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KUMASI, GHANA

Solid Waste Management in Poor Peri-Urban Communities-

Case Study of Prampram Township

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Solid Waste Management in Poor Peri-Urban Communities-

Case Study of Prampram Township

By

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CERTIFICATION

I hereby declare that this submission is my own work towards the MSc. and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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THIS THESIS IS DEDICATED TO SUSA AND COLAN CONSULT.

Abstract

Solid waste management remains one of the biggest challenges to most Metropolitan, Municipal and District authorities in Ghana. Over the years Metropolitan, Municipal and District authorities have tried to curb the problems with solid waste without much success.

This study seeks to assess the challenges and barriers affecting performance of technologies and practices used in solid waste management and propose sustainable solutions for improvement in Prampram township.

The study adopted a combination of qualitative and quantitative methods to get deeper understanding of underlying issues of solid waste management in Prampram township. The qualitative methods included Focus Group Discussions (FGDs) and in-depth interviews. Quantitative methods included household surveys, field measurements (physical characteristic;-solid waste composition, bulk density and generation rate) and GPS mapping.

The solid waste generation was about 0.7kg/capita/day, with a bulk density of 270kg/m3. The daily estimated generation volume is 20.5m3 with a weight of about 5.5 tonnes. The composition of solid waste does not vary from other low income communities in Ghana, however varies in percentage; organics (21%), plastics (1.6%), cans (1.35%), Textiles (2.9%), Paper (2.5%), Human excreta (7.5%), glass bottles (0.6%) and miscellaneous (52%). The rather high miscellaneous (mostly sand mixed with ash, animals droppings etc) is attributable to the setting of the community. The rather low organic composition is attributable to the practice of feeding food (organic) waste to animals. Segregation practices and the activities of waste pickers and itinerants are prominent, particularly for economic earnings. Solid waste disposal practices in the communities include disposing of at communal

container, burying on compound, dumping at un-authorised places and burning refuse in the vicinity of the compound. Improved disposal method is about 40% of the disposal practices. Only 27% of the solid waste generated in the community is collected to safe engineered disposal site at Kpone, 23km away from Prampram. The collection system is not accessible and has limited coverage or usage. The frequency of lifting of communal storage container is not prompt and the capacity of refuse storage is not adequate. Disposal places in the community pose environmental and public health threat. There is no cost recovery towards the disposal of the refuse and hence management system not financially sustainable. Challenges and barriers to performance include poor layout, economic status of the community, poor accessibility, institutional and organisational weakness and bad attitude towards waste management.

Among the proposal for improvement is to establish buy-off point for recyclables, implement a block collection system, upgrade communal collection sites to sanitary transfer sites having bigger storage containers, resource Environmental Health Officers to undertake their responsibilities of ensuring proper solid waste management practices and educate and sensitise communities on waste reduction. It is concluded from this study that the performance of solid waste management in Prampram is poor and needs improvements. To ensure proper and sustainable solid waste management in the community, it is necessary to incorporate and encourage reduction, reuse and material recovery practices. It is also necessary to introduce cost recovery mechanism to sustain the management system. Public health and environmental sustainability is key to existence of life and therefore effectiveness of collection and safe disposal should be ensured.

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List of Abbreviations and Acronyms

CBO	:	Community Based Organisation
DESSAP	:	District Environmental Sanitation Strategy and Action Plan
EHO	:	Environmental Health Officer
EHSD	:	Environmental Health and Sanitation Department
FGDs	:	Focus Group Discussions
GAMA	:	Greater Accra Metropolitan Area
HHs	:	Households
ISWM	:	Integrated Sustainable Waste Management
KL	:	Kley Community
LE	:	Lower East community
LW	:	Lower West Community
MDG	:	Millennium Development Goals
MLGRD	:	Ministry of Local Government and Rural Development
MSW	:	Municipal Solid Waste
NESP	:	National Environmental Sanitation Policy
NGO	:	Non-Governmental Organisation
OL	:	Olowe Community
SHEP	:	School Hygiene education Programme
SWM	:	Solid Waste Management
TMA	:	Tema Metropolitan Assembly
UN	:	United Nations
UNICEF	:	United Nations International Children Emergency Fund
YESDEC	:	Youth Enterprise and Skill Development Centre

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1 Introduction

Management of solid waste all over the world is one of the first important priorities to the protection of community health as well as the environment (Ladu et al., 2012). Solid waste management however remains one of the biggest challenges to most Metropolitan, Municipal and District authorities in sub-saharan African. Rapid population and economic growth worsens the situation.

UN (2011) reported that there have been some positive strides towards the targets for MDG 6 in relation to malaria and other diseases, which are largely sanitation based or related. UN (2011) further reported that deaths from malaria are down, globally, by 20%. The largest absolute decrease was observed in Africa, the report stated. The strides, in all countries, are however attributed to increased funding and attention to effective and intensive control mechanisms or efforts, particularly in sub-saharan Africa. The mechanisms mentioned include long-lasting insecticide-treated mosquito nets and artemisinin-based combination therapies. What is conspicuously missing is the contribution of improvement in environmental sanitation. The primary root of most of these targeted diseases is poor environmental sanitation; poor drainage and solid and liquid waste management.

The Revised Ghana National Environmental Sanitation Policy (GNESP), 2010 recognises environmental sanitation as among the powerful drivers of human development as it affects quality of life – improving health and rising wealth. Environmental sanitation cuts across all sectors of the economy including those that concern health, environmental protection, improvement of human settlements and services, tourism, and general economic productivity (GNESP, 2010).

Solid waste management, as recognised in the GNESP (2010), is a key component of environmental sanitation. The growth and development of any community brings about an increase in the volumes of waste generated and its attendant challenges. The problem is further aggravated in a poorly planned community and greatly impacts on the health and well-being of the people.

1.1 Problem Statement

UN (2011), reports that despite the achievements made in the MDG 6, 90 percent of all deaths from malaria still occur in sub-saharan Africa. This disease, like many others common diseases in sub-saharan Africa, is related to the cleanliness of the environment in which people live.

In Ghana, environmental sanitation related diseases, though preventable, continue to be the major reason for seeking medical care at the Outpatient Departments in the country (MLGRD, 2001). Attendance records show that diseases related to environmental sanitation are the most frequently reported (MLGRD, 2001). The results of inadequate waste management continue to be a major drain on the country's economy through high health expenditure and loss of productivity through illness. The budgets of individuals and families suffer further as their meagre incomes are used to pay medical costs as alluded to by MLGRD (2001).

MLGRD (2001) reports that, solid waste production in urban areas in Ghana currently exceeds 1 million tonnes a year, of which only a third is collected. The remaining two thirds are left to pollute the environment, supporting rats, vultures, insects and other vermin and blocking drainage channels, leading to flooding and breeding of disease vectors. Dumping of wastes is generally crude, creating environmental and health hazards.

The problem of solid waste in Accra has been characterized by single and ad hoc solutions such as: mobilizing people to collect waste and desilt chocked gutters after a flood disaster or for an occasion (Anomanyo, 2004).

The alarming waste management situation described above is not surprising. With the growth in population and economy, the situation is bound to get out of hand if proper waste management systems are not put in place. The 2000 census revealed that the population is growing on average at 2.7% per annum with an increasing rate of rural –urban migration. Accra's capacity to contain population growth has been exceeded, leading to population spillovers into peri-urban areas (Oteng-Ababio, 2011; Yankson et al., 2004), and this has a serious implications for solid waste management and overall environmental sanitation. With the above, there is the need to assess the current waste management practices in the poor peri-urban communities and promote innovative ways in providing sustainable waste management solutions, for which reason this research was undertaken. This research forms part of SUSA Ghana lunched in 2010, covering a broader scope of research into environmental sanitation in Prampram. It is jointly undertaken by University of Copenhagen, University of Ghana and Kwame Nkrumah University of Science and Technology in association with the Dodowa Health Research Centre.

1.2 Rationale or Justification

It is obvious the un-integrated and uncoordinated as well as ad-hoc approach to managing waste is unsustainable and therefore the need to assess current waste management practices and trigger sustainable waste management in our communities. This is the rationale for this study.

The study is to provide knowledge into current management practices and technologies employed and challenges and barriers to improvements in solid waste management in poor peri-urban communities.

1.3 Theory and Conceptual Framework

Authorities continue to struggle with Solid Waste Management (Oteng-Ababio, 2010; Doan,1998) because they have failed to appreciate that sustainable SWM practice entails proper waste collection, transportation, treatment and eventual safe disposal of the residuals (Oteng-Ababio, 2010; Obirih-Opareh and Post, 2002; Baud et al., 2001). Authorities are challenged to achieve acceptable quality services in the face of budgetary constraints and lack of cooperation among waste generators (Oteng-Ababio, 2011). As a way out of this dilemma, Zia and Devadas (2008), as quoted by Oteng-Ababio (2011), suggests the adoption of integrated solid waste management which, according to Tchobanoglous et al. (1993), entails the selection and application of suitable techniques, technologies and management programmes to achieve specific goals and objectives, including environmental and health regulations, economic reliability and social acceptability.

Heimlich et al. (2005) in a Fact Sheet (CDFS-106-05) titled Integrated Solid Waste Management, stated that no single solution completely answers the question of what to do with our waste. Every community or region has its own unique profile of solid waste. The composition of the waste varies, depending on such diverse variables as urbanization, commercial enterprises, manufacturing, and service sector activities. Similarly, they added, the attitudes of people in different states and regions of the country vary regarding waste management practices. Heimlich et al. (2005) submitted that community diversity and waste diversity are two reasons why no single approach to waste management has been accepted as the best method. Since

there is no preferred method, every community must create its own best approach to dealing with its waste. However, Heimlich et al. (2005) said, all communities have the same alternatives. Heimlich et al. (2005) asserted that the emphasis in modern solid waste management is on reduction, reuse, and recovery before disposal.

One key feature of the Integrated Solid Waste Management system is the waste hierarchy approach which involves waste collection, storage, transportation, processing, treatment, recycling and final disposal (Cheeseman et al., 2000). It is a simple, affordable system (socio-economically and environmentally) and guarantees equitable provision of services to both the poor and the rich (Oteng-Ababio, 2011).

Wilson and Scheinberg (2010) reported that they used a framework namely Integrated and Sustainable Waste Management (ISWM), when they had to define and judge what constitutes good practice. ISWM was first developed in 1996 under the umbrella of a global community of practice, the Collaborative Working Group on Solid Waste Management in Low- and Middle Income Countries (CWG) (Wilson and Scheinberg, 2010). They (Wilson and Scheinberg) submitted that ISWM is essentially a lens for viewing a city's solid waste management system. Wilson and Scheinberg (2010) submitted that "to be successful a city must address all three key drivers/physical components of an ISWM system: public health, with a focus on waste collection and street sweeping; environment, with a focus on improving disposal to protect ground- and surface-water and avoid air, water and soil pollution; and resource recovery, to close the loop of both materials and organics management".

Wilson and Scheinberg (2010) emphasised that every tonne of waste reduced, reused or recycled (the 3Rs) is a tonne of waste that the city does not have to pay to collect and dispose of safely. Wilson and Scheinberg (2010) further stated that ISWM gives the opportunity to develop win–win solutions, in which the city authorities, citizens, businesses and the informal/micro-enterprise sectors work together to progress the 3Rs and contribute to sustainable resource management and sustainable development.

Wilson and Scheinberg (2010) ISWM concept agrees with Heimlich et al (2005) concept of Integrated Solid Waste Management.

This concept shall be explored in this research with emphasis on sustainable local practises and management. This concept brings together a range of management options, considering the local conditions, while aiming at social, economic and environmental sustainability.

1.4 Research Questions

The questions relating to sustainable management of solid waste, that was explored by this research include the following:

- What are the practices of the community in the management of solid waste along the value chain (primary generation source to the final disposal; domestic, commercial, institutional)?
- What is the role or impact of the socio-economic and cultural practice in the management of solid waste?
- What are the technologies employed by the key stakeholders in the management of solid waste in the community?
- Are these practices and technologies acceptable and sustainable?

- How effective are these management practices and technologies?
- What are the barriers to improved solid waste management in the community?
- What is the most feasible and sustainable way of improving solid waste management?

1.5 Objectives

The main objective of this research is to assess the challenges and barriers affecting performance of technologies and practices used in solid waste management and propose sustainable solutions for improvement in Prampram township.

1.5.1 Specific objectives

1. Determine solid waste characteristics of the community;
2. Identify technologies and practices used in solid waste management (all along sanitation value chain);
3. Evaluate performance and factors affecting performance of technologies and management practices used in solid waste management;
4. Propose sustainable improvement of the technologies and management systems.

1.6 Scope of Study

The scope of this research in the Prampram township covers domestic, institutions (schools) and commercial. This research does not cover the industrial activities in Prampram.

Only physical observations and examinations shall be conducted. Laboratory works were not undertaken.

1.7 Limitation

The unwillingness of service providers to provide information on cost of operation, for fear of competitors, was the limitation to this study. The current cost of transportation and disposal of solid waste from Prampram could not be computed the aforementioned reason.

1.8 Structure of the Report

This report is structured into five chapters as represented below.

Chapter One: Introduction presents background to study, study objectives, problem statement, rationale or justification to study, scope of the study and limitation to study.

Chapter Two: Literature Review presents review of available literature, mainly publications and textbooks on the subject.

Chapter Three: Methodology presents the study area and methods employed in this study.

Chapter Four: Results and Discussions presents the findings of the study and proposals for improvement.

Chapter Five: Conclusions and Recommendation presents conclusions drawn from the findings of the study and the recommendations made.

2 Literature Review

2.1 Definition of solid waste

Waste, garbage, trash, junk, debris, and refuse are all names given to that "stuff" that is no longer useful in its current form (Heimlich et al, 2005).

Solid waste or refuse is regarded as anything human beings consign to the garbage or dispose of in any manner. It consists of organic matters such as papers, rags, discarded packages, food scraps gardens refuse and inorganic materials such as worn out appliances, junk automobiles, furniture, industrial waste and debris of construction projects. Waste is organic and inorganic material produced by households, commercial and industrial establishments that have no economic value to the owner (Ezebilo and Animasaun, 2011; UNICEF, 2006).

Solid wastes comprise all solid waste material generated by households, institutions (including health-care waste from hospitals and clinics), commercial establishments and industries, and discharged from their premises for collection; all litter and clandestine piles of such wastes; street sweepings, drain cleanings, construction/demolition waste, dead animals and other waste materials (GNESP, 2010). These are definitions the researcher ascribed to.

2.2 Characteristics of solid wastes

As mentioned by Heimlich et al (2005), waste characteristic is an important determinant in the choice of waste management system. The technological choice in solid waste management is largely dependent on the characteristics of the solid waste from the waste generator.

2.2.1 Physical characteristics

Solid waste composition

This is the term used to describe the individual elements that make up the solid waste stream and their relative distribution, usually based on percent by weight (Mensah, 2010). Municipal solid waste includes degradable (paper, textiles, food waste, straw and yard waste), partially degradable (wood, disposable napkins and sludge, sanitary residues) and non-degradable materials (leather, plastics, rubbers, metals, glass, ash from fuel burning like coal, briquettes or woods, dust and electronic waste) (Jha et al 2011; Herat 2009; Jha et al., 2007; Tchobanoglous et al., 1993). Information about the nature of waste is critical for assessing the effects on the environment if specific composition is found in Municipal Solid Waste (Mensah, 2010; Zeng et al, 2005; McDouglal et al, 2002).

Tables 2-1 to 2-6 present composition of solid waste determined by Cointreau (2006). It gives an indication of the difference in composition for various categories of income.

Table 2-1: Global perspective on urban solid waste characteristics

Composition of Raw Waste (by wet weight %)	Low income countries	Middle income countries	High income countries
Vegetables/putrescible	40-85	20-65	7 to 55
Paper and Carton	1-10	15-40	15-50
Plastics	1 to 11	2 to 13	2 to 20
Metals	1 to 5	1 to 5	3 to 13
Glass	1-10	1-10	4-10

Composition of Raw Waste (by wet weight %)	Low income countries	Middle income countries	High income countries
Rubber, Misc.	1 to 3	1 to 5	2 to 12
Fines (sand,ash,broken glass)	15 to 50	15 to 40	5 to 20

Source: Cointreau, 2006

Table 2-2: Solid waste properties for Accra

Item No.	Component	Weight (%)
1	Organic	65
2	Paper	4.2
3	Plastics	3.5
4	Metal	1.8
5	Inert material	22.5
6	Glass	1.9
7	Miscellaneous	1.1

Source: Mensah, 2010; Waste Management Department-AMA

Table 2-3: Comparison of solid waste characteristics for Kumasi

Solid waste component	Characterisation by KMA	Characterisation in High income areas by Kotoka (2001)
Greens/Vegetable/Fruits	44	43.87
Plastics	3.52	1.145
Fabrics/Textiles	3.2	0.505
Paper/Cardboard	3.1	2.275
Bottles	0.64	1.165
Metals	0.64	0.565
Rubber	0.3	0.32
Miscellaneous (including ash, food waste, sand etc)	44.6	50.31
Total	100	100

Source: Mensah, 2010; Kotoka, 2001

Table 2-4: Solid waste composition for three income groups in Kumasi

Component	Low income group	Middle income group	High income group
Organic	48	56	71
Plastic	8	5	6
Paper	2	2	4
Metals	2	1	2

Glass	1	2	2
Wood	2	1	1
Textile	3	6	2
Miscellaneous	34	27	12

Source: Mensah, 2010; Ketibuahn et al, 2004

Table 2-5: Solid waste composition for three income groups in Kumasi

	Low income	Middle income	High income
Component	% by weight	% by weight	% by weight
Organic	45	69	71
Faeces	7	3.5	-
Plastic	8	10	10
Paper	1	2	5
Glass	0	1	10
Textile	2	1	-
Wood	-	-	-
Metals	1	2.5	2.5
Miscellaneous	36	12	0

Source: Mensah, 2010

Cointreau (2006) submitted that in developing countries, a significant portion of the human waste generated in a city ultimately reaches the solid waste system because of

inadequate sanitation systems. In the poorest countries, because of a paucity of sanitation systems, people defecate along roadways and on open lots, night soil is deposited in open drains, and the resulting street and drain cleanings contain feaces. Where buckets or bedpans are used, the human waste is often placed in a plastic bag or wrapped in newspaper before discarding it with the solid waste (Cointreau, 2006).

Bulk density of solid waste

Density is a critical criterion for the estimation of storage, collection, transportation as well as landfilling of waste (Mensah, 2010). It must however be said that density is important in determining capacity of storage containers and frequency of collection based on duration of storage. Density might not be that crucial in the determination of mode of transportation of waste but important in determining capacity of sanitary landfill sites.

Bulk density of waste is used in the determination of volume of waste, knowing the weight of the waste generated. The weight-volume analysis is mostly used in determining the density of solid waste materials. This involves the measurement of the weight and volume of waste generated over a period (Mensah, 2010)

The bulk density of waste generated in the Accra Metropolis is 500kg/m3, as cited by Mensah (2010). The densities vary from 250 to 600kg/m3 for low income countries like Ghana (Mensah, 2010). Typical values obtained from high income community-KNUST ranged between 366.7kg/m3 and 392kg/m3 and that by Kotoka (2001) was 235kg/m3 (Mensah, 2010). Mensah (2010) recorded 381kg/m3, 237kg/m3 and 306kg/m3 for low, middle and high income communities, respectively, in Kumasi.

2.3 Solid waste management

Waste management includes collection, transportation, processing, recycling or disposal of waste materials (UNICEF, 2006)

According to Ezebilo et al (2011), waste management includes collection, transportation, processing, recycling or disposal of waste materials.

Waste management systems should be considered as phases in the flow of materials from generation (source) up to the final treatment and disposal stage. It is a combination of various phases in the management of the flow of materials within the City and the region (Adebuason, 2010; Klundert & Anschutz 2001).

The main elements that constitute solid waste management are generation, storage, collection, transportation, treatment (processing), final disposal.

2.3.1 Solid waste generation

Waste generation is the first element of waste management (Mensah, 2010). The knowledge of how much solid waste is generated in a community informs largely the waste management plan and approach.

Table 2-6: Global Perspective on Solid Waste Quantities

Waste generation	Low income country	Middle income country	High income country
Mixed Urban Waste – Large City (kg/capita/day)	0.50 to 0.75	0.55 to 1.1	0.75 to 2.2
Mixed Urban Waste –	0.35 to 0.65	0.45 to 0.75	0.65 to 1.5

Medium City (kg/capita/day)			
Residential Waste Only (Kg/capita/day)	0.25 to 0.45	0.35 to 0.65	0.55 to 1.0

Source: Cointreau, 2006

2.3.2 Waste collection

Cointreau (2006) submitted that most low-income countries experience low levels of collection service. Typically only 30% to 60% of the municipal solid wastes are collected (Cointreau, 2006). Cointreau added that the waste discharged for collection seldom is stored in a plastic or metal container and covered with a lid.

Adebuason (2010) submitted there are various forms of waste collection practiced in developing countries. He cited UNCHS (1988) as classifying them into four namely;

***Communal collection*:** Under this system, householders discharge their wastes at pre-determined sites containing some form of communal storage facility, and refuse collection vehicles collect the wastes at frequent intervals, usually once a day. The frequency of communal storage distribution depends on the degree of community willingness to cooperate in its proper utilisation. This method prefers the use of portable containers for realisation of high labour and vehicle productivity. In addition, the distance between two containers should not exceed 200 metres. This method is relevant since it reduces considerably the number of waste collection sources. It must be added however that, it is rare for communal storage containers to be lifted daily.

***Block collection*:** Under this system, a collection vehicle travels a pre-determined route scheduled by an urban authority at intervals, usually every two to three days and stops at selected sites. Upon hearing the bell, the house holders bring their refuse containers and hand them to the crew, after which the containers are emptied and returned to them. Under this method, no containers are left outside household premise or on communal land. However, vehicle and labour productivity lies between low and medium.

***Kerbside collection*:** In this system, the collection crew collects refuse containers which are deposited at the kerbside (entrance) at fixed and specific intervals, usually twice a week. This system requires a regular and well organised collection service in order to enable householders leave out their wastes at appropriate times. This system is applicable in high income areas of developing countries due to the relatively high collection cost associated with it.

***Door-to door-collection*:** In this system, the collection crew enters each premise, takes out the container and sets it back after the waste is emptied into collection vehicles. This system offsets the non-involvement of householders by increased labour costs in accessing all premises. This method is only productive when collection is infrequent, especially once a week. However, although this method is common in developed countries, it is rarely practiced in developing countries. In addition, its intrusion on the privacy and security prevents its consideration as a collection option in some communities.

According to UNCHS (1988), while the above represent the basic methods of collection, the most productive and economical method from different countries in urban areas will be a combination of them (Adebuason, 2010).

2.3.3 Waste disposal

In high-income countries, essentially all collected wastes go to safe sanitary landfill, composting, and materials recovery or incineration facilities that are designed and operated to meet high environmental protection standards (Cointreau, 2006). Landfill is still the primary method of disposal used by most high-income countries, because it is a relatively low cost compared to other disposal options (Cointreau, 2006).

Cointreau (2006) submitted that because of a shortage of land licensed for land disposal in Europe, some European countries maximize the amount of waste recycling and composting possible, prior to landfilling of those materials that are unsuitable for resource recovery. In 1998, landfilling in the USA accounted for 55.4% of the nation's municipal solid waste disposal (down from 83.2% in 1986). Incineration and materials recovery, and to a lesser extent composting, shared the remaining 44.6% (Cointreau, 2006). Cointreau (2006) revealed that, in middle-income countries, probably less than 25% of collected wastes are deposited in controlled landfills, and probably less than 15% are deposited in modern sanitary landfills. The rest is discharged to open dumps, most of which burn openly and have hazardously steep side slopes. In low-income countries, nearly all of collected wastes are deposited within open dumps (Cointreau, 2006). The cost and resources required to implement waste technologies are often regarded as too prohibitively high to be sustained (Cointreau, 2006).

2.3.4 Solid waste management costs

Table 2-7 shows how general cost ranges for solid waste collection, transport and sanitary landfill vary as a function of average GNP income. In developing countries, while the per capita quantities of wastes and labor costs are low, the costs of providing solid waste management (even at their current lower standard of operation)

are not proportionately low (Cointreau, 2006). Equipment capital costs and fuel costs in low-income countries are comparable to those in high-income countries, and sometimes are higher because of importation costs and currency exchange variations. Cointreau (2006) submitted that solid waste management cost is higher in low-income countries, when viewed as a percentage of personal income. Given the proportionately high cost of operating a full service in developing countries and competing urban infrastructure needs, the prevailing low levels of solid waste service are likely to continue for several more years (Cointreau, 2006).

Table 2-7: Global perspective of cost of solid waste management

	Low income country	Middle income country	High income country
Average waste generation	0.2 t/capita/y	0.3 t/capita/y	0.6 t/capita/y
Average income from gnp	370 $/capita/y	2,400 $/capita/y	22,000 $/capita/y
Collection cost	10-30 $/t.	30-70 $/m.	70-120 $/t.
Transfer cost	3-8 $/t.	5-15 $/t.	15-20 $/t.
Sanitary landfill cost	3-10 $/t.	8-15 $/t.	15-50 $/t.
Total cost without transfer	13-40 $/m.t.	38-85 $/t.	90-170 $/t.
Total cost with transfer	16-48 $/t.	43-100 $/t.	105-190 $/t.
Total cost per capita	3-10 $/capita/y	12-30 $/capita/y	60-114 $/capita/y

	Low income country	Middle income country	High income country
Cost as % of income	0.7-2.6%	0.5-1.3%	0.2-0.5%

Source: Cointreau, 2006

2.4 Solid Management Approaches

The conventional approach to solid waste management in developing countries, particularly in poor communities is collection and disposal. The non-conventional approaches incorporate recovery processes; recycling and composting.

The current solid waste management approach being encouraged is Integrated Sustainable Waste Management (ISWM). This is not different from Integrated Solid Waste Management.

2.4.1 Integrated Sustainable Waste Management

ISWM recognises high profile elements namely; 'collection', 'transfer', and 'disposal' and treatment'. It also gives equal importance to the less well perceived elements of 'waste minimisation','re-use' and 'recycling and compositing (Adebuason, 2010; Klundert & Anschutz, 2001).

2.4.1.1 Principles of Integrated Sustainable Waste Management

The concept of ISWM has four basic principles (Adebuason, 2010; Klundert & Anschutz 2001) namely;

Equity: all beneficiaries are entitled to an appropriate waste management system due to environmental health concerns and this should go beyond ethical considerations.

Effectiveness: the extent to which the service objectives have been fulfilled in practice. The waste management model adopted should be capable of removing all the waste generated.

***Efficiency*:** waste management should entail benefit maximisation, cost minimisation, resource optimisation and should consider issues of equity, effectiveness and sustainability. Efficiency is achieved when benefits that accrue from clean streets are balanced by all beneficiaries through their financial, labour, material, equipment or managerial contributions.

***Sustainability*:** the waste management system is tagged to the local conditions and should be technically, environmentally, socially, economically, institutionally and politically feasible. The system should also have a self maintenance mechanism overtime while optimising the resources on which it depends (Adebuason, 2010; Klundert & Anschutz, 2001).

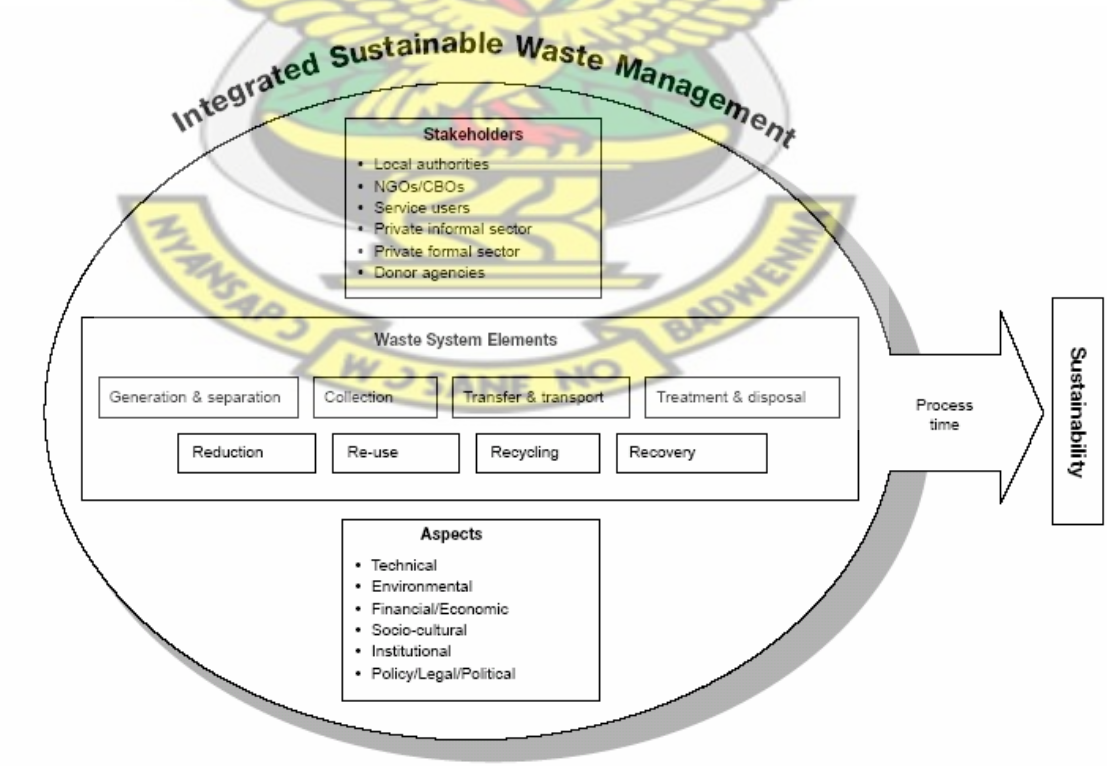

Figure 2-1: Integrated Sustainable Waste Management

Source: Adebuason, 2010; Klundert & Anschutz (2001, p.14).

2.4.1.2 Strategic aspects of Integrated Sustainable Waste Management

According to (Klundert & Anschutz 2001), as cited by Adebuason (2010), the concept of ISWM distinguishes six lenses through which the existing waste system can be assessed and with which a new or expanded system can be planned. A brief review of case studies indicates the following experiences in relation to the strategic aspects of the ISWM (Adebuason, 2010; Klundert & Anschutz 2001):

Technical performance aspects: these entail the visible practical execution and maintenance of all of the waste elements. It focuses on which equipment and facilities are in use and those for future use. It also focuses on how they are designed and their applicability. In addition, it also evaluates the cleanliness of the city on a consistent basis.

***Financial-economic aspects*:** these pertain to budgeting and cost accounting within the waste management system in relation to the local, regional, national and international economy. It also considers some salient issues such as; privatisation, cost recovery and cost reduction. In addition, the impact of environmental services on the economic activities is also considered. In Accra, Ghana, the solid waste system according to Post et al., (2003), as cited by Adebuason (2010), remains highly dependent on extra local funding due to absence of cost recovery mechanisms, arising from public resistance and inaccurate household data. This however contrasts with that of Chibesa (2006) and Babu (2008) who mention regular payment of fees, willingness to increase fees and affordability of fees by service users in Kitwe, Zambia and Riruta, Nairobi respectively (Adebuason, 2010).

Institutional aspects: these entail the political and social structures that control and perform waste management; the division of roles and responsibilities. It also focuses on the organisational structures, procedures and methods entailed and consideration of the available institutional capacities and actors especially the private sector which could be brought on board. This is an important aspect of waste management as community members, especially in poor areas, feel left out and the appropriate institutions at the local level are not well resourced (in terms of logistics and human resource capacity) to effectively manage solid waste in the communities. According to Babu (2008), as cited by Adebuason, SWM in Riruta, Nairobi is characterised by community participation in decision making through weekly meetings, partnerships with public, NGOs and CBOs and a clear understanding of roles and responsibilities by various departments. This situation however differs from that in Dhaka and Chittagong, Bangledesh, where the efficiency of waste delivery is affected by lack of coordination among different departments/ sections due to unnecessary delays (Adebuason, 2010; Bhuiyan 2010).

***Political/legal aspects*:** these address the boundary conditions in which the waste management system exists. In this aspect, goals and priorities are set, roles and jurisdictions are determined and in case the legal and regulatory framework is nonexistent, it is planned for.

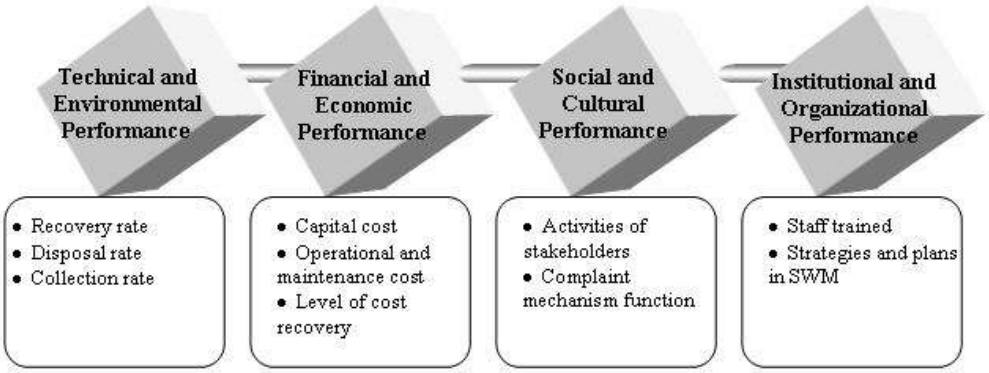

Figure 2-2: Key indicators for assessing solid waste management systems

Source: Adebuason, 2010; Suttibak & Nitivattananon, 2005)

3 Methodology

3.1 Study Area

Location & size:

Prampram is one of the coastal communities of the greater Area Region located in the south-eastern part of Ghana. Geographically, Prampram is located on Latitude $5^{o}42'$N and Longitude $0^{o}06'$E and administratively located in the Ningo-Prampram District. It is the district capital of the Ningo-Prampram district. The people of the entire township share common cultures and values. The study area is concentrated on Lower West, Lower East, Olowe and Kley communities of Prampram. The study area covers a total area of about 4.1sq km.

Population, Household Size and Growth Rate

Prampram has a population of 7,787 (DHRC, 2011). It has a growth rate of about 2.1%. This is not different from the growth rate for the Damgbe West District. Prampram has an average Household size of about 4.8.

Occupation

The predominant occupation of the people of Prampram is Fishing and Trading (Fish selling). Other occupations include farming and skilled and unskilled labour (masonry, carpentry . etc.).

Settlement and Housing

The study community can be sectioned into two areas; the old town and newly developing area. The old section of the community is densely nucleated. Buildings are very close and share common compounds and entrances. The houses or building spaces are not well laid out.

The buildings are predominantly built of mortar bricks. There are also wooden structures, mainly used as stalls for petty business (trading) and some as kitchens. Houses have bathhouses outside the houses but either within the compound or close to the compound. Some houses have no bathhouses and so patronise public bathhouses. Most households cook outside, in the open.

Topology & drainage

The topography of Prampram is gentle sloping towards the Atlantic. It is a low plain with heights not exceeding 70 metres. Prampram has no major streams traversing the study areas (GhanaDistricts.com-MLGRD).

Climate

Prampram is part of the Southeastern coastal plain of Ghana, which also encompasses the Dangme West District, The Southeastern coastal plain is one of the hottest and driest parts of the country. Temperatures are however subjected to occasional and minimal moderating influences along the coast and altitudinal

influences affected by the Akwapim range in the northwest (GhanaDistricts.com-MLGRD).

Temperatures are appreciably high for most parts of the year with the highest during the main dry season (November - March) and lowest during the short dry season (July - August). They average a few degrees lower on the coast and close to the Akwapim range than they do over most of the plains. The absolute maximum temperature is 40° C.

The most complete absence of cloud cover for most parts of the year gives way to very high rates of evaporation which leaves most parts of the district dry and with parched soils. The combined effects of high temperatures and high insulation levels, on the other hand, are of invaluable asset to the salt-making industry, as they account for the high and rapid rates of salinization and crystallization crucial for the winning of salt. They also provide enormous potentials for solar power development (GhanaDistricts.com-MLGRD).

Rainfall is generally very low with most of the rains, very erratic in nature and coming mostly between September and November. Mean annual rainfall is 762.5 millilitres on the coast.

Vegetation

The predominant vegetation type found in the Project vicinity is of the short grass savannah interspersed with shrubs and short trees, a characteristic of the Sub- Sahelin type. A large portion of vegetation remains dry for most parts of the year particularly towards the south except for the short rainy season.

Soils

At the coastal south, the predominant soil type is associated with coastal sand dunes, backed by a discontinuous series of narrow, saline or brackish lagoons. These soils to some extent support coconut growth.

Under the prevailing climatic conditions, there tend to be draught in the topsoil, but lower layers have a good moisture storage capacity. These soils, to some extent, are favoured for cultivation as they are easily workable.

Infrastructure

The infrastructure available in Prampram includes electricity, roads, water and telecommunication. The community has over 90% coverage of electricity. Water to the community is supplied by the Ghana Water Company Ltd. This is however erratic, compelling members to resort to alternative sources which may not be wholesome. Prampram has telecommunication services from the major telecommunication service providers (MTN, Vodafone Ghana, Tigo and Glomobile Ghana). The community has an internet cafe from Vodafone Ghana and MTN. Other infrastructure includes Police Station and Health infrastructure.

For Governance infrastructure, the township is overseen, politically, by Ningo-Prampram District Assembly. The community is represented by four Assembly members at the District Assembly. Socio-culturally, the community is led by the local chief who is supported by community elders.

3.2 Study Method

The study adopted a combination of qualitative and quantitative methods to get deeper understanding of underlying issues of solid waste management in Prampram township. Table 3-1 presents the methods adopted to achieve each objective.

Table 3-1: study objectives and respective study methods

Study objective	Method
1. Determine solid waste characteristics of the community;	• Measurements
2. Identify technologies and management practices;	• HH surveys (targeted sampling), • Observations and GPS mapping
3. Evaluate performance and factors affecting performance of technologies and management practices ;	• FGDs • HH surveys • In-depth interviews • Document reviews
4. Propose sustainable improvements	• Analysis of solutions to identified challenges

3.3 Qualitative Methods

For qualitative methods, Focus Group Discussions (FGDs) were held. In-depth interviews were also conducted with key informants, local community heads, managers of communal container sites, private solid waste operators (J. Stanley-

Owusu Ltd. and Zoomlion Ltd.) and EHSD officers. Field observations were made through transect walk in the study communities.

3.3.1 Focus group discussions (FGDs)

Due to set-out of the study communities, the entire study area was divided into two; the lower community (Lower West and Lower East communities) and Upper community (Kley and Olowe communities). Table 3-2 presents the groupings for the discussions.

Table 3-2: Groupings for discussions

	Lower West and East Communities	Olowe and Kley communities
Group 1	Opinion Leaders	ACI, Zoil and Zoomlion sanitary workers
Group 2	ACI, Zoil and Zoomlion Sanitary workers	Cooperation Association
Group 3	Fishermen group	Community Leaders

The discussions focussed on:

- the history of solid waste management;
- barriers/challenges to solid waste management;
- performance of management practices and technologies;
- and proposed sustainable solutions to improved management of solid waste.

Voice recordings were taken at these group discussions for transcription. Content analysis was carried out on the transcripts.

3.3.2 In-depth interviews

The in-depth interviews focussed on acquiring in-depth understanding of the challenges and barriers to improved solid waste management in the study community. Interviews with service operators were geared towards acquiring information on the challenges to their performance and knowledge of the cost of their operations.

3.4 Quantitative Methods

Quantitative methods included measurements of solid waste generation and characteristics (bulk density and composition), household surveys, communal container user counts, field observations and mapping and review of records from the sanitary landfill site.

3.4.1 Measurements and user counts

To determine the solid waste generation rate of the Prampram township, households disposing of refuse at the communal containers were sampled and their wastes were weighed. Weight of waste, duration of storage of the waste and the household size were recorded for each sample. Each sample weighed is segregated into various components (organics, plastics, glass, paper, feaces, cans, textiles and miscellaneous) and each component is weighed. Each component's weight was computed as a fraction of the total weight.

Daily counts of community members disposing solid waste at the communal storage containers were conducted for one week.

The results from these was analysed and presented in Microsoft Excel.

3.4.2 Household survey

Questionnaires were given to selected households in the study communities. The questionnaire used is a hybrid of open-end and close-ended questions. Respondents were largely women. Microsoft excel was used in the analysis and presentation of the results of the surveys.

3.4.3 Field observation and mapping

Key observations of practices and technologies employed in solid waste management were noted and captured on a digital camera. Locations of approved and unapproved

disposal sites were captured with a GPS. Properties of these sites were noted. Observations were also made in the various houses visited.

3.5 Sampling and Sample size

Sampling for FGDs and the in-depth interviews were purposive while that for the measurements and household surveys were random. The sample sizes for the measurements and the household surveys were determined using:

$$n = \frac{N}{1 + N(1-\sigma)^2}$$

$n = sample\ size$
$N = Population$
$\sigma = confidence\ level$

A confidence level of 95% and 90% were used for the measurements and household survey, respectively. The total household sizes for the various study communities as gathered from DHRC were the population from household surveys while the total count of the number of community members disposing solid waste at the communal storage container during the peak hours were the population for the measurements. It is interesting to note that the compound housing setting in the communities made it unnecessary to repeat questioning in the same house since the practices where similar. The separate settlements within the communities were duly captured in the sample size.

3.6 Evaluation of Performance of SWM Practices and Technologies

Table 3-3 presents indicators used in the evaluation of performance of identified management practices and technologies.

Table 3-3: Indicators of performance evaluation

Performance Indicator	**Measurement**

1. Technical Performance	
Effectiveness	• Amount collected/total amount generated
Adequacy (capacity of storage);	• Size of container, volume of waste generated, duration of storage
Accessibility and Coverage	• No. of users/total population
Frequency of service	• Collection per month against required frequency for duration of storage
Environmental sustainability (protection);	• Scientific (safe) disposal of solid waste-improved disposal sites against total disposal sites
2. Institutional and Organisational Performance	
Institutional capacity	Training of staff, logistics
Strategies and plans for solid waste management	Level of implementation of strategies and plans
3. Social and Cultural Performance	
Activities/Practices of community	
Awareness of community	Extents and frequency of public educations

4 Results and Discussions

4.1 History of Solid Waste Management in Prampram Town

According to the elders of the community, early settlers at Prampram designated locations to be used as cemetery and refuse dump. These dumps were tidied periodically through communal labour and burnt. With growth in the population and extension of settlement areas, refuse dumps emerged at various parts of the community, along the beach and within the settlement. It was the norm that residents bury or burn their waste on their compound. Some residents also disposed of on undeveloped lands, in nearby bushes.

Communal collection in Prampram was instituted in 2008 under the Private Public Partnership policy of the Government of Ghana. In 2008, Zoomlion Ghana Limited (a waste management company), under the Public Private Partnership, provided a 15m^3 roll-on refuse container for communal collection of solid waste from the community for onward transportation to the Landfill, 23km away from Prampram. In 2010, ZOIL, a subsidiary of Zoomlion Ghana Limited, responsible for coastal sanitation was launched in the Prampram. ZOIL is responsible for the cleaning of the beach. Also in January 2012, Azontaba Corttage Industries (ACI) provided 8m3 skip containers for Lower west and Olowe communities for communal collection of waste. The Assemblymen of the communities sited the containers and designated them for use in June 2012. ACI also launched a sanitation service; sweeping of public places in 2012.

A door-to-door waste collection service was introduced by a YESDEC beneficiary, using the 1100litre container motorised tri-cycle truck (photo-novo truck). This service lasted for only 5 months. In an interaction with the service provider, he

intimated that he had to suspend the service due to the attitude of the clients (community members) and reluctance in paying for service. He added that dumping at the disposal site was challenged by the poor access and layout out of the site.

4.2 Solid Waste Characteristics

4.2.1 Generation

The solid waste generation rate was found to be about 0.7kg per capita per day. This was determined from the weight measurements taken at the communal refuse containers in the beneficiary communities. Lower East and West communities recorded a trim-mean of 0.70 and median of 0.72. Kley and Olowe communities recorded 0.80 and 0.68 for trim means, respectively and median of 0.69 and 0.72, respectively. The daily per capita generation in Prampram is higher than the 0.5kg/capita/day for Accra as quoted by Mensah (2010) as published by Waste Management Department-AMA. The generation for Prampram is again higher than 0.54kg/capita/day and 0.6kg/capita/day (Mensah, 2010) for Low income and middle income communities of Kumasi. It is however comparable to the generation rate of 0.728kg/capita/day (Mensah, 2010) for high income communities in Kumasi. It was noted that sand and ash mixed with animal dropping (from house compound sweepings) took a greater part of the weight. This probably accounts for the deviation and not necessarily increases in economic activities. This also gives an indication that solid waste management in Prampram should be addressed with the same seriousness as that of the major cities in Ghana. With population growth, solid waste management problems in Prampram would be as serious as that of Accra and Kumasi.

The bulk density of waste generated in the community as determined is 270kg/m3. This is lower than 500kg/m3 for Accra (Source: AMA) and 350kg/m3 for Kumasi (source: KMA)

With an estimated population of 7,787, the estimated daily waste generated in Prampram is 5.45tonnes of solid waste a day, translating into about 20m3 of solid waste.

4.2.2 Waste composition

Eight categories were identified namely, Plastics, Tins (Cans), Paper, Textiles, Organics, Glass bottles, Human Excreta and Miscellaneous. Human excreta was categorised because it featured prominently in the composition of waste, mostly wrapped in polythene bags and diapers. Miscellaneous includes largely sand/soil and ash mixed with animal droppings. Table 4-1 presents the composition of solid waste generated in the communities in Prampram. The composition gathered from Prampram is comparable to that of the low income communities of Kumasi as presented by Mensah (2010). Mensah (2010) recorded Organics (45%), miscellaneous (36%), Plastics (8%), Faeces/Human excreta (7%).

Table 4-1: Solid waste composition for Prampram

Category	Lower West and East Communities	Kley Community	Olowe Community
Organics	17.05	18.08	28.16
Plastics	9.48	8.88	16.52
Cans	1.5	0.97	1.47

Category	Lower West and East Communities	Kley Community	Olowe Community
Textiles	1.39	4.81	2.42
Paper	1.41	1.44	4.76
Human excreta/Faeces	3.38	8.93	10.06
Glass bottles	0.53	1.04	0.36
Miscellaneous*	65.27	55.83	34.81

*sand/soil mixed with animal droppings and ash swept from compounds.

Comparing the figures in Table 4-1 to Table 2-2, 2-3, 2-4 and 2-5, the figures recorded by Mensah (2010) for low income communities, the organic composition of the waste in Prampram is considerably low and miscellaneous category is very high. This is attributable to the setting of the communities and the predominant practices of feeding food left-overs or waste to animals. The study revealed that about 55% of the community feed their food wastes to animals (Figure 4-1). Oteng-Ababio (2010) submitted that in the poorer communities (in GAMA) it is the common practice to use organic waste (food left-overs) to feed domestic livestock and some people even sell organic waste to livestock owners. The miscellaneous comprising of sand/soil mixed with ash and animal dropping is as a result of domestic cooking activities using charcoal and the practice of sweeping unpaved floors for disposal. It is imperative to give account of this component because it is a product of practice and setting of the community. Moreover this component ends up at the communal collection point.

The lack of Household toilet facilities is the reason for the inclusion of feaces in solid waste. Lower communities (West and East) recorded the least composition weight for feaces (human excreta) because of the practice of disposing of human excreta at the beach.

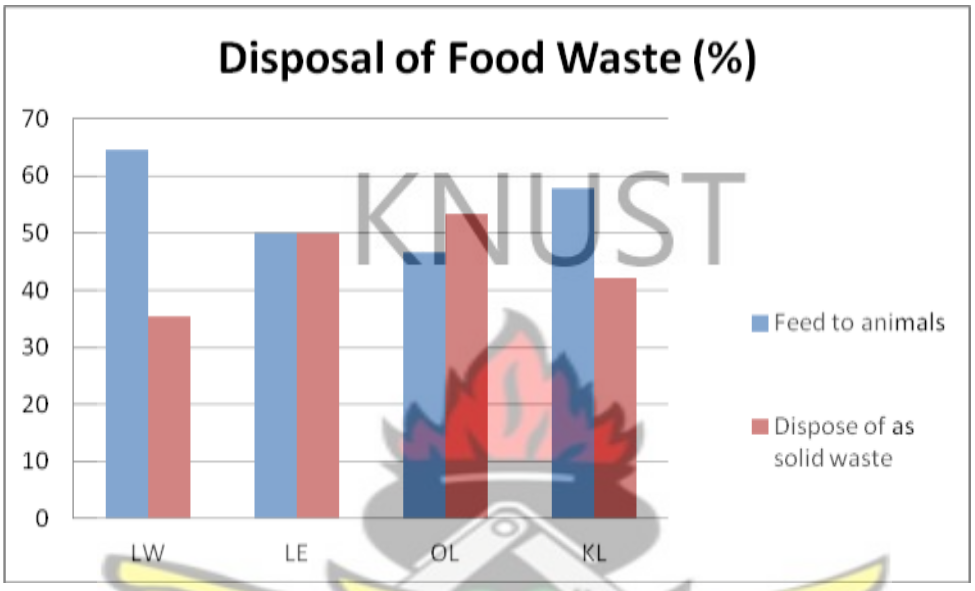

Figure 4-1: Disposal of food waste (putrescibles)

Data on waste composition of plastics reported by Mensah (2010) from Agyapong (1974), Kotoka P (2001), WMD-AMA, Ketibuah et al (2004) gave figures of 0.3%, 3.52%, 3.5% and 8%, respectively. Mensah (2010) recorded 8% for low income communities in Kumasi. Prampram records an average of 11.6%. This percentage is despite the reuse and recycling practices.

4.3 Technologies and Management Practices

4.3.1 Primary storage of solid waste

Most of the residents store their waste in non-standardise containers; aluminium pans, polythene bags, 20L-25L HDPE containers (jerricans), 15-18L plastic buckets. Household store their waste in the house for two days, on the average. Plates 4-1, 4-2 show some storage containers used in the study communities.

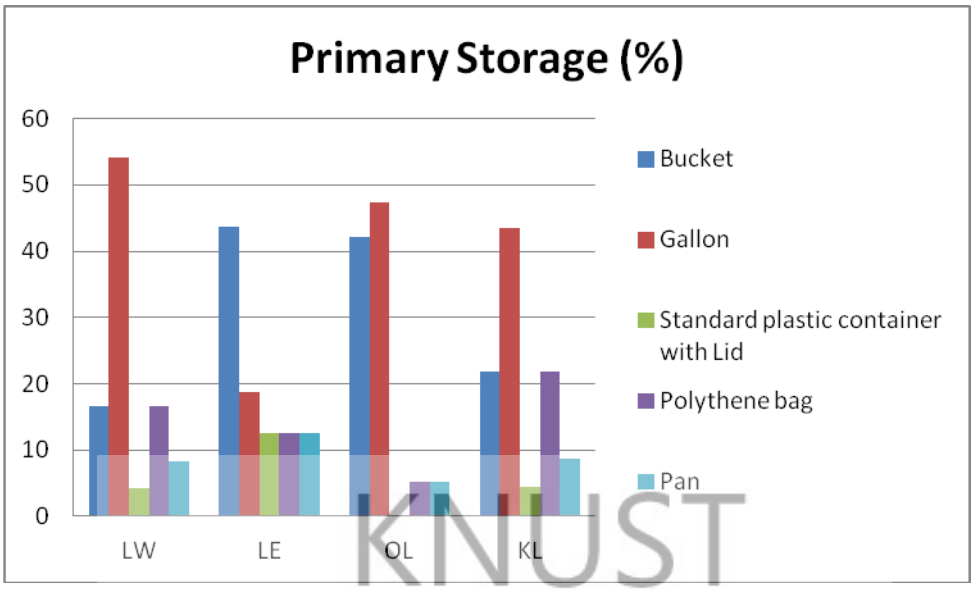

Figure 4-2: Storage containments

The study revealed that the economic status of the households determined the type of storage container used. This was highlighted during the Focus Group Discussions in the various communities under study. Participants at these discussions indicated that the lack of sustainable jobs in the community is affecting the economic status of households and hence cannot afford standard bins with covers to store refuse. It was revealed that the health risk associated with storing refuse in open containers with animals feeding from it did not compel households to go for standard bins. It was rather the norm to dispose of refuse every morning to avoid contracting diseases. All respondents and participants at FGDs however agreed that proper storage of refuse in households was key to preventing diseases. The limiting factor, they insisted, was the economic (purchasing) power.The method of storage poses health risk to the households. The presences of flies, as observed and confirmed by all respondents and participants at FGDs, reveal the public health risk; likelihood of outbreak/transmission of diseases.

Plate 4-1: Plastic basket for storage of solid waste

Plate 4-2: 25L-storage container

4.3.2 Primary collection and secondary storage of solid waste

There is currently no door-to-door collection service in the community. The operating collection system is the communal system. Households are required to carry their solid waste to the designated communal site. Majority of the household in the community dispose of their solid waste daily (Figure 4-3). Lower West and down section of Lower East share a 8m3 communal skip container, Olowe community has one 8m3 communal container while Kley community has 15m3 roll-on-roll off communal container. According to the service provider, J-Stanley-Owusu Ltd., the communal containers at Olowe and Lower West communities are lifted once a week. The communal refuse container at Kley is lifted by Zoomlion Ltd. once a week. Observations and confirmation from attendants and residents indicate there is most often over flow of solid waste. Users are made to leave their waste with their containers at the communal container site, while others are sent back home or to the nearest dumpsite. Attendants say they often have to call the drivers of the trucks to inform them of the filled container.

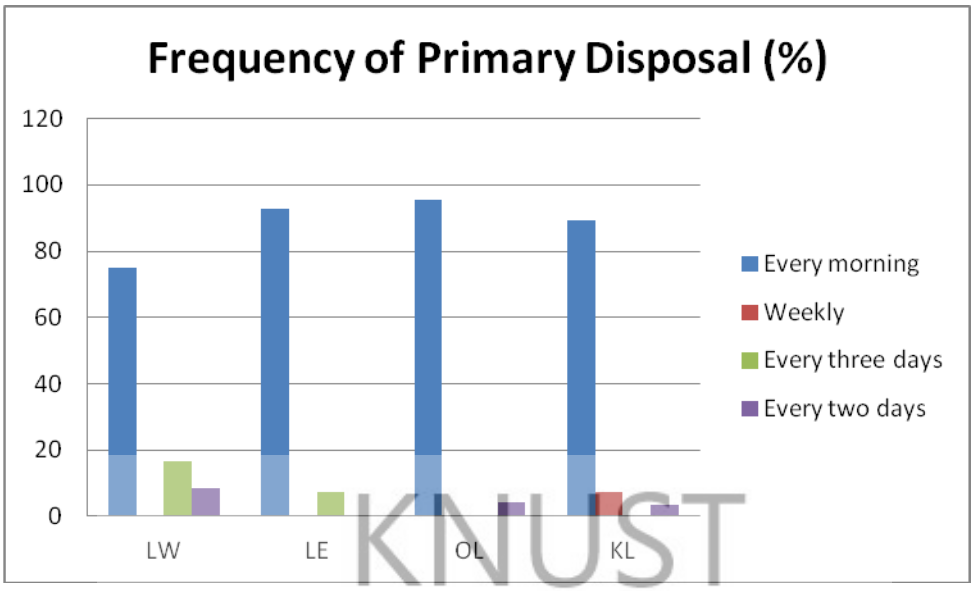

Figure 4-3: Frequency of disposal of solid waste from Households

4.3.3 Primary disposal practices

The study revealed that in Lower West community, 67.74% of residents dispose of their waste at communal container provided at the sanitary transfer site (communal site), 12.9% dispose their waste into nearby bushes, 6.45% dispose of refuse at unauthorised refuse dumps and 3.23% bury their waste either in the house compound or vicinity. In the Lower east community, 42.86% of the residents dispose of their waste at unauthorised refuse dumps littered in the community. 21.43% of the residents dispose of their refuse at the communal container situated in the Lower West community, 28.57% incinerate their waste on the compound or vicinity of the house, 4% dispose of waste into nearby (surrounding) bushes, while 3.57% bury their waste on their compound. In Olowe community 43.33% of HHs incinerates their waste on their compounds and vicinity, while 23.33% dispose of waste into nearby bushes. 16.67% of HHs disposes of their waste at the communal container designated to the community, while 3.33% bury their waste on their compound.

The study in Kley community revealed that 52.63% of resident dispose of their waste at the communal container, while 28.95% incinerate their waste on their compound, 10.53% of the residents dispose of waste at unauthorised refuse dumps, 2.63% each patronise "kaya bola" (individual who collect solid waste from household for disposal), dispose of waste into nearby bush and bury their waste on compound.

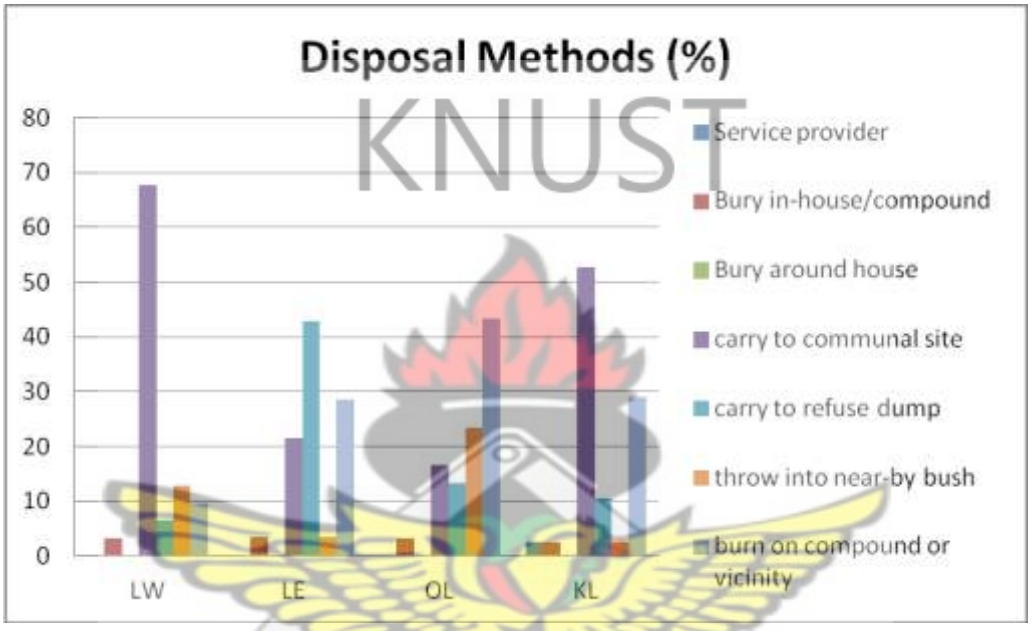

Figure 4-4: Solid waste disposal practices

The contrast in the disposal practices of the households (HHs) in the various communities is attributable to the settlement pattern and setting of the community. In the Lower West and Kley communities, most of the HHs are clustered and built up. This compels HHs to carry their solid waste to the communal container, the reason for which the predominant disposal practice is to carry refuse to the communal container. In the Lower East and Olowe communities, the community is only clustered at a small section and largely sparse and the communal container site/sanitary transfer site is only accessible to a section. This accounts for the larger portion of these communities practising un-improved or crude disposal methods.

4.3.4 Segregation, recycling and reuse practices

The study revealed that sections of the community practise segregation (Figure 4-5). This practice cuts across all study communities. The study did not however cover the estimation of amount of materials (plastics, etc) segregated and recovered in Prampram. Materials segregated are mainly plastics for sale to itinerants and stationary waste collectors (buyers). The study showed that 77.42% of the Lower west community practices segregation, while 76.32% of Kley community practices segregation. 46.43% and 36.67% practice segregation of mainly plastics in Lower east and Olowe community, respectively. The plastics are mostly PE used for sachet water. Out of those who practice segregation, 96%, 45%, 83%, 100% of lower west, Kley, Lower east and Kley communities, respectively, segregate waste into PE (sachet) plastics and other waste materials. 4%, 55% and 17%of lower west, Kley and lower east communities, respectively, segregate their waste into PE (sachet) plastic, PET plastic bottles and other materials.

The sachets for water (PE plastics) are stacked in large polythene sheets and hay sacks for sale (Plate 4-3). It was gathered that the business of segregation and sale earns income for those practicing and hence the encouragement to segregate. Some community members in the lower west community were seen picking such plastics (PE sachets for water) within the community.

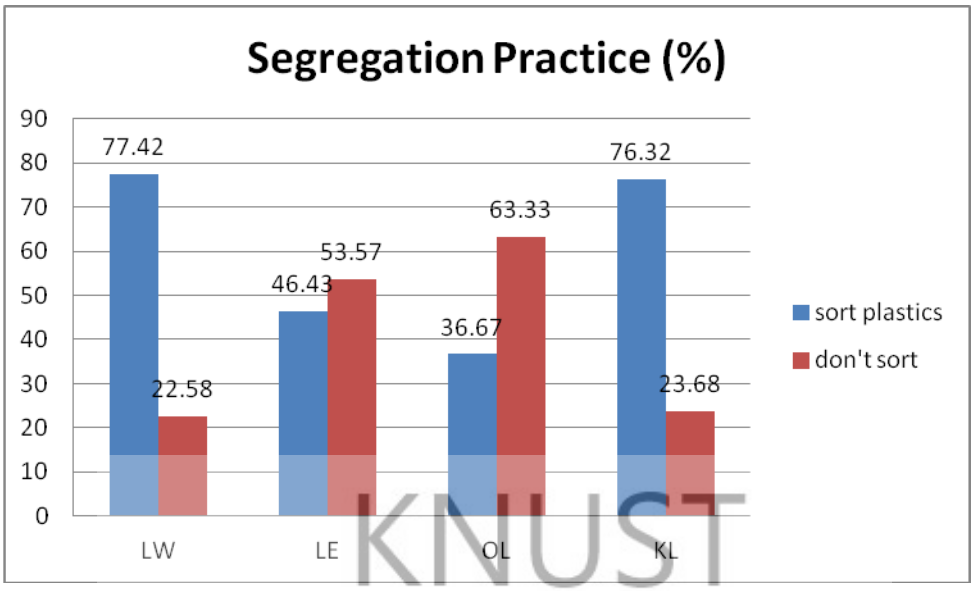

Figure 4-5: Segregation practice in Prampram

The HDPE 25L containers are mostly reused for storage of solid waste and water. PET plastics bottles are used for packaging of local beverages and cooking oils (Plate 4-5). There are waste pickers or collectors popularly known as "Kaya bolas" who go round the community to buy plastics and metals. Itinerants have buy off points in Lower West, Lower East and Olowe communities, where plastics and metals are bought from the communities (Plate 4-4). Activities of waste picker or Kaya bolas are prominent in Prampram. Indeed these activities are not limited to Prampram. Jha et al (2011) cited Zia & Devdas (2008) and Vidanaarachchi et al. (2006) admitting that informal waste picking is prominent and not only limited to rag pickers but also at source by lowest grade municipal workers for extra income. Oteng-Ababio (2011) also revealed that the activities of waste pickers are instrumental in solid waste management as an informal sector. Oteng-Ababio (2011) submitted that the waste pickers broaden their sources of income and lower the cost of recycling for assemblies. The cardinal point is that the activities of waste pickers are for economic gains and are prominent in solid waste management.

In addition to plastics, food wastes (organics) are fed to animals (Figure 4-1). These are mostly practiced by households rearing animals or have neighbours rearing animals. Local restaurants mostly known as "chop-bars" give their food waste to households who are into animal rearing. The practice of feeding food waste to animals greatly contributes to the reduction of organic composition of solid waste generated in the communities as indicated in Table 4-1.

No segregation practices were observed at the communal container sites in the study communities. This was particularly an interesting observation made, considering that there are waste pickers or Kaya bolas in the community.

The waste reduction practices are good practices that favour sustainable solid waste management. Despite the economic gains made by the people engaged in the practices, there are some limiting factors. Of the respondents in the communities who do not segregate their waste, 57%, 100%, 95% and 71% of Lower West, Lower East, Olowe and Kley, respectively, have the perception that all waste is waste and therefore no need to segregate. This indicates that social perception is a limiting factor to improvement of the segregation practices which can be largely attributed to lack of education or sensitisation. Some HHs indicated clearly that they are ready to segregate, sort out particularly plastics, if it was properly institutionalised. This section constitutes 43%, 5% and 29% of Lower West, Olowe and Kley communities, respectively of those who do not practice segregation. From the FGDs, participants submitted that establishment of buy-offs, for particularly thin film plastics, will greatly reduce the plastic composition of solid waste generated in the communities. Public health improvement and environmental protection were found not to trigger the public interest to segregate waste.

The sorting, recycling and reuse activities in Prampram are contributing to reduction of pollution, which is also widely observed in other communities and cities in Ghana that battle with the nuisance of plastic waste. It was admitted by the participants of the FGDs that the up-scaling or institutionalising segregation activities by households and waste pickers has reduced the littering of thin film plastics. There were suggestions of recycling of other thin-filmed plastics in addition to the currently recycled plastics. To this extent, the types of plastics recycled should be widened.

Sorting, waste picking and reuse is gradually gaining social acceptability, more particularly when it is a source of income. Respondents of the HH surveys and participants of the FGDs admitted that sorting activities and waste picking should be encouraged. It can be attributed to the fact that the nuisance associated with activities of waste pickers at collection points was absent. In fact, Jha et al (2011) submitted that sorting at collection points should be discouraged to avoid litter and contamination spread. Jha et al (2011) also submitted that waste picking cannot be a sustainable solution because of low social acceptance. This submission does not appear to apply to residents of Prampram, who have greatly accepted and appreciated the role and benefits of waste pickers in solid waste management.

Reuse is in no doubt a waste reduction or minimisation measure for sustainable management of solid waste but can be mode of transmission of communicable disease, particularly where standards are not adhered to.

Plate 4-5: Collection of PE sachet plastics

Plate 4-3: Buy off points for PET plastics

Plate 4-4: Emptied bottles to be reused

4.3.5 Communal collection sites and dumpsites

The sanitation map presented in Figure 4-6 shows the locations of the communal container sites and the dumpsites.

Figure 4-6 : Sanitation map for prampram township; DS is dumpsite

Lower East community

Lower east community has no communal container site. Eleven (11) refuse dumpsites were identified within the community. Some of these dumps were authorised until the adjourning community (Lower West community) was presented with communal refuse containers. There are two large refuse dumps in the community.

Plate 4-6: Unapproved refuse dumpsite at Lower East community

One located close to the beach and the other situated within the settlement at the old cemetery on coordinate $5^{o}42'22.09"N$, $0^{o}07'05.68"E$ and $5^{o}42'44.18"N$, $0^{o}06'47.17"E$, respectively. The refuse dump at the old cemetery within the community spreads over a wide area. The refuse is however concentrated over an area of about 30m x 20m. Dumping is indiscriminate and the site has been left unattended to, refuse is widely littered. This refuse dump is used by residents within a radius of less than 100m settlement. The dumpsite located at the beach is not widely and often used as observed. It is only used by those in the immediate surroundings, less than 50m radius. Like the former, this site is also open and spans over a wide area. Sanitary workers from ZOIL and ACI are detailed to keep the place tidy and limit the further spread of refuse at the beach. The refuse is sometimes incinerated.

Residents close by these refuse dumps complained of the odour they are subjected to. They attributed most to the human excreta in the waste disposed of at these sites. This was emphasised by representatives present at the FGDs. Sanitary workers lamented of the practice of disposing human excreta wrapped in polythene bags at these sites. According to the sanitary workers, they gather the human excreta and bury close to the beach.

In addition to the dumpsites discussed above, there are other localised dumpsites. These sites are mostly created by residents living close to undeveloped plots of land and bushy areas. The presence of these dumps poses health threat to the community members. The environment is also at risk. Refuse on these dumps are susceptible to being carried away by stormwater runoff. This can lead to disease break-out, particularly because of transport of human excreta. Uncontrolled incineration of refuse has its own devastating effect on the environment.

Olowe Community

The Olowe community has one designated communal container site. The site is located on coordinate 5°42'46.20"N, 0°05'54.20"E. It is located along the road that divides the indigenous community and the new developing area. The capacity of the skip container at the site is 8m3, for storage of refuse for onward transfer to the final disposal site. The site is not fenced and hence opened to stray animals and playing children. The communal container was provided by ACI, an affiliate of rlg Communications Ghana Ltd. The responsibility of lifting the container has been contracted to J Stanley-Owusu Ltd (a waste management company). 10 - 20pesewas is paid for dumping into the communal container.

Plate 4-7: Communal skip container located in Olowe community

There is an attendant who collects revenue from users. He (the attendant) is however not able to assist children who come to dispose of refuse because he is physically challenged. The site is not user friendly as it has no properly constructed stairs for children. There is no platform for the refuse container.

There is no spraying of site to disinfect and neutralise odour. Some paper waste are incinerated by the attendant. The attendant has no basic tools and protective clothes. There are no scavenging activities at the site.

Unauthorised refuse dumps

A number of unauthorised refuse dumps were noted and captured on the sanitation map. These dumps are dotted within the community. Seven (7) crude dumpsites were identified in the community. These pose health risk and nuisance to the community and pollute the environment.

Plate 4-8: Un-approved refuse dump at Olowe

There is one approved or recognised but not improved disposal site, east of Olowe community. It is located on 5°42'41.95"N, 0°05'54.20"E. However, the waste service providers handling the communal containers do not use this disposal site. This site spans an area of approximately 2451.2m2 and has a perimeter of about 235m. The site is a sand-winned excavation, now being used as a receptacle for waste. The site is not engineered; not lined, no leachate control facility, no cover material. The site is located within the area demarcated for residential purposes. This was evident by the siting of a plot demarcation pillar within the perimeter of the disposal site.

Dumping of refuse at this site is crude and uncontrolled. Leachate from deposited waste was sighted at the site. Stench from the site is a nuisance to the settlements close to the site.

It was gathered that the site was used by the door-to-door waste collector in the Prampram community. Following the suspension of that service, the site is only being used by the fish processing company located in the lower east community of Prampram.

Fish waste was observed decomposed at the site during a visit to the site. The waste at the site is incinerated. Birds were observed feeding at the site. The site is not suitable for landfilling. The leachate poses great environmental pollution. Groundwater is at the risk of pollution. The site is also susceptible to stormwater runoff. The health threat to the residence around cannot be overemphasised. Stench from waste decomposition and flies nuisance is a great discomfort and hence not socially acceptable.

Plate 4-10: Recognised refuse dumpsite

Plate 4-9: Leachate problem at the approved dumpsite

Plate 4-11: Encroachment indication at the dumpsite

Lower West Community

Plate 4-12: Communal container at Lower West community

The Lower west community has one designated communal container site. The site is located on coordinate 5°42''21.66"N, 0°06'47.19"E within the settlement close to the beach and adjacent the police quarters. The capacity of the skip container on site is 8m3 skip container. The site is not fenced and hence not excluded to stray animals and playing children. This communal skip container was also provided by ACI, rlg communication, with the same lifting agreement. There is an attendant whose duty is to collect revenue and manage the site. There is no stairs for children to climb and dump.

Littering of refuse on site is limited to circumference of the site. No leachate problems were observed. There is no disinfection of the site and the attendant has no basic tools and protective clothes to work. There are no scavenging activities at the site.

Dumpsites in Lower West

Eight (8) unapproved refuse dumps were identified within the Lower West community. In addition to this, there are a number of indiscriminate disposal points within the community. These sites are point sources of pollution and poses health risk to the people living close to them.

Plate 4-13: Un-approved refuse container near the beach

Kley Community

Plate 4-14: Communal container at Kley

The Kley community has a 15m3 roll-on communal collection container at its designated sanitary transfer site. The site is located on coordinate $5^{o}43'03.42"N$, $0^{o}06'31.11"E$. The site is located within the settlement of the community. This is inappropriate and a threat to public health. The containers used are in poor conditions; rusty and without the covers. The site is not fenced hence open to stray animals. The site spans an area of about 50m x 70m. Zoomlion Waste Experts are responsible for the communal container, under the PPP arrangement with the district authorities.

The site has no stairs for easy access to the container. According to the attendant, there are periodic scavenging activities. Materials sorted include PET and glass bottles, metals, tins and HDPE plastics.

Dumping fee ranges from 10p to 50p, depending on the size of container emptied at the site, at the discretion of the attendant. This arrangement, according to community representatives, is a great disincentive to the usage of the communal container.

The site has no shelter for the attendant. Basic working tool like spade, rake, broom and protective gears like hand gloves, overall wears, nose marks are not available. There is no water on site for sanitary keeping. These expose the attendant to health hazards. The attendant complained of fly and mosquito nuisance.

Dumpsites at Kley

Four (4) unapproved refuse dumps were identified within the Kley community. These dumps are not managed and hence pose health risk and pollution sources, particularly deposited human excreta.

4.3.6 Waste management in schools

Solid waste management in the schools and other institutions is not significantly different from that of the HHs.

Observation and surveys in the schools revealed that the refuse generated in the schools were disposed of at the periphery of the compounds. The dumpsites of the schools are not cordoned. Refuse was observed littered in the surrounding of the refuse dumps. The schools have inadequate number of litter bins. It was pathetic to see school children playing and some defecating on the refuse dumps. Some pick papers from the dump site for anal cleansing after defecation. This was particular to children who are too young to use the dilapidated school toilet. According to the SHEP coordinators contacted, the school organises the schools on Fridays to gather refuse littered around the refuse dump and incinerate them.

4.3.7 Secondary collection and transportation of solid waste

The communal skip and roll-on containers are lifted by skiploader and roll-on trucks, respectively and transported to the TMA Sanitary Landfill site. The frequency of lifting is 4 times per month, according to J-Stanley Owusu, Service contractor. The sanitary landfill site is located in Kpone, about 23km away from Prampram.

4.3.8 Institutional Arrangement for Solid Waste Management in Prampram Township

The Environmental Health and Sanitation Department (EHSD) of the District has been tasked with the responsibility for the overall management of solid waste management in the community, according to the head of the department. Interaction with the officers and the head of the department revealed that the department is not well resourced to carry out a supervisory role on the waste service providers and waste management practices of the community. This is largely due to the fact that the district is a newly created district which was yet to develop short to medium term plans for the community. It was also revealed that the Prampram township did not receive much attention when it was under the Damgbe West District Assembly.

At the community level, there are Environmental Health Officers detailed from the EHSD to conduct routine sanitary inspections of households and other premises in the community. The Assemblymembers representing the communities are responsible for the communal container sites. They engage attendants at the sites to manage the site; collection of fees, cleaning of the sites. Currently, the Assembly members liaise with the waste management service providers (J-Stanley Owusu Ltd. and Zoomlion Ltd.). The attendants at the respective sites account to their respective Assembly members.

ACI and Zoomlion sanitary workers are responsible for street sweeping, cleaning of the beach and other public places. These service providers do not have any service contract with the EHSD in the community.

At the primary level, households are responsible for the sweeping of their immediate surrounding and conveyance of their solid waste to the communal container sites.

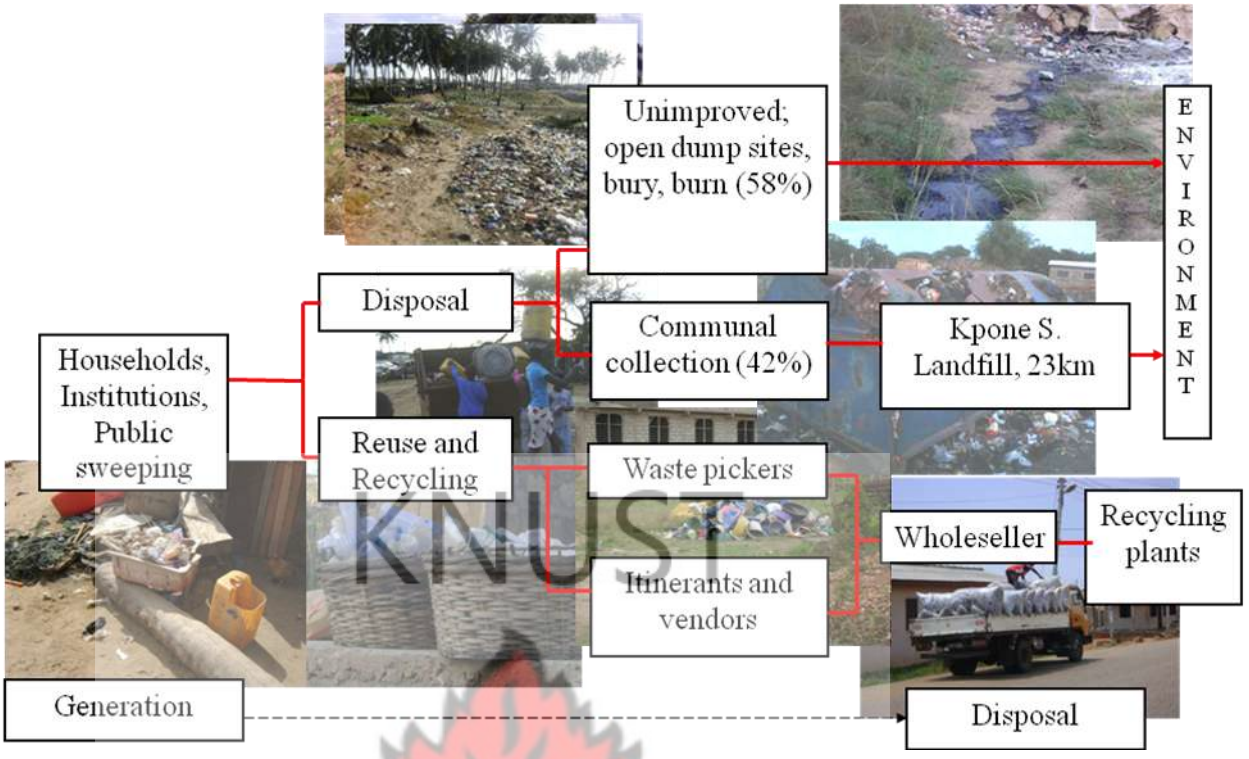

Figure 4-7: Schematic flow chart of solid waste management in Prampram

4.4 Performances of Management Practices and Technologies

The prime aim of solid waste management is to effectively collect solid waste from the settlement of the community and dispose of safely. This is because of public health and environmental protection.

4.4.1 Recap of indicators for performance evaluation

Performance Indicator	Measurement
1. Technical Performance	
Effectiveness	• Amount collected/total amount generated
Adequacy (capacity of storage);	• Size of container, volume of waste generated, duration of storage
Accessibility and Coverage	• No. of users/total population
Environmental sustainability (protection);	• Scientific (safe) disposal of solid waste-improved disposal sites against

	total disposal sites
2. Institutional and Organisational Performance	
Institutional capacity	Training of staff, logistics
Strategies and plans for solid waste management	Level of implementation of strategies and plans
3. Social and Cultural Performance	
Activities/Practices of community	
Awareness of community	Extents and frequency of public educations

4.4.2 Technical performance

4.4.2.1 Effectiveness of collection scheme

The collection efficiency of wastes is a tool for knowing the MSW management status (Jha et al., 2011). Generally collection points are open and unattended for a day or more and are clubbed with poor collection efficiency which is even less than 50% in low income cities (Jha et al., 2011; Shimura et al., 2001). This assertion is true for Prampram township. In this study, the collection efficiency submitted by Jha (2011) is described as effectiveness of collection as presented in section 4.4.1. This was determined as percentage of total waste generated in the community collected and transported to the Sanitary Landfill Site. The estimated monthly generation volume of solid waste in Kley, Olowe, Lower East and West was 3.86m3, 4.34m3, 7.86m3 and 4.43m3, respectively. With the collection frequency of 4 times in the month, the effectiveness of the collection system was 48%, 25%% and 9% for Kley, Olowe and Lower East and West, respectively. The highest effectiveness of collection was recorded for Kley because of the capacity of the storage container

(15m3). The 9% for Lower East and West was due to the fact both communities (Lower West and East) share a skip container capacity of 8m3. Olowe also uses a collection and storage container capacity of 8m3. The sizes and number of communal collection containers are the cause of the low effectiveness of the collection system. The observations and submission from FGDs as well as interviews revealed that users resorted to un-improved methods of disposal of their solid waste when the communal collection/storage containers in the communities are filled.

Table 4-2 : Effectiveness of Solid Waste Collection System in Prampram

	generation (kg/c/day)	population	daily generation (Kg)	daily volume of generation	monthly generation (m3)	monthly collection (m3)	Effectiveness
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
			=(a) x (b)	=(c)/270*			
Kley	0.685	1521	1,041.89	3.86	115.8	56	48%
Olowe	0.72	1628	1,172.16	4.34	130.2	32	25%
Lower East	0.715	2967	2,121.41	7.86	235.8		
Lower West	0.715	1671	1,194.77	4.43	132.9	32	9%

*bulk density

4.4.2.2 Adequacy of storage capacity

Storage capacity of collection containers is linked to the effectiveness of solid waste collection system. The capacity of the communal collection/storage containers should be adequate to store refuse for the desired retention time to meet a determined frequency of disposal to the final disposal site. Adequacy of capacity of storage of solid waste generated in the community was determined by the daily generation multiplied by the retention time (duration of storage). Table 4-3 presents the required capacities and the current capacity, indicating the inadequacy of the current capacities of the communal collection/storage containers in the various communities in the Prampram township.

Table 4-3: Adequacy of storage capacity

	Retention Time (Days)	Daily Generation m3	Total capacity required m3	Current Capacity m3	No. required	Current no.
	(a)	(b)	(c)	(d)	(e)	(f)
			= (a) x (b)		= (c)/(d)	
Kley	7	3.86	27	15	2	1
Olowe	7	4.34	30	8	4	1
Lower East	7	7.86	55	8	7	
Lower West	7	4.43	31	8	4	1

4.4.2.3 Accessibility and Coverage

A study by Oteng-Ababio (2010) in GAMA (include some peri-urban communities) revealed that those who have to travel longer distances to a waste container site to dispose of waste have the tendency of finding an alternative place, which is normally very close to their place of abode. Oteng-Ababio (2010) submitted that 50% of respondents in the low income areas were willing to access waste containers within the 50m radius while only 5% were prepared to travel about 200m for the same

purpose. The long distance coupled with the fact that these containers are always over-flowing, serve as enough deterrent to residents who then look for alternative dumping sites (Oteng-Ababio, 2010). The study in Prampram township recorded similar results. Over 90% of the households are situated beyond 150m radius of the communal container sites.

Plate 4-15: Accessibility/coverage map for Olowe and Kley

Plate 4-16: Accessibility/coverage map for Lower West and Lower East

Figure 4-8 presents the user coverage of communal collection as revealed from the survey. Coverage for Lower West and Kley communities are quite encouraging. This is mainly due to the clustered nature of settlement and population density as seen from Plates 4-15 and 4-16. User coverage for Lower East and Olowe communities are poor. This can be attributed to the settlement pattern as a result of which many households are beyond 300m from the refuse container. In addition, HHs easily found alternative places because there are lots of undeveloped lands within the settlement.

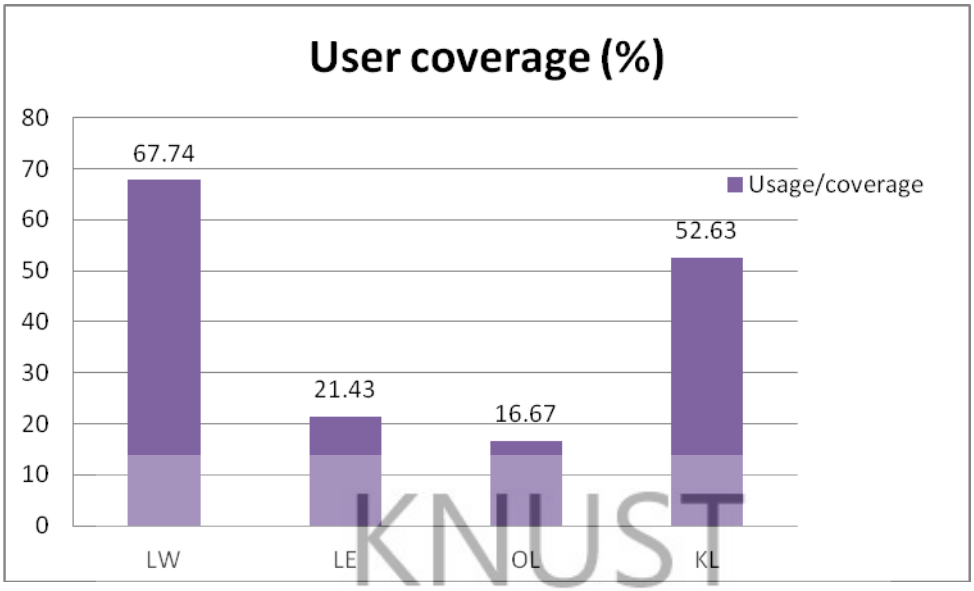

Figure 4-8: User coverage of communal collection

4.4.3 Environmental sustainability (protection)

Safe disposal of solid waste is necessary to protection the environmental against pollution. Crude dumpsites serve as point sources of pollutions to water and soil contamination. Leachate from decomposition of solid waste dumpsites is a source of ground and surface water pollution.

The study revealed that there are about 30 dumpsites in the community. These are un-authorised dumpsites used by the community. There are three communal collection sites with storage containers used by the communities. It can therefore be said that safe disposal site for the community is 3 out of the total 33 disposal sites in the community. The solid waste management situation in Prampram township threatens the sustainability of the environment.

4.4.4 Institutional and organisational performance

Interactions with EHOs revealed that the EHSD office in Prampram has not been very functional. The office is greatly challenged in its effort to carry out their responsibilities. The NESP adjourns the EHSD to develop DESSAP. The EHSD in Prampram is yet to develop any strategy plan for Prampram. This is largely because the district is less than a year old and yet to fully develop short and medium terms under the Ningo-Prampram district. The communal container sites have been left to the care of the Unit Committee and the Assemblymen. The management of the communal containers is very poor. It was gathered that periodic neighbourhood clean-up exercises are organised by the Assemblymen. The work of the sanitary workers detailed to sweep the beaches and other communal and commercial areas is encouraging.

4.4.5 Social and cultural performance

The FGDs held in the study communities revealed that the community members have appreciable awareness on the need for good practices in the management of solid waste in the community. It was gathered that the reason for the daily disposal is to avoid the breeding of pest and rodents within the settlement. This awareness coupled with other incentives (mostly economic) has resulted in the segregation and reuse practices observed in the community. Periodic education on the need for cleanliness and personal hygiene is carried out mostly by civil society organisations as Hope Line Institute. In addition, School Hygiene Education Programme (SHEP) has been instituted in the various schools in the communities to educate the children about environmental cleanliness. Each school has a SHEP coordinator who goes for periodic training workshops. These notwithstanding, some community members have bad attitudes towards solid waste management.

4.4.6 Barriers and challenges affecting performance

4.4.6.1 Challenges to performance

Poor layout of the community

The poor layout of the community poses difficulty in the appropriate siting of communal containers within the community. As a result of improper planning, sites have not been earmarked for communal collection sites or sanitary transfer sites. This poses a challenge in placing collection containers within appropriate ranges from the settlement of the community. The assemblymember for Olowe indicated that the community kept the designated communal container for four month unused because of the difficulty in locating a site for it. The Lower East community has no communal container because of poor vehicular access to proposed sites. The communal collection system was adopted because of the settlement pattern and layout but has failed because the designated site has very limited coverage area.

Economic status

One issues that was prominent in the FGDs was the ability to pay for sanitation services rendered in the community. Participants complained of the low income status of the community and hence difficulties in the payment of the daily fees at the communal container site. One of the Assemblymembers revealed that a monthly solid waste collection fee of GHC1.00 per household was instituted in the Kley community but couldn't be sustained because of the low economic status of the indigenes of the community. It was evident that sections of the community practice crude disposal methods in their avoidance to pay at the communal collection point. The attendants at the communal collection sites submitted that people dispose of solid waste at the sites at odd times, when they (the attendants) are not at post. The

inability to pay threatens the financial sustainability of the solid waste management system.

Limited resources to EHSD

The limited logistics available to the officers of the EHSD in Prampram poses serious challenges to the inspectorate works in solid waste management. The EHSD head uses his private car. The head submitted that this hinders work in the department. Basic office equipment have not been provided to the department.

4.4.6.2 Barriers to performance

Accessibility to communal container

The effective collection of solid waste from the community is hindered by the communities' poor access to communal collection containers. The study revealed that 90.54% of the community that practice crude disposal methods attributed their practice to lack of access to communal collection/storage containers. Some community members who are willing to use the communal collection container have to traverse more than 600m to have access.

Attitude toward solid waste management

The attitude of some community members to solid waste management is a serious constraint to the management performance in the community. Some community members were observed picking quarrels with attendants at the communal container site over payment. Some willingly by-passed the communal collection container to dump at un-authorised refuse dumps. In the Lower west community, a refuse dump was sited less than 20m from the communal collection container. Some participants at the FGDs complained of the bad attitude of some neighbours with regards to solid

waste disposal. Some simply prefer to practice the old crude disposal methods, participants at FGD submitted.

Lack of law enforcement

Due to obvious logistical constraints, the EHOs are not able to effectively enforce the community bye-laws of sanitation in the community. This is barrier to the management of solid waste. Some community members get away with solid waste management practices that threaten public health, as submitted at the FGDs. Discussions with the sanitary workers in the community revealed that some people still dispose of solid waste at prohibited sites within the community.

Lack of community ownership

The community does not own the management system employed in the community. The system was instituted as a corporate social responsibility of a company and hence the community does not effectively participant in the process. The community would have acted much better if they felt part of the management system. This was the submission from the FGDs.

Lack of proper institution for segregation

The segregation practices in the community could be enhanced if the practice is duly formalised with the institution of collection/buy off points. The study revealed that about 90% community is prepared to practice segregation if there is proper institutionalisation. Majority of those who don't segregate submitted that it was because there was no ready picking up by the wholesellers.

4.5 Proposals for Improvement

4.5.1 Establish buy-off points for recyclables

The study revealed the extent to which the community practices segregation for economic gains. Even though the study could not establish the amount of PE and PET plastic recovered by segregation per period from Prampram, for lack of records, it is believed that a sizable amount is recovered and can be improved. For this reason, it is proposed that a buy-off point (garage) be established for recyclable materials (plastics etc.).There is currently an increasing demand for recovered plastic which has received further boost by a Government policy of recycling of plastics. It has been established that recyclables have a large market in Tema Municipal Assembly (TMA), yet to be tapped into (Oteng-Ababio, 2010). Blow Plast Industry Limited is a company engaged in plastic waste recycling, with a total capacity of 24metric tonnes a day. The company currently pay GHC5.25 for a kilogram of P.E plastic (sachet water bags).

4.5.2 Implement block collection with motorised tri-cycle

It is proposed that a block collection system be instituted to collect waste from the HHs and other generation points. This proposal is to solve the problem of poor access to communal collection containers and poor layout of the community, which affects effectiveness of collection. In this system, a motorised tri-cycle (1100L capacity) should make daily stops at predetermined collection points in various zones of the community. This collection scheme should replace the communal collection scheme. This scheme of collection will work in tandem with proper primary storage facilities. This collection scheme will discourage the placing of solid waste storage container outside the house. The placing of storage containers outside the houses for pick exposes the waste to stray animals. This is the typical situation in Prampram.

4.5.3 Upgrade the communal collection sites to sanitary transfer site

To ensure proper sanitary management of communal storage sites, the communal collection/storage sites should be replaced with or upgraded to a sanitary transfer site. This site should be designed to hold 5no. 15m^3 roll-o-roll-off containers with lid covers. The motorised tricycles for the block collection should discharge at the sanitary transfer site for onward transportation to the TMA landfill site at Kpone. The retention (storage) time for each container should be 3 days. Table 4-4 presents the computation supporting this proposal. The management of the sanitary transfer site and collection system should be under the EHSD. Provision should be made at the site for an office for EHSD. A layout of the proposed sanitary transfer site is presented in Appendix 3.

Table 4-4: Computations for proposed waste storage facility

Description	Value
Estimated Daily Generation	20.5m3
Retention (storage time)	3days
Total Capacity of Storage	61m3
Capacity per container	15m3
No. of Containers	5 (one extra for contingency)

4.5.4 Fix tariff based on weight/volume of refuse

As a measure to further encourage waste reduction and promote equity in service delivery, it is proposed that tariffs be fixed based on weight of refuse. This is based on the premise that sections of the community were discouraged from disposing of solid waste at the communal container by the discretionary fee charging. Alternatively, the standard container volumes could be employed as comparison to waste container brought by community member, based on which a fee could be charged. It is recommended that the charge for 10kg of waste be set at GHC0.45. A

10L container of solid waste may be set at GHC0.10, while that of 18L and 25L containers be set at GHC0.20 and GHC0.30, respectively. Breakdown of cost is presented in the subsequent sections.

4.5.5 Cost recovery

The estimated cost of waste management service delivery system is detailed into collection and transportation cost.

Collection cost

The collection cost is estimated based on a 1.1m3 capacity motorised tricycle collection vehicle per community.

Table 4-5: Collection cost per month

Item description	Cost (GHC)
Running cost	720.00
Driver and janitor	1000.00
Maintenance (servicing)	600.00
Depreciation on collection truck	400.00
Depreciation on storage container	500.00
Wear and tire/repairs	333.33
Cost of collection	**3,553.33**

Transportation Cost

The transportation cost is based on 15m3 roll-on-roll-off container and 16-tonne transportation truck. The cost of the truck is estimated at GHC30,000.00

Table 4-6: Transportation cost of waste per month

Item description	Cost (GHC)
Running cost	1,564.00
Driver and ganitor	550.00
Maintenance (servicing)	253.00
Depreciation on truck	500.00
Wear and tire/repairs	83.33

Total cost of transportation	**2,950.33**

Table 4-7: Collection and Disposal cost per tonne of waste

Total cost of collection and disposal per month	GHC 6,503.67
Tonnes of waste per collected month	144
Cost per tonne	GHC 45.16
Cost per 10kg	GHC 0.45

Cost of construction of sanitary transfer site

The construction of the sanitary transfer site with all accessories is estimated at GHC 70,000. It is recommended that funds for this should be sourced by the District Assembly from its development partners.

5 Conclusions and Recommendations

5.1 Conclusions

Solid waste management is an issue both in the urban areas and the peri-urban areas. The problem of solid waste management in the poor Peri-urban communities has not received much attention. In the big cities of Ghana, solid waste management problems easily receive attention from the public and the media, necessary remedial actions, howbeit adhoc. With the increase in population and the extension of settlement to the peri-urban communities, it is imperative to dedicate attention to these areas. In another vein, there are practices in these poor peri-urban areas which could be formalised and developed so as to minimise waste production

The study attests that management practices of segregation for reuse and recycling contributes to significant change in composition of waste disposed of. The segregation practice has not resulted in significant reduction in waste because of the practice of including human excreta and sand and ash from housing sweeping to the waste disposed of.

The study revealed that the predominance of crude management practices of burying waste on compound, burning of waste domestically and disposal at un-authorised places is the reason for the low waste collection effectiveness in the community. Collection Effectiveness of 27% implies that only 27% of the solid waste generated in the community is collected for safe disposal. Inadequate number and storage capacities of communal collection containers available to the community also contribute to the low waste collection. Poor accessibility and coverage of the communal collection system can be linked to the low effectiveness. The poor solid waste management in Prampram threatens environmental sustainability due to the pollution effect of the crude practices.

The study revealed that no efforts are made towards cost recovery for service delivery. This threatens the financial sustainability of the management system and hinders improved management.

The low performance of the solid waste management system in Prampram is due to the obvious barriers and challenges of poor layout of community, low economic status, bad attitude of sections of the community and ineffective institution and organisation for solid waste management and enforcement of bye-laws on acceptable practice.

5.2 Recommendations

For improvements, there is the need to integrate various practices encouraging reduction, reuse and recovery. It is important to provide the various infrastructures for improved management practices and technologies.

Recommendations from this study include the following:

- The establishment of buy-off points in poor Peri-uban communities for recyclables should be encouraged. This provides some economic gains and helps in the reduction of waste as well as cost of recycling.
- Institutionalisation of polluter-pay policy should be encouraged in poor Peri-urban communities with properly fixed tariffs according to weight or volume of waste.
- Implementation of block collection system should be encouraged as a replacement to the communal waste collection system, where community layout is very poor, as is the case of most poor Peri-urban communities. This is believed to improve the collection and minimise dumping at un-authorised places.

- Construction of sanitary transfer sites should be encouraged in poor Peri-urban community as a replacement to the communal container sites. This is deemed to curtail the problem of lack of space to locate communal containers. This would also improve the health risk that is posed by improper management of communal collection sites.

- Proper resourcing of EHSDs should be encouraged. It is their primary responsibility to protect the health of the community by ensuring good waste management practices as well as hygiene. There is the need for the bye-laws on waste management to be enforced. This is necessary to prevent people employing crude practice in the avoidance of payment for proper disposal of solid waste.

- Education and sensitisation should be encouraged. Focus should be on waste minimisation practices.

- Domestic sanitation facilities should be promoted to prevent the disposal of human excreta with solid waste.

In addition to the above, further studies should be conducted into the sustainability of the use of motorised tricycles in solid waste collection and disposal. Studies should also be conducted into public health implications of reuse practices in poor peri-urban communities.

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7 Appendix

Appendix 1: Transcript on FGDs

Appendix 2: Field Data

Appendix 3: Layout of Proposed Sanitary Transfer Site