Obligated	1= A little obliged	2= Obligated	3= Quite Obligated	4= Very obliged		
46) Do you know the process of getting a standard waste container registered for collection?						
1. Yes <input type="checkbox"/>	2. No <input type="checkbox"/>					
47) How confident are you that you can dispose your waste safely into a waste bin for collection?						
0= Not confident <input type="checkbox"/>	1= A little confident <input type="checkbox"/>	2= Confident <input type="checkbox"/>	3= Quite confident <input type="checkbox"/>	4= Very confident <input type="checkbox"/>		
48) How confident are you that you will continue to dispose waste safely into waste bins for collection considering the substantial amount paid for collection?						
0= Not confident <input type="checkbox"/>	1= A little confident <input type="checkbox"/>	2= Confident <input type="checkbox"/>	3= Quite confident <input type="checkbox"/>	4= Very confident <input type="checkbox"/>		
49) In case the waste collection trucks do not pick up your waste up as frequent as they should and you start disposing your waste unsafely, are you confident that you can start using the standard waste container and the collection services						



0= Not confident <input type="checkbox"/>	1= A little confident <input type="checkbox"/>	2= Confident <input type="checkbox"/>	3= Quite confident <input type="checkbox"/>	4= Very confident <input type="checkbox"/>		
50) Do you have a plan on when to dispose your waste in the day? If yes, could you specify the point in time?						
51) How much attention do you pay to disposing waste safely in waste bins for collection?						
0= Pay no attention <input type="checkbox"/>	1= Pay little attention <input type="checkbox"/>	2= Pay attention <input type="checkbox"/>	3= Quite pay attention <input type="checkbox"/>	4= Pay much attention <input type="checkbox"/>		
52) Do you have a plan on how to manage your own waste safely even if collection trucks are unavailable? (Burn them, dump them in bush=bad plan; separate organics from inorganics, give plastics out for recycling =good plan)						
53) How often do you forget to dispose waste into standard waste container?						
0= Never <input type="checkbox"/>	1= Seldom <input type="checkbox"/>	2= Sometimes <input type="checkbox"/>	3= Often <input type="checkbox"/>	4= Very Often <input type="checkbox"/>		
54) How important is it for you to dispose your waste safely into standard waste containers?						
0= Not important <input type="checkbox"/>	1= A little important <input type="checkbox"/>	2= Important <input type="checkbox"/>	3= Quite important <input type="checkbox"/>	4= Very important <input type="checkbox"/>		



APPENDIX B: INTERVIEW GUIDE

INFORMAL SETTLEMENTS AND POLLUTION BEHAVIOUR IN THE ADENTAN MUNICIPALITY

INTERVIEW GUIDE

Interview Protocol for Environmental Health Officer

Interview Date..... Time

My name is Eugenia Ama Akofua Annan. I am a student from the Institute for Environment and Sanitation Studies, University of Ghana. As part of my MPhil Programme, I am conducting a study on ‘**Informal settlements and pollution behaviour in the Adentan Municipality, Accra.**’ As an Environmental Sanitation Student your input will help give me a better understanding of the environmental challenges these settlements pose to the municipality and measures in place to resolve such challenges. The interview is anonymous, and all information gathered will be treated with confidentiality.

A) Biodata

1. Position of interviewee.....

2. Gender: 0. Male 1. Female

- 1) Tell me about yourself and your responsibilities in the Adentan Municipality?
- 2) What are the characteristics of informal settlements in the municipality?
- 3) In which areas in the municipality are informal settlements prominent?
- 4) Is there a map for only informal settlements in the Municipality?
- 5) Do you think that informal settlements are suitable for residential purposes? If not, why?
- 6) What are the sources of environmental challenges experienced in informal settlements?
 - Which of the environmental challenges do you think are more prevalent in informal settlements?

- 7) How do these challenges pollute the environment?
- 8) What do you think are the possible solutions to the negative impacts which informal settlements have on the environment?
- 9) Are there any health risks associated with the environmental impacts present in informal settlements?
 - If yes, how?
- 10) What measures have authorities in the Adentan Municipality taken to reduce pollution from indiscriminate waste disposal and open defecation in informal settlements? Do these measures include any behaviour change strategy?
- 11) What is the behaviour of dwellers in informal settlements towards their responsibility in limiting pollution (indiscriminate waste disposal and open defecation) in their environment?
- 12) How is waste disposed of in informal settlements?
- 13) How can waste be minimized in informal settlements?
- 14) How frequent does municipality collect garbage in informal settlements?
- 15) Is there any need to protect the environment from pollution? How best do you think this could be done?
- 16) Do you know of any health problems associated with pollution from indiscriminate waste disposal and open defecation? If yes, what are they?
- 17) With regards to these health problems, what do you suggest people should do to minimize them?

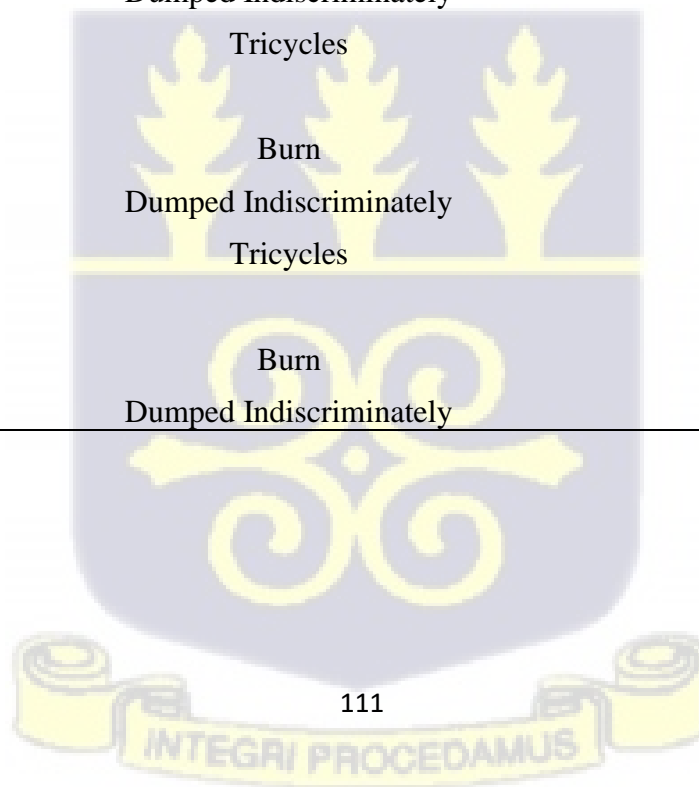
Interviewer: Eugenia Ama Akofua Annan

Course: Environmental Sanitation Studies

Institution: University of Ghana Legon

APPENDIX C: WASTE DISPOSAL METHODS IN COMMUNITIES

ADRINGANOR	Waste Disposal Methods	Frequency	Percent
	Burn	26	29.50%
	Dumped Indiscriminately	56	63.60%
	Tricycles	6	6.80%
OBOJO			
	Burn	32	36.40%
	Dumped Indiscriminately	5	5.70%
	Tricycles	51	58%
ADENTA			
	Burn	20	22.80%
	Dumped Indiscriminately	9	10.20%
	Tricycles	59	67.00%
AMANFROM			
	Burn	40	45.50%
	Dumped Indiscriminately	48	54.50%



APPENDIX D: RANKING OF MAJOR ENVIRONMENTAL CHALLENGES IN EACH COMMUNITY

Adringanor

	Mean	SD	RII	Rank
Air Pollution	3.71	0.19	0.66	4
Water Pollution	4.47	0.12	0.57	6
Land Pollution	4.82	0.11	0.91	1
Noise Pollution	4.74	0.11	0.84	2
Fire Hazards	3.73	0.16	0.61	5
Pests and Flies	4.24	0.13	0.78	3
Flooding	4.49	0.21	0.55	7

Adenta

	Mean	SD	RII	Rank
Air Pollution	3.91	0.18	0.69	4
Water Pollution	4.57	0.18	0.47	6
Land Pollution	4.92	0.1	0.93	1
Noise Pollution	3.83	0.17	0.71	5
Fire Hazards	4.64	0.12	0.83	2
Pests and Flies	4.34	0.15	0.79	3
Flooding	4.59	0.2	0.55	7

Obojo

	Mean	SD	RII	Rank
Air Pollution	4.84	0.13	0.84	2
Water Pollution	4.11	0.19	0.79	4
Land Pollution	5.11	0.11	0.98	1
Noise Pollution	4.63	0.22	0.59	7
Fire Hazards	4.67	0.18	0.57	6
Pests and Flies	4.45	0.16	0.81	3
Flooding	3.83	0.17	0.71	5

Amanfrom

	Mean	SD	RII	Rank
Air Pollution	4.83	0.16	0.85	3
Water Pollution	4.96	0.17	0.92	2
Land Pollution	6.11	0.14	0.99	1
Noise Pollution	4.63	0.22	0.61	7
Fire Hazards	4.12	0.17	0.77	5
Pests and Flies	4.41	0.18	0.81	4
Flooding	4.78	0.19	0.67	6



APPENDIX E: TARGETTED BEHAVIOURAL FACTORS AND ASSIGNED BCTS

Broad BFs	Targeted BFs	Mean (->1)	Assigned BCTs
Risk Factors	Health Knowledge	2.98	Information BCT on (HR on ID, scenarios: how it leads to diseases)
Attitude Factors	Feelings	3.9	Present vivid description of performing the preferred behaviour (pleasant) and health consequences
	Costs and Benefits- Time	2.69	Reward the person each time waste is disposed in a bin for collection
	Costs and Benefits- Health	2.17	Invite participants to others talk about disposing waste safely into bins for collection
	Costs and Benefits- Effort	2.11	A cost benefits analysis on indiscriminate waste disposal and disposing waste into bins for collection
Norm Factors	Personal Importance	2.77	Prompt regret scenarios of dumping waste indiscriminately



Broad BFs	Targeted BFs	Mean (->1)	Assigned BCTs
Ability Factors	Confidence In Recovering	5.75	Prompt Coping with relapse. Participants should know that lapses are normal when adopting a new behaviour (waste disposal into bins for collection
	Confidence In Performance	5.4	Provide waste disposal infrastructure and collection services for Households, Prompt Coping with relapse; prompt guided practice
	Action Knowledge	3.79	Provide instructions about how to improve the behaviour of waste disposal into bins for collection
Self –Regulatory Factors	Action Planning	3.79	Stimulate participants on how to dispose waste safely into bins for collection, when to and how he/she intends to achieve that
	Action Control	3.01	Provide feedback on performance
	Barrier Planning	4.01	Identify barriers to waste disposal into bins for collection
	Remembering	3.11	Use memory aids and environmental prompts (when <i>borla</i> taxis pass by and when bin is about to get full)
	Commitment	6.12	Prompt to goal setting and agree on Behavioural Contracts

