ASSESSMENT OF WASTE BATTERIES MANAGEMENT IN PERI-URBAN SETTLEMENT, CASE STUDY AT KIGAMBONI/TEMEKE DISTRICT

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN ENVIRONMENTAL STUDIES OF THE OPEN UNIVERSITY OF TANZANIA

2016

CERTIFICATION

The undersigned certifies that he has read and hereby recommends for acceptance by the Open University of Tanzania a dissertation entitled: "**Assessment of Waste Battery Management in Peri-Urban Settlement, Case Study of Kigamboni/ Temeke District"** in partial fulfilment of the requirements for the degree of Master of Science in Environmental Studies of the Open University of Tanzania.

.....

Dr. Lawi Yohana

(Supervisor)

…….

Date

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DECLARATION

I, **Kayombo, Jarome Ansgary**, do hereby declare that this dissertation is my own original work and that it has never been presented and will not be presented to any other University for similar or any other degree award.

…..……..

Signature

…..……..

Date

DEDICATION

This study work is dedicated to my wife Peles W Mhanze and my boys, Jerry Jr. Jarome and Jeffry Jarome. Further I extent my dedication to my lovely brother Deodatus Mtitu and my late Parents Ms.Theresia Severino Mtitu and Mr. Ansgary Joseph Kayombo.

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ABSTRACT

This study assessed the Waste Batteries Management in Peri-Urban Settlement, Case study Kigamboni/Temeke District. Specifically the study was done at Kisalawe II ward, Tumaini and Kichangani Mtaa jurisdiction area. A total of 57 respondents from Tumaini and Kichangani Mtaa as well as officials from Government authorities were involved. Data were collected using direct observation, interview and questionnaires among household producing waste batteries and focus group discussion to government officials. Both descriptive and inferential statistics were used for data analysis. Findings indicates that there is Dry cell waste batteries (455 Pc/HH/3yrs), Cell Phone waste batteries (2.1Pc/HH/3yrs) and Lead acid waste Batteries (2.2Pc/HH/3Yrs). Also there is no treatment facility for Dry cell waste batteries and cell Phone waste batteries and only two recyling indutry for Lead acid waste batteries counrty wise. Furthermore, the study revealed that Dry cell and Cell phone waste batteries are mixed up with other domestic waste while the Lead acid batteries are collected to lead acid recycling facilty. The use of rechargeable batteries minmizes the waste batteries generation, also increased investment on Waste Battery Recycling Industries reduces the pollutant burden to environment. Lastly, awarenes raising among the users on the hazardousness and safe handling of waste batteries should be emphasised to control environmental pollution.

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LIST OF ABBREVIATIONS

A	Lager size Dry cell batteries
AA	Medium size Dry Cell batteries
AAA	Smallest size Dry Cell batteries
Ar	Arsenic
Cd	Cadmium
CPWB	Cell Phone Waste Batteries
DCWB	Dry Cell Waste Batteries
EA	Environmental Audit
EIA	Environmental Impact Assessment
EMA	Environment Management Act
Hg	Mercury
HH	House Holds
ISO	International Organization of standards
LAB	Lead Acid Batteries
LGA	Local Government Authority
LQAS	Logical Quality Assessment Sampling
MW	Megawatt
NEMC	National Environmental Management Council
NG'OS	Non-Government Organization
Pb	Lead
PC'S	Personal computer
PV	Photovoltaic

REA	Rural Energy Agency
TCRA	Tanzania Communication Regulatory Authority
TV	Television
ULAB	Used Lead Acid Batteries
URT	United Republic of Tanzania
USA	United States of America
WB	Word Bank

CHAPTER ONE

BACKGROUD OF THE PROBLEM

1.1 Introduction

Batteries are commonly used all over the world; they are used as source of electric power. In Tanzania there about three common types of batteries used such as dry cell batteries (DCB), lead acid batteries (LAB) and Cell phone batteries (CPB). The batteries are of single use (non-rechargeable) and rechargeable batteries that can be used several time. The rechargeable one last for long time for example LAB have maximum life up to seven years. This phenomenon has implication on generation rate of battery waste where as those with short life span have higher battery waste generation rates as compared to those rechargeable batteries.

This study aimed at assessing the waste batteries management in Peri-urban settlement, case study of Kigamboni/Temeke District. The study was specifically conducted at Kisalawe II ward, in Tumaini and Kichangani Mtaa jurisdiction area. In addition it included Temeke Municipal, Dar es Salaam city councils and National Environment Management Council (NEMC) officials. In this chapter I introduce the study by providing background to the study, research problem, research objectives and accompanying research questions and significance of the study.

1.2 Background of the Study

Batteries are devices that changes chemical energy to electric energy. They are widely used all over the world. Therefore, Tanzania as well as countries the use of batteries at household level is unavoidable, almost every household uses batteries for

different purposes. Some of the batteries used in Tanzania include and not limited to dry cell, lead acid, battery pack, cell phone batteries etc.

In addition even the developed nations like USA, batteries are used at household level. The literature has revealed that each household dispose off not less than 8 waste batteries per year in average. Furthermore the literature shows that these batteries are used running remotes, torch, phone,

The demand for power in Tanzania grows at an average annual rate of 10 to 15%; this trend is expected to be skyrocketing in the nearby future. In Tanzania about 35.4% of electric power is from hydropower, 33.2% from natural gas and 31.3% from HFO. However, only 24% of mainland Tanzania population is connected with electricity services of which only 7% is in rural settlement areas (*URT, 2014*)**.**

Due to above facts, the majority of Tanzanian use alternative sources of energy among them being batteries, the phenomenon which is common in rural and semi-urban settlement as compared to urban settlement. The batteries are commonly used for portable radios, MP3 players, torch, laptops, cell phones, cars, Personal Computers, Solar power etc.

Also there is increasing usage of motorcycle in both urban and rural Tanzania to save the transportation demands. The motorcycle also uses lead acid batteries; hence the increase in number of motorcycle results to increase of Lead acid waste batteries. The reports show that there is an increasing number of cell phone subscriber's in the country. Data from Tanzania Communication Regulatory Authority (TCRA) of June

2012 shows that in the country there are a total of 28,024,611 subscribers, among them 12317029, 7504511, 5613330, 2356467, 227424, 1050 and 4810 from Vodacom, Airtel, Tigo, Zantel, TTCL, Benson and Sasatel respectively. Therefore this indicates that there is increasing rate of using cell-phones in the country so does the cell phone batteries and power park. It should be noted that this is the number of subscribers (28,024,611 people) but not the number of cell-phones in the country (TCRA, 2015). Most of cell phone batteries are rechargeable but not single use batteries. They will turn into waste trash though may take long time. The advantage with rechargeable battery is that it minimises waste burden and cost.

Some batteries contain heavy metals such as mercury, lead, cadmium and nickel. These heavy metals react with chemical electrolyte to produce the battery power. For example the data from *Panasonic Energy Co. LTD*, revealed that among dry cell batteries used in Tanzania like Panasonic, ABC, Eveready, Tiger heads contain heavy metals mentioned above (Panasonic, 2009).

In developing countries, general solid waste management system is not well functioning, for example the study done by (Makoba, 2008*)* shows waste generation rates is 3100 tons/day and only 39% is collected and dumped in designated dumpsites. However sorting of waste is not done thus there is a likelihood of waste batteries being mixed up with general municipal waste. The scenario has likelihood of polluting water, soil and air where human and other forms of life are found.

Heavy metals are naturally occurring substances and therefore they are often present in the environment at low levels. However when occurs in larger amount they

become lethal. In general people become exposed to these metals through ingestion or inhalation. Working or living in contaminated environment like living on or near sites where the heavy metal have been improperly disposed increases the likelihood of being exposed.

The studies shows that some heavy metals cause cancer, affect vital organs like lungs, kidney and liver, also some have injurious impacts on nervous systems, causes miscarriage to women, affect sperm production in male also when taken in subsequent amount causes anaemia, blood pressure, vomiting and diarrhoea depending on exposure dose and type of heavy metal taken (Sabine, Martin, 2009). This suggests that there is a need to combat the poor disposal of waste batteries and this study will provide baseline data for waste batteries management strategy.

The study done by *Department of industrial Chemistry, Abiastate University-Nigeria* revealed that waste batteries are mixed up with municipal waste therefore there is a urgent need to introduce an adequate well-established system for collection, separation, storage and management of municipal/ industrial waste containing primary and secondary batteries wastes and similar toxic to halt the open burning of such waste within inhabited areas.

1.3 Statement of the Problem

The generation of hazardous waste in Tanzania is skyrocketing due to advancement of social life, population growth and technology development which commands for power demand. Gradually hazardous waste management is becoming an issue of concern in Tanzania. In the past, hazardous waste management has not been

accorded its due importance and recognition essentially because of low level of awareness, financial and technological constrains. Also the generation of hazardous waste like organic solvents, refrigerants, propellants, batteries, electronic waste, gadget, absorbents, paints, varnishes etc., at household level is growing spontaneously (M.E. Kaseva & Mbuligwe, 1999).

Despite the fact that there is a number of hazardous waste generated at household level, this study will focus on waste battery management among others. The generation of components using batteries is growing fast in the world, which in turn increases the amount of battery waste. Studies shows that the current battery demand is skyrocketing due to communication revolution (use of mobile phones), power demand (use of solar energy system), increased number of motorcycles and vehicles (to meet transportation demand) and household battery use due social life advancement like use of TV, Radio, MP3 Players etc. *(Panasonic energy Tanzania Limited, 2015).*

Waste batteries are considered as hazardous waste due to composition of heavy metals in them, battery composes of heavy metals like Mercury (Hg), Lead (Pb), Arsenic (Ar) and Cadmium. The impact of poor waste batteries management is more noticeable into receiving body like soil, water and air where they are dumped. These heavy metals in battery are lethal to all forms of life, environment as well as other living organisms (Steven Krar, ….).

However, the increased volume of the used batteries hasn’t matched with the support system to manage waste batteries, as a result poor disposal poses health and

environmental risks. Among of reasons for failure of system of managing waste batteries is lack of data on waste batteries generation rates, knowledge on hazardous nature of waste battery, availability of waste batteries recycling plants, handling of waste batteries at point of source (household level).

Hence there is a gape of knowledge on waste battery generation rate, how waste batteries are handled at point of source and availability of disposal options. There are no studies that have been done on waste battery in particular, most of them includes waste battery to electronic waste thus there is no clear information on waste batteries management trends in the country.

1.4 Research Objectives

1.4.1 Main Objective

The overall objective of this study is to assess the waste batteries management practices available in peri-urban settlement.

1.4.2 Specific Objectives

(i) To characterize the types of waste batteries generated in the study area,

(ii) To assess the waste batteries generation rates among residents in study area,

(iii) To assess the methods for waste batteries collection/management in the study area, and

(iv) To assess the methods for waste batteries disposal options in study area.

1.5 Research Questions

(i) What types of waste batteries generated in the study area?

(ii) The waste batteries generation rate is assumed to be insignificant so does its effects to environment and life forms.

(iii) There is no waste batteries handling/management strategy in the area prior final disposal.

(iv) The community members are not aware of the best option/practices to manage waste batteries.

1.6 Significance of the Study

Wastes batteries are of concern due to hazardous content in them hence are categorized to hazardous waste. Batteries contains heavy metals like Lead, Mercury, nickel, Cadmium, Lithium, Silver, Zinc and Manganese and Lead acid batteries contain acid (sulphuric acid).

Improper handling of waste batteries can result to spillage of corrosive materials or heavy metals, which are toxic to both flora and fauna and alter the setting of natural environment. Once released to environment they end up polluting the receiving body like underground and surface water, soils and air if in powdered form. Heavy metals are said to have bio-accumulative and bio-magnification effects hence are cancer causing agent.

In general, this study aims at determining the types and amount of waste batteries generated and how they are managed so as to minimize the effects to both living organisms and overall environment.

1.7 Conceptual Framework

This is an analytical tool with several variations and contexts. It is used to make conceptual distinction and organize ideas. The strong conceptual frameworks capture something real and do this in a way that is easy to remember and apply.

The waste batteries management requires various interrelated essentials, if when all are considered then the waste batteries management are impeccable accomplished. The first essential in waste battery management is determination of types and amount of waste battery generated means of collection at source, storage, transportation to disposal /recycling site and finally is final waste battery treatment such as disposal or recycling.

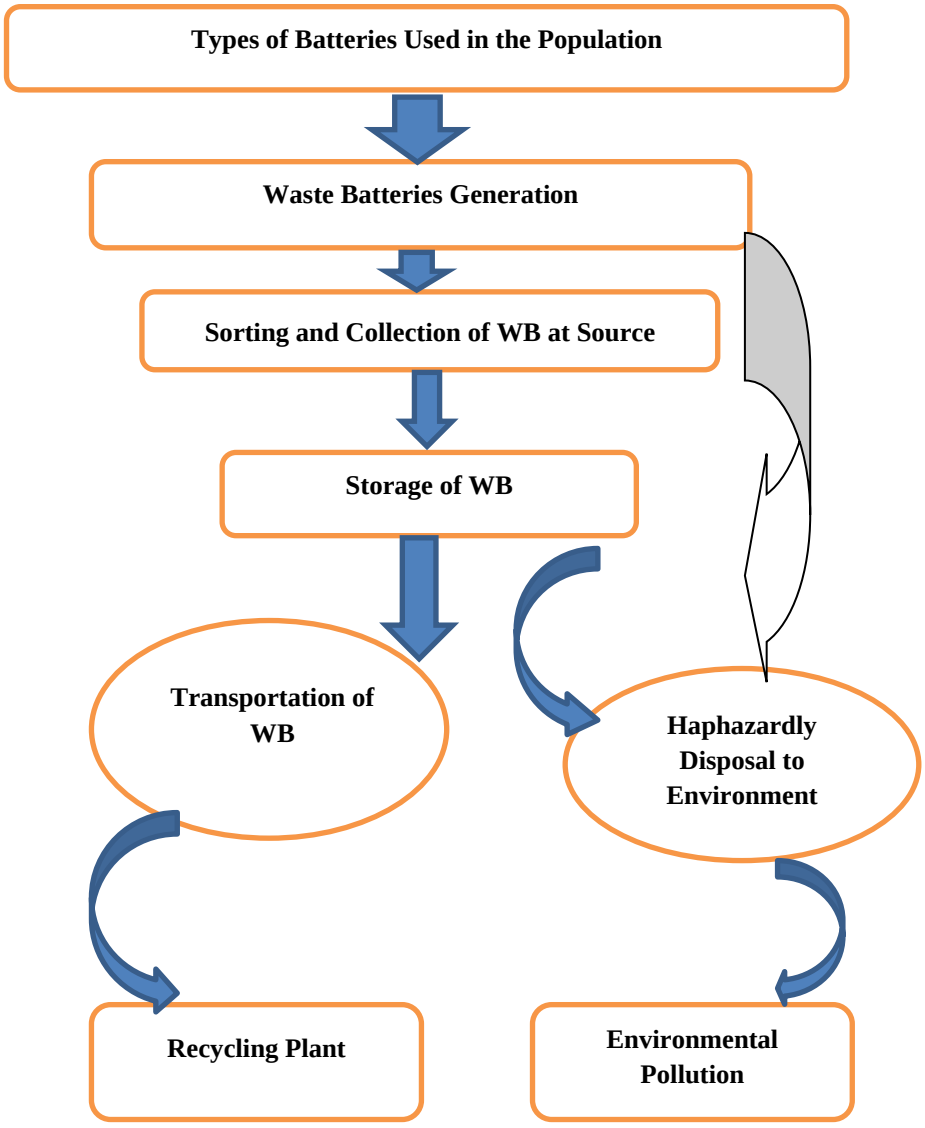

Figure 1.1: Showing Interrelationship of Functional Element Comprising a Waste Batteries Management

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter offers the review of literature related to waste batteries management. It includes the discussion of the related concepts of the study compared to what other researcher's findings. It mainly discusses on over view of the waste batteries management; hazardousness of contents available in batteries, the types of batteries used, generation rates, waste batteries handling at point of source, availability of recycling companies and roles of various government agencies on waste batteries management.

2.2 Meaning, Chemical Composition of Batteries

Batteries are devices that changes chemical energy to electrical energy. Batteries are widely used all over the world and Tanzania being one of them. The study finding shows that in the area there are various types of batteries used like Lead acid batteries, dry cell batteries and cell-phone batteries. Among these batteries, some are rechargeable and some are of single-use batteries, lead acid batteries and cell phone batteries are rechargeable while dry cell batteries are not. Batteries are used in running various devices like torch flashlights, vehicles, motorcycles, radios, solar energy systems and cell phones. (www.solarpowernotes.com/ Panasonic energy Co. LTD report).

These batteries contains heavy metals like Lead (Pb), Mercury (Hg), Arsenic (Ar), Cadmium (Cd), Nickel, Lithium, Silver, Zinc and Manganese. These heavy metals

are toxic to most life forms so they pose environmental concerns. (Steve Krar, ...& *www.Duracell.com*).

With respect to *ISO 14001* (Environment management standard) and *European directive on batteries and accumulators* (Proposal of European Economic and Social Committee article 21-2). It prohibit the placing of on market the battery and accumulator containing heavy metals above allowable standard. This means due to limitation of technology it allows addition of heavy metal in specified standards.

Also the Environmental Management act of 2004 cap 191 and its regulation gives prominences on management of hazardous waste, batteries being among of them. It provides legal procedures and stresses on using the best and environmental sound technology in handling such waste (*EMA-2004).*

2.3 Types of Waste Batteries Generated and their Uses at Household Level

The types of waste batteries generated is the function of availability and frequency of use of appliances that need batteries for its function or lack of electric power supply hence battery being used as alternative source of energy. Availability of appliances like radio, torch, remotes, cell-phone, potable DVD players, vehicles, motorcycles and power demands commands for the use of batteries resulting into generation of waste batteries.

The phenomena is common is most area in the world especially in developing countries where power supply is limited. The report from *Panasonic Energy Co. LTD-Tanzania (2015)* shows that the company commands for 40% of domestic

market of dry cell batteries which is about 250million pieces per year hence others are supplied by other agent like Tiger heads, Duracell, Eveready e.tc. to cover the 60% demand equivalent to 375million pieces.

Also the increasing subscribers go hand in hand with increased use of cell-phone so does the cell phone batteries. The Report from TCRA *(2015*) shows increased subscribers up to 39,808,419 by December 2015.

Lastly, Tanzania profile report on Renewable Energy in Africa, *African development Bank, (2015*) indicates there is speedy increase of installation solar system in institution and individual household level through individual initiatives or government support through REA. In addition the increasing importation and use of vehicle and motorcycle calls for increased demand of lead acid batteries.

2.4 Generation Rates of Waste Batteries

In this aspect the study concentrated on the waste batteries generation rate so as to determine the load of waste batteries generated so does the amount of hazardous/ heavy metals generated via use of batteries. *Michael, B., (2013)* in his study of '*Rechargeable and disposable batteries- The Environmental Impacts'* he narrated out that rechargeable batteries gives more sense to environment and financial perspectives, that means one piece of battery can be used for long time hence cost less and reduces hazardous waste burden to the environment.

So far so good, in Tanzania the demand of dry cell batteries per year was about 625 million by 2015, the cell phone subscribers has increased up to 39,808,419 by 2015

while the importation of Lead acid batteries is increasing due to power demand and need to run vehicle's and motor cycles. The studies shows that the electricity access rate is 36% (11% in rural) therefore the use of alternative energy is inevitable such as solar energy system, dry cell batteries and generators hence will foster the importation of batteries.

2.5 Availability of Company Dealing with Collection of Waste Batteries

Generally, the study findings indicates that in the country there is only companies dealing with collection and recycling of Lead acid waste batteries where as Dry cell and cell-phone waste batteries are not recycled hence left on environment unattended.

The study done by Agenda, (2016) titled "*Lead recycling Africa project-Used Lead acid recycling in Tanzania*" points out that used lead acid batteries are collected by scrap metal dealers in various areas in Dar es Salaam city with buying price of approximately TShs 6000/= -10,000/= It indicates that there is company known as Steelcom LTD located at Keko Mwanga area dealing with collection scrap metal and used lead acid batteries. The company collects in average of 10 ton per day and further sell them to Ok-plast LTD. The Ok-Plast Company is located at Vingunguti industrial area; it deals with recycling of used lead acid batteries with capacity to handle up to 280-300 tonne per day.

2.6 Handling & Disposal Options of Waste Batteries

Handling of waste batteries includes sorting of waste batteries from other domestic waste, storage and transportation to treatment facility or disposal points. This study

therefore aimed at finding the handling practice at point of source (household). Its common that in most cases dry cell and cell-phone waste batteries are seen disposed haphazardly within residential settlement, though it is not common to Used Lead acid batteries.

The study done by *Shepek, (1996),* shows that in most cases in developing countries waste batteries are not separated from normal solid waste. The household batteries contributes about 52% of CD and 88% of Hg found in the municipal solid waste, and they comprises less than 1% by weight of municipal solid waste.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter gives a description on the methodology adopted during this study including geographical location, study paradigm, study design, study population, sample and sampling procedures, sample size and data analysis strategy.

3.2 Study Area and Population

3.2.1 Description of the Study Area

The study area was conducted in Dar es Salaam Region at Temeke District/ Kigamboni, Kisalawe II ward, Tumaini Mtaa and Kichangani Mtaa. The site is located about 12km from Kigamboni ferry and it is accessible through Kigamboni ferry to Kongowe road at Kibada bus-stand.

SKETCH MAP SHOWING THE STUDY AREA

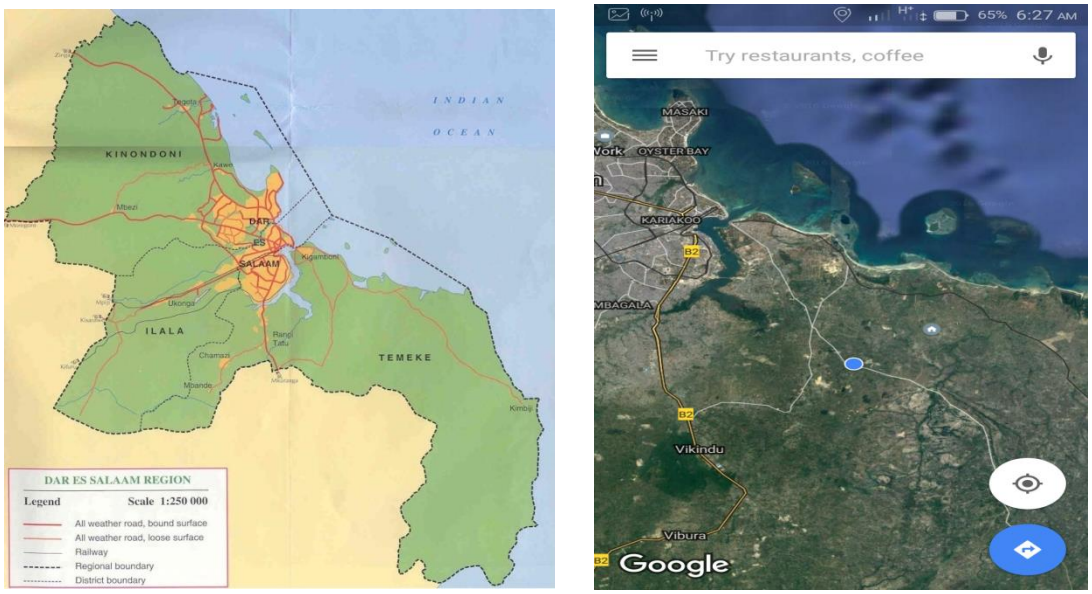

Figure 3.1: Study Area (Kisarawe II, Kigamboni District)

Kisalawe II is located on left hand side about 3km from Kibada through the Kibada-Mwasonga road. The Kisalawe II ward is bordered with Pembamnazi, Kimbiji, Somangira, Mjimwema and Kibada wards. Specifically, the study was conducted at Tumaini and Kichangani streets.

3.2.1 Demographic Characteristic

The Kisarawe II ward has a total household no of 2372 with 4721 male and 4542 female. The Kichangani has a total of 649 households with total population of 2610 among them 1348 being male and 1262 Female. The Tumaini Mtaa has a total of 301 households with total population of 1033 among them 496 being Male and 537 female. (*Data found in Kichangani Mtaa and Tumaini Mtaa Government offices respectively*).

The bases of selection of study area were due to possibility of availability of data, since the area was not connected to national grid or any other source of electricity hence increasing chances of using alternative energy source like solar power and dry cell batteries. Also the study involved the government authorities in Dar es Salaam region such as Local Government authorities dealing with waste management from Temeke Municipal and Dar es Salaam city council. The samples from regulatory agencies are selected due to their knowledge, experience and expertise on the field in question.

3.3 Sampling Procedures

The study adopted stratified random sampling (*Lot Quality Assurance Sampling-LQAS*), Valadez,J.J et al (2007). The strata for sampling were identified and there after the sample from each group were selected randomly.

The sample were grouped into three strata, two residents strata were grouped based on locality whereas one stratum involved people from government institution dealing with waste management. The strata were as follows:

(i) Kichangani street

(ii) Tumaini street

(iii) Government authority dealing with waste management and waste battery recycling industries.

The samples from residents were selected based on ownership of Solar battery, motorcycle or both. The study involved all types of battery but the solar battery and motorcycle battery were used as a base of selection of sample.

Simple survey was done to identify the household with solar energy system, Motorcycle or both. The identified households from each street (Mtaa) based on sub areas (Members of Mtaa government Authority) were listed, cumulative population were calculated and from the list a total of 19 responded from each Mtaa were selected randomly using randomly table.

Also the sample from government agencies and industries dealing with battery recycling (NEMC, Temeke Municipal & Dar es Salaam City Council Ok plast and Gaiya battery recycling industries) were selected based on officers who are direct involved in waste management or environmental Law/regulation enforcement.

Staff dealing with waste management was identified from waste battery collection and recycling industry, Municipal, City and national level (NEMC), and then a

sample of 19 officers, among them 7 from NEMC, 4 from Temeke Municipal Council, 2 from Waste battery collection agency, 2 from Battery Recycling Industry and 4 from Dar es Salaam City Council, the information were gathered through structured questionnaire.

3.4 Sample Size

During study, three strata were identified namely; Tumaini Street, Kichangani Street and Government Agencies & industries dealing with battery recycling (Gaia and Ok Plast battery recycling industries) whereas from each group 19 people were randomly selected making a total of 57 people. Randomly selection ensures representation of all groups using batteries and dealing with waste battery management in study area.

The sample of 19 provides an acceptable level of error and the sample larger than 19 has practically the same statistical precision as 19, they larger sample than 19 doesn't result in better information but do cost more, *Joseph J. Valadez et al (2007*).

From each strata the households with Solar energy and motorcycle was listed and the cumulative population were calculated so does the sampling interval. Then the randomly number were selected using a random number table. The 19 respondent were selected by beginning with random number and sampling interval to identify the responded for the 19 sets of interviewee.

3.5 Data Collection Methods

The findings of this study were based on two major kinds of data, Primary data that was collected by means of questionnaires and observation. Also secondary data that

was collected through intensive literature and reports review, thus all relevant data was collected and reviewed accordingly.

3.6 Data Analysis

Primary data was analyzed and grouped according to the levels of education, age and social economic status. The Comparison was made to correlate the data obtained with those available in literature. Moreover, frequencies, percentages and tabulation were employed to determine relationship between variables. Also intensive literature review was done to find out the work of other scholar on the topic in question. In general data have been analyzed by quantitative data analysis approach.

3.7 Data Analysis Plan

Data collected from the questionnaire survey was digitally compiled, coded and edited. Data entry was manually cross-checked to ensure accuracy. The coded items were summed up to provide frequencies and percentages were calculated using SPSS software. Data from the interviews and site observations were further processed and edited. Comments from waste batteries handler's professionals, the authors' judgments and results from interviews were used as a basis for the analysis and interpretations of the qualitative data.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

This chapter mainly involved the major findings of the study in relation to the objectives of the research study. the study aimed to speculate the types of waste batteries generated, generation rates, methods of waste batteries storage and management as well as the disposal options available at household level and municipal and city council at larger.

4.2 Social & Demographic Issues

4.2.1 Age Set of the Respondents'

The research findings indicates that, the consulted respondents range with age from 18 to 79, among them age group of 11-20 were 2.6%, 21-30 were 34.2% and age group of 31-40 were 28.9% and 41-50 were 15.8%, 51-60 were 13.2%, 61-70 were 2.6% and 71-80 were 2.6%.

The study tried to find out the relationship between age and preference of using batteries as alternative source of power. The findings doesn't show any clear relationships though the active battery user group ranges from 21-50 years of age making a total of 78.9% of batteries users among the respondents (21-30 were 34.2% and age group of 31-40 were 28.9% and 41-50 were 15.8%).

Table 4.1: Frequency Table Showing Age set of Respondents

Age of Respondents		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	21-30	13	34.2	34.2	34.2
	31-40	11	28.9	28.9	63.2
	41-50	6	15.8	15.8	78.9
	51-60	5	13.2	13.2	92.1
	61-70	1	2.6	2.6	94.7
	71-80	1	2.6	2.6	97.4
	10-20	1	2.6	2.6	100.0
	Total	**38**	**100.0**	**100.0**	

Therefore, majority of household producing waste battery are active working group ranging from 21-50 years. Only 18.5% of respondents (People producing waste battery) are among residents of above 50 years. This indicates that the prevalence of using batteries is related with economic status or ability to earn money.

4.3.2 Level of Education of the Study Population

The study findings indicates that about 73.7% of respondents have got primary education, 15.8% secondary education and only 7.9% have been to tertiary education. Also 2.6% have never been to school at all. In terms of education, general, the population of primary education level (73.7%) with few secondary education levels.

In this study, the level of education was determined so as to understand if the willingness of using alternative energy or handling of waste batteries is influenced

with levels of education. But the general results show that level of education has nothing to do with willingness of using neither batteries nor the best practice in handling waste batteries.

Table 4.2: Frequency Table Showing Level of Education of Respondents

Education level of respondents		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Primary	28	73.7	73.7	73.7
	Secondary	6	15.8	15.8	89.5
	College/university	3	7.9	7.9	97.4
	Illiterate	1	2.6	2.6	100.0
	Total	**38**	**100.0**	**100.0**	

4.4 Types of Batteries Used Among Households in the Study Area

One of the objectives of this study was to ascertain the types of batteries used in the study population. The study findings have indicated that various types of batteries are used in study area for various purposes such as running solar system, radio, torch, Cell-phone, vehicle, motorcycle etc. The batteries identified in the study area include dry cell, Lead acid and Cell phone batteries as narrated below:

4.4.1 Dry Cell Batteries

The study identified three category of dry cell battery being used in the study population. These include but not limited to Smallest dry cell battery (AAA), Medium size dry cell battery (AA) and larger size dry cell battery (A). Also the study speculated the rate at which the households are using each type of battery, the results are as follows:

Table 4.3: Showing Household using dry Battery (AAA, AA &A)

		Smallest size Dry Cell (AAA)		Medium size Dry Cell (AA)		Larger size Dry Cell (A)	
		Frequency	%	Frequency	%	Frequency	%
Valid	Yes	26	68.4	16	42.1	28	73.7
	No	12	31.6	22	57.9	10	26.3
	Total	38	100.0	38	100.0	38	100.0

The findings indicates that 68.4% of households are using smallest size dry cell batteries (AAA), 42.1% of population are using medium size dry cell batteries (AA), 73.7% of population are using larger size dry cell batteries (A). The use of some types of dry cell batteries is inevitable (Smallest size and medium size dry cell batteries) since they are required for remote control, torch etc. However lager size dry cell batteries that are often used to run radio and torch can be minimized by availability of efficiency power supply or introducing rechargeable batteries. The March 2015 report from Panasonic Energy Tanzania limited shows that the company commands for 40% of domestic market demand of dry cell battery which is about 250 million pieces of dry cell battery per year. Thus the general total demand of dry cell battery in Tanzania is equivalent to 625 million piece of dry cell per year.

GreenMax Capital Advisory in Partnership with REA (2013) reveals that the existing lighting options for off-grid households are mostly tin lamps (commonly known as “koroboi”), used by 27% of population; kerosene hurricane lamps (“chemli”), used by 37.2% of population; dry cell battery powered LED torches, used by 19.3% of population; candles, used by 17.9% of population and to a smaller extent, solar lighting, used by 4% of population. Hence the report scores that lack of effective power supply among Tanzanian accelerates the use of dry cell batteries.

4.4.2 Lead Acid Batteries

The study findings indicated that almost all of the consulted stakeholders are using lead acid batteries for various purposes. The size of lead acid batteries vary depending on use, such that the size of battery for running motor cycle are almost the same in size, while for running solar energy system do vary so does for those running vehicles.

Table 4.4: Showing Household using Lead Acid Batteries

Lead Acid battery	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	38	100.0	100.0	100.0

The study has shown that 100% of the respondents are using Lead acid batteries. This is due to the fact that Lead acid batteries are widely used to run solar energy systems in the area, in running motor cycle, vehicles, radio as well as charging of cell phones. In general, the increased consumption of solar panel is influenced by shortage of national grid connections to households where only 40% of Tanzanian has access to power from national grid thus promoting the use of solar power as alternative source.

4.4.3 Cell Phone Batteries

In general, all households within the study population are using cell phone so does the cell phone batteries. All cell phone batteries are rechargeable therefore the life span depends on brand of the cell phone and handling of it.

Table 4.5: Showing Household using Cell phone batteries

Cell phone batteries	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	38	100.0	100.0	100.0

The study shows that 100% of household are using cell phones batteries this goes hand in hand with increasing modernization communication demands. The TCRA reports show that there was 28,024,611subcribers by June 2012 and 31.86 million subscribers by April 2014 and 39,808,419 subscribers by December 2015 and the trend is skyrocketing. In this case therefore we expect the environment to continue receiving a handsome amount of Cell-phone waste batteries in future.

4.5 Uses of Batteries tn the Study Population

Batteries are devices that changes chemical energy to electrical energy, are widely used all over the world so does Tanzania. They are used for various purposes such as running of flashlights, vehicles, motorcycles, PCs, running radio, Laptops, cell phones e.t.c. The use of batteries depends on type of batteries though sometimes one type of battery can be used for different purposes. In general there is major three types of batteries commonly used in the area namely; Dry cell, Lead acid and Cell phone batteries:-

4.5.1 Dry Cell Batteries

The dry cell batteries are categorised into three groups, the Smallest size (AAA), Medium size (AA) and Larger size (A) dry cell batteries. In this

4.5.1.1 Households Using Dry Cell to Run Radio

The study findings show that about 63.2% of the households are using dry cell batteries to run radio and only 36.8% of the study population are not using dry cell batteries to run radio. Those who don’t use dry cell batteries to run are either they

don’t have radio or they use other type of power like solar power energy to run them. Thus availability of radio among household contribute to dry cell waste battery generation.

Table 4.6: Frequency Table Showing Number of Household using Dry Cell Battery to Run Radio

Availability of Radio using Dry Cell battery		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	24	63.2	63.2	63.2
	No	14	36.8	36.8	100.0
	Total	**38**	**100.0**	**100.0**	

4.5.1.2 Household Using Dry Cell to Run Torch

The study also aimed to explore the contribution of uses Torch on generation of dry cell battery, the findings indicates that only 42.1% of study respondents’ are using dry cell battery to run torch, majority doesn’t use torch or use alternative power to run their torch.

Table 4.7: Showing the no of Households using Dry Cell Battery to Run Torch

Availability of Torch Using Dry Cell		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	16	42.1	42.1	42.1
	No	22	57.9	57.9	100.0
	Total	**38**	**100.0**	**100.0**	

4.5.1.3 Household Using Dry Cell to Run Remote

Among other things the study noted the contribution of dry cell battery generation is due to use of remote, these included and not limited to remote for TV, Radio and

DVD player. The finding indicates that about 71.1% of the respondents are using dry cell to run their remote; the 28.9% are not using remotes.

Table 4.8: Frequency Table Showing no of Household using Dry Cell Battery to Run Remote

Availability of Remote using Dry Cell Battery		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	27	71.1	71.1	71.1
	No	11	28.9	28.9	100.0
	Total	**38**	**100.0**	**100.0**	

4.5.1.4 Household Using Dry Cell to Run DVD Player

The research findings reveals that majority of Kisalawe II doesn't use dry cell to run DVD players only 2.6% are using dry battery to run DVD player.

Table 4.9: Frequency table Showing no of Household using Dry Cell Battery to Run DVD Players

Availability of DVD Player using Dry Cell		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	1	2.6	2.6	2.6
	No	37	97.4	97.4	100.0
	Total	**38**	**100.0**	**100.0**	

4.5.1.5 Household Using Dry Cell to Run Lamps for Lighting

In addition the study also speculated the households in Kisalawe II using dry cell battery to run potable lamps. The findings indicated that only few individuals are using dry cell battery on Lamps (7.9%) whereas to majority is not common phenomenon.

Table 4.10: Frequency Table Showing Household using Dry Cell Battery to Run Lamps

Availability of Lamp for Lighting Using Dry Cell		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	3	7.9	7.9	7.9
	No	35	92.1	92.1	100.0
	Total	**38**	**100.0**	**100.0**	

In general, the study findings have indicated that dry cell batteries are often used for running Radio (63.2%), Torch (42.1%), Remote control (71.1%), DVD player (2.6%) and Lamps (7.9%). Furthermore, the study has stressed that larger size dry cell batteries (A) are often used for running radio, lamps and torch while the smallest size (AAA) and medium size (AA) are habitually used for remote control. Thus, the consumption rate of large size (A) dry cell batteries is expected to be higher due to the fact that they are widely used to run high power demanding devices like radio, lamps and torch but have short life span since are not rechargeable.

The report USA Environmental Protection Agency as narrated by *Erik Devaney* (www.techwalla.com//) indicates that in average every individual in USA goes through 8 batteries per year, using them for remote control, flashlight and running small devices. This means despite being connected to national grid, the used of dry cell batteries is inevitable. In addition, the '*Tanzania Market Intelligent Report'* of December 2013 Published by Green Max Capital Advisory in collaboration with Rural Energy Agency (REA) underscores out that, in Tanzania the dry cell powered LED torch is used by 19.3%, candles is used by 17.9% and solar energy by 4% as alternative sources of power in areas where there is no grid connection.

4.5.2 Lead Acid Batteries

Among of the type of batteries found to be used in study area are the Lead Acid batteries, they are commonly used for running solar energy systems(PV), motorcycle, vehicle and charging of various appliances like Cell phone, rechargeable torch. Below are various uses of lead acid batteries of the households within the study area:

4.5.2.1 Household using Lead Acid Battery for Running Solar Energy System

The findings indicate that all consulted residents are using lead acid batteries; the results are due to the fact that a lead acid user was among of the sampling factor. The findings indicate that all individuals who own lead acid batteries (100%) use them for solar energy generation compared to other uses as shown in the frequency tabular below:

Table 4. 11: Frequency Table Showing no of Household using LAB to Run Solar System

Lead Acid battery used for solar system		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	38	100.0	100.0	100.0

4.5.2.2 Household using Lead Acid Battery to Run Motorcycle

The study findings indicates that 57.9% of household are using lead acid batteries to run motorcycle this is due to increased importation and transport needs in the area.

Table 4. 12: Frequency Table Showing No of Household using LAB to Run Motorcycle

Lead acid battery used for motorcycle		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	22	57.9	57.9	57.9
	No	16	42.1	42.1	100.0
	Total	**38**	**100.0**	**100.0**	

4.5.2.3 Household using Lead Acid Battery to Run Vehicle

The study has revealed that about 18.4% of respondents are using lead acid batteries to run vehicle.

Table 4.13: Showing No of household using LAB to Run Vehicles

Lead acid used in Car		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	7	18.4	18.4	18.4
	No	31	81.6	81.6	100.0
	Total	**38**	**100.0**	**100.0**	

The findings indicates that 100% households in Kisalawe II uses Lead acid batteries for running Solar power systems, 57.9% for running motorcycle and 18.4% for running vehicles. The use of lead acid batteries is mainly due to solar energy demands which means lack of power supply system in the area contributes to these facts. The solar system in the area is used for providing light in household, running of TV, Radio and charging various appliance at household level.

It should be pinpointed that in Tanzania only 36% (11% in rural) have access to national electricity with and expectation to reach to about 75% by 2035 though, it should be noted that access is not direct connection. Also of this available access, the private sector and NGO (Independent power producers) contribute to about 40% the remaining 60% are due to government efforts.

The shortage of national electricity connections or access calls for alternative energy source like use of solar photovoltaic (PV), diesel generators, wind power e.t.c. "*The*

Renewable Energy in Africa Report (Tanzania Country profile)" of 2015 developed by African Development Bank in joint venture with World Bank (WB) reveals that solar photovoltaic system generating up to 6MW has been installed countrywide especially in schools, hospitals, police posts and household level. It further scores that more than half of solar energy system are installed at household level. The government through REA is supporting the solar energy system development since it's less expensive as compared to disease generators. The use of solar system is skyrocketing as its not only used to generate electricity but also used for water heating systems and drying of agricultural products like cereal crops and coffee.

It should be noted that the use of solar photovoltaic system goes hand in hand with use of lead acid batteries as devise for storing electric energy to be used when sun light is off, thus the increased installation of PV system in direct proportional with increased importation of lead acid batteries. Also lead acid batteries has various use as indicated in research upshot like running of motorcycle, vehicles and other uses all these contributes to lead acid batteries consumption so does waste lead acid batteries generation.

4.5.3 Cell phone Batteries

The study findings reveal that all consulted household have cell phone, meaning 100% of Kisalawe II households possess cell phone.

Table 4.14: Frequency Table Showing No HH using Cell Phone

Cell phone battery		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	38	100.0	100.0	100.0

The research outcome shows that all consulted respondent's (100%) uses cell-phone batteries, meaning that they all use cell phone. The TCRA reports show that there is a handsome increment on cell-phone users in the country. For example it was reported that there was 28,024,611subcribers by June 2012 and 31.86 million subscribers by April 2014 and 39,808,419 subscribers by December 2015 and the trend is skyrocketing.

It should be noted that almost all cell-phone batteries are rechargeable hence may long life span as compared to non-rechargeable batteries. The research finding indicates that cell-phone battery may last for at least up to two years depending on the brand of cell-phone. Despite the average that everyone owns the cell-phone but its waste generation is not as much compared to non-rechargeable batteries.

4.6 Generation Rate of Battery Waste

Waste batteries generation depends on two principles; that is batteries consumption rates and nature of batteries itself. There are two categories of batteries rechargeable and non-rechargeable batteries.

Table 4.15: Frequency Table Showing Generation Rates of Various Batteries in the Study Area

Statistics		Generation Rate of Smallest Dry Cell Battery AAA	Generation Rate of Larger size Dry Cell Battery A	Generation Rate of Medium size DryCell Battery AA	Generation Rate of Lead acid Battery	Generation Rate of Cellphone battery
N	Valid	38	38	38	38	38
	Missing	0	0	0	0	0
Mean		17.2632	379.2632	58.3421	2.2105	2.1053
Median		12.0000	432.0000	.0000	2.0000	2.0000
Std. Deviation		21.41190	303.31624	94.97547	1.29777	1.55597
Sum		656.00	14412.00	2217.00	84.00	80.00

The rechargeable batteries used in the area include Lead acid batteries and Cell-phone batteries. These have long life span compared to non-rechargeable batteries. In this study the generation rate were estimated to the period time of three years so as to accommodate the long lasting rechargeable batteries of lead acid and cell phone batteries on which the literature shows may last up to seven years.

4.6.1 Waste Dry Cell Batteries

The finding reveals that there is three categories of dry cell waste batteries namely smallest size (AAA) dry cell batteries, medium size (AA) dry cell batteries and larger size (A) dry cell batteries with generation rates of 17.3pieces, 58.3pieces and 379.3pieces respectively.

The larger size dry cell waste batteries are highly generated about 379.3pc per household in three years (about 189.7pc/hh/year) because have wide range of uses and are not rechargeable. They are used for running radio, torch and potable lamps. In general the dry cell batteries are highly generated as compared to other types of batteries because they are easily affordable, available, they are of single use (have short life span) and have a wide range of use.

The study done by *C.R Malavika*, June 2003, discovered that an average person residing in the United States owns about two button batteries, ten disposable alkaline batteries (A, AA, AAA, 9V, etc) and throws away about eight household batteries per year.

Figure 4 1: Showing DCWB found to One of the Respondent House

This might seem to be a very negligible amount of goods that is discarded, but imagine the entire population of the United States (approximately 291 million people, 2003 estimates) throwing away used batteries, or even better, the amount of batteries disposed by the world population (approximately 6 billion according to the 2003 World Population Data Sheet). This would be an insurmountable heap of solid waste with grave environmental effects.

In total 17,285 pc of dry cell waste batteries are produced in period of three years, equivalent to 5761pc in a year with average generation rate of 151.6pc per household per year. The generation rate of 151.6 pc is almost 19 times the generation rate of dry cell waste batteries of USA.

This is significant amount to cause significant pollution to receiving body when cumulative totals are calculated in the country. Also if one calculates the amount of

heavy metals in each piece and multiply with this cumulative total then everyone will realize that there is significant pollution from batteries.

4.6.2 Waste Lead Acid Batteries

The study has pinpointed that the generation rates for Lead acid batteries being 2.2 per three years per households. The amount is seems to be negligible but when cumulatively calculated it is still alarming. The small amount of waste lead acid batteries is also due to the fact that these types of batteries are rechargeable with life span up to seven years.

The Tanzania profile report on Renewable Energy in Africa *African development Bank (2015*) indicates there is speedy increase of installation solar system in institution to individual household level through individual initiatives or government support through REA. In this case therefore, the amount of lead acid waste batteries generation is increasing spontaneously.

Despite the number of waste lead acid batteries generated, they contain larger amount of hazardous element (heavy metal like Lead, mercury) as compared to dry cell batteries. Also they contain sulphuric acid which is corrosive hence may alter the pH of receiving body and affect the normal environmental setup.

4.6.3 Cell Phone Waste Batteries

The study findings indicate that the generation rates of Cell-phone batteries is 2.1 per person in the period of three years. Despite everybody owns the cell-phone but the cell-phone waste battery generation seems to be low, this is due to the fact that the

cell-phone batteries are rechargeable thus last for long period of time. In average it can take up to 2-3 years depending on brand and normal uses of the owner.

The study done by Michael Bloch, September 2013, concludes that rechargeable batteries gives more sense in environmental and financial perspectives, that one piece of batteries can be used for long time hence reduces the cost of buying new one and hazardous waste burden to receiving environment get reduced. However, the generation rate of 2.1 pc in three years it seems negligible but its not, if one think of skyrocketing number of subscribers in the country (39,808,419 subscribers by December 2015) then the cell phone batteries have high contribution to the increasing heavy metal pollution in the country.

4.7 Waste Battery Management Strategy Available

Among the principle objective of this study was to narrate the availability of waste battery management strategy, among them being sorting of waste battery from other domestic wastes, handling and disposal option available in the study population as well as in the Dar es Salaam city in general. In this aspect the study tried to speculate how waste batteries are handled form generation point (household level) to the final disposal. Also tried to obtain view from various stakeholders especially government department dealing with waste batteries management.

4.7.1 Sorting of Waste Battery

The study findings indicate that all waste dry cell batteries (100%) generated are not sorted; whereas 92.1% of waste lead acid battery and 21.1% of waste Cell phone batteries are sorted at household level. The sorting of waste is influenced by two

major things; that waste lead acid batteries are being traded to scrape metal vendors and cell phone batteries are sorted with hope that they will be used again in future. Here are some findings summarised indicating the option of waste batteries sorting for each category of waste battery.

4.7.1.1 Dry Cell Waste Batteries

Table 4.16: Frequency Table Showing Response of Respondent on Sorting of Dry Cell Waste Batteries (DCWB)

		Smallest size Dry Cell (AAA)		Medium size Dry Cell (AA)		Larger size Dry Cell (A)	
		Frequency	%	Frequency	%	Frequency	%
Valid	Not sorted	26	68.4	17	44.7	31	81.6
	Not generated	12	31.6	21	55.3	7	18.4
	Total	38	100.0	38	100.0	38	100.0

The findings shows that 100% of dry cell waste batteries are not sorted at household level they are just mixed/disposed of with other domestic waste. This means the dry cell waste batteries generators are not aware of the hazardousness of this type of waste or there is no established means of handling of such waste like availability of recycling plant or disposal point.

Also the study speculated if there is any company or organization dealing with management such as collection of dry cell waste batteries in the area. The 100% of respondents have pinpointed that there is no company or organization dealing with collection/ management of dry cell waste batteries. This implies that no private or government initiatives to manage the dry cell waste batteries in its cycle.

In USA they have developed a guideline on how to manage the Dry Cell waste batteries major principles includes Reducing the battery usage, Recharge reusable battery and recycling waste batteries. Others includes sorting of used batteries from normal solid waste and safe storage of dry cell waste batteries.

4.7.1.2 Used Lead Acid Batteries (ULAB)

Table 4.17: Showing Response of Respondents on Sorting of ULAB

Lead -Acid waste battery Being sorted		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sorted	35	92.1	92.1	92.1
	Not Sorted	2	5.3	5.3	97.4
	Not generated	1	2.6	2.6	100.0
	Total	**38**	**100.0**	**100.0**	

About 92.1% of the consulted respondents revealed that the lead acid waste batteries are sorted from other type of batteries prior disposal. Only 7.9% indicated that they didn't sort their lead acid waste batteries. They further highlighted that the reason of collecting and sorting the lead acid waste batteries is due to the fact that they are marketable; they are sold to scrap metal dealers with price ranging from Tshs. 5000/- to 10,000/-.

The Agenda (2016) report on Lead acid Africa project, Used lead acid batteries recycling in Tanzania (www.agenda-tz.org) pointed out that Used Lead acid batteries (ULAB) are collected by scrap metal vendors in various places in Dar es Salaam city,

the market price of ULAB ranges between Tsh. 6000/= to 10000/= depending on the size of battery.

The residents of Kisalawe II sort ULAB with the aim of earning money not for the purpose of safe handling the hazardous waste to safeguard the environment. However, the ULAB producers don't know the end disposal of the waste and they are not aware of any harm associated with batteries.

The study findings shows that 92.1 of waste lead acid batteries are being sorted from other kind of waste generated in the household levels only 5.3% are not sorted hence dumped anywhere mixed with other types of waste.

4.7.1.3 Waste Cell Phone Batteries

Table 4.18: Showing Response of Respondent on Sorting of Cell Phone Waste Batteries (CPWB)

Waste Cell phone Battery Being Sorted		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Sorted	8	21.1	21.1	21.1
	Not sorted	24	63.2	63.2	84.2
	Not Generated	6	15.8	15.8	100.0
	Total	**38**	**100.0**	**100.0**	

The study findings indicates that only 21.1% of the respondents have shown that Cell-phone waste batteries are sorted from other type of waste, meaning 63.2% of the

household doesn't sort Cell-phone batteries and 15.8% have not yet generated the Cell phone waste batteries.

4.7.2 Company /Group Collecting Waste Battery

The study have revealed that there is no company or group of people dealing with collection of dry cell waste batteries while 76.3% of respondents have revealed waste lead acid battery and 7.9 of respondents have shown that cell phone waste batteries are collected. The frequency tables below shows responses of study population on the availability of company or groups dealing with waste battery collection in the study area:

4.7.2.1 Waste Dry Cell Batteries

In general there is no company or group of people who usually collects or deals with collection of waste dry cell batteries as indicated in results below:

Table 4.19: Showing Response on Availability Company Dealing with Dry Cell Waste Batteries (DCWB) Collection

		Smallest size Dry Cell (AAA)		Medium size Dry Cell (AA)		Larger size Dry Cell (A)	
		Frequency	%	Frequency	%	Frequency	%
Valid	Not available	26	68.4	16	42.1	28	73.7
	Not generated	12	31.6	22	57.9	10	26.3
	Total	**38**	**100.0**	**38**	**100.0**	**38**	**100.0**

The dry cell waste batteries are not collected and there is no company dealing with collection of dry cell waste batteries. Therefore they are mixed up with domestic waste batteries and just dumped within the residential premises.

The studies have revealed that, solid waste are not sorted at source and only 39% of solid waste is collected and disposed off, hence about 61% of solid waste generated are left unattended (***Makoba, 2008***). This point out that since the dry cell waste batteries are not sorted and collected they are among those waste left unattended hence polluting the environment.

4.7.2.2 Company Dealing with Collection of Cell Phone Battery

The study findings indicates that only 7.9% of respondents are aware of the company/group of people dealing with collection/management of cell phone battery and 73.7% of them are not aware of any company or group and 18.4% have not yet generated the Cell phone waste batteries.

Table 4.20:Showing the Response on Availability of Company Dealing with Collection CPWB

Company/Group Collecting Cell phone Battery		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Available	3	7.9	7.9	7.9
	Not Available	28	73.7	73.7	81.6
	No generation of particular type of battery	7	18.4	18.4	100.0
	Total	**38**	**100.0**	**100.0**	

In general this means there is no company dealing with Cell phone waste batteries collection hence cell phone waste batteries are mixed up with other normal domestic wastes.

4.7.2.3 Company Dealing with Collection of Lead Acid Waste Battery

The study has revealed that 76.3% of the respondent agreed that there is company/group of people (scrap metal vendors) who also deals with collection of used lead acid batteries in the study area, although they don't know the final disposal or treatment option of the waste lead acid battery.

Table 4.21: Frequency Table Showing the Responses on Availability of Company or Group of People Dealing with Collection of Used Lead Acid Batteries (ULAB)

Company/Group collecting Lead-Acid waste battery		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Available	29	76.3	76.3	76.3
	Not Available	8	21.1	21.1	97.4
	No generation of particular type of battery	1	2.6	2.6	100.0
	Total	**38**	**100.0**	**100.0**	

The collection and storage of used lead acid batteries is influence by market demand and not the knowledge on the impacts of the batteries wastes among the residents. About 76.3 respondents revealed that there is companies/group of people (Scrap metal vendors) who buy the used lead acid batteries though they are not aware of the final destination or disposal point.

The Agenda 2016 underscores that, the used lead acid batteries are collected by scrap metal dealers in various areas in Dar es Salaam city with buying price of approximately TShs 6000/= -10,000/= It indicates that there is company known as

Steelcom LTD located at Keko Mwanga area dealing with collection scrap metal and used lead acid batteries. The company collects in average of 10 ton per day and further sell them to Ok-plast LTD. The Ok-Plast company is located at Vingunguti industrial area, it deals with recycling of used lead acid batteries with capacity to handle up to 280-300 tonne per day.

4.7.3. General Overview from Government Departments Dealing with Waste Management

In this study, various government officials from Temeke Municipality, Dar es Salaam city councils and National Environment Management Council (NEMC) were involved through focus discussion methodology especially those departments direct dealing with waste management. The followings were the comments raised by these government officials especially on package of waste batteries management:

4.5.3.1 Views from Temeke Municipal Council Office

Waste Management Officials from Temeke Municipal, revealed that dry cell and cell phone waste batteries are not sorted at source, they found mixed up within other type of domestic wastes. They said it's very rare case to find used lead acid batteries mixed with domestic solid waste and once found they are recollected back vended to scrap metal dealers by scavenger at dumpsite.

4.5.3.2 Views from Dar es Salaam City Council Office

The Pugu Kinyamwezi dump site Manager (Mr. Kishere, Richard) nailed out that even scavenger are not concerned in recollecting the dry cell and cell phone waste batteries since are not marketable. He further explained that it is not possible to find

the used lead acid batteries in waste stream, even if they are found the scavenger recollect them to lead acid waste batteries vendors or direct to recycling plant Ok Plast LTD industry located along Vingunguti Industrial area.

4.5.3.3 Views from National Environment Management Council Office

The comments from National Environment Management Council (NEMC) officials, pointed out that the Council is not dealing direct with daily operation of domestic waste management since powers of solid & liquid waste management are invested to local government authorities by law, Environmental Management act cap 191 of 2004. They are duty bound to provide technical assistance and provisions of permits/ certificates and or approving sites for disposal or means of disposal through various rooms such that Environmental Impact assessment (EIA) and Environmental Audit studies (EA).

They further pointed out in this particular case of waste batteries management, the Environmental Management Act of 2004 and its regulations like Hazards Waste Management regulation of 2010 and Fees and Charges regulation of 2016 in particular gives them mandate to be involved in waste battery Management. In this particular case they pointed out that NEMC are involved in issuing waste battery Collection Permits, EIA and EA studies and monitoring for waste battery dealers since waste battery are categorised under hazardous waste by EMA 2004.

The experience shows that most of waste battery dealers seek for permit to collect used lead acid batteries merely and not the other type of batteries and there is only

two industries country wide (Ok Plast LTD and Gaiya Eco Solution(T) LTD) that deals with recycling of used lead acid batteries only.

4.8 Disposal Options for Waste Batteries at Household Level

One of the objectives of this study was ascertain the disposal option of waste battery available at household level/waste battery generator. The study have concluded that Dry cell and Cell phone waste batteries are disposed haphazardly to environment untreated, only lead acid waste batteries are collected to waste battery recyclers.

4.8.1 Disposal Option for Dry Cell Batteries

The study have revealed that 57.9% of waste dry cell batteries are dumped haphazardly, 21.1% are dumped to solid waste pits at household area mixed with various types of domestic waste, 2.6% are dumped to Pit latrine. The table below shows the disposal option of dry cell battery available in the study area.

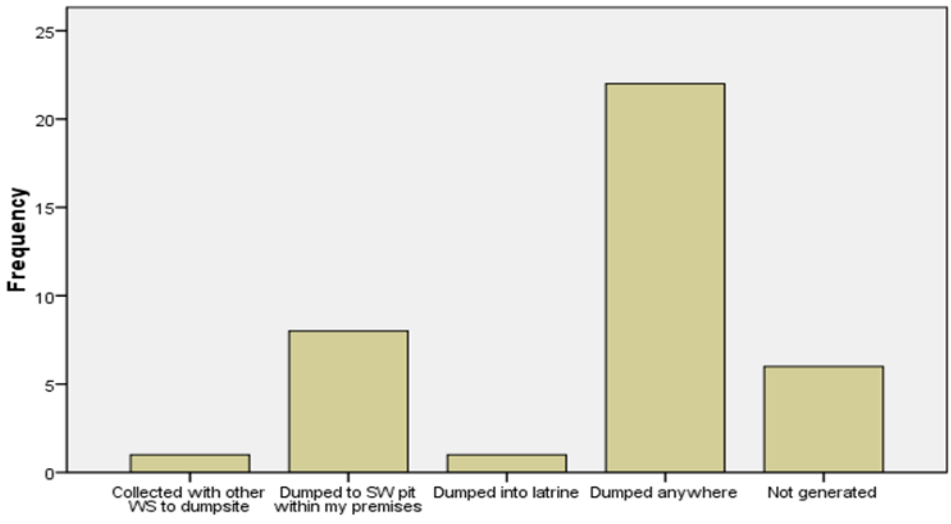

Figure 4.2: Disposal Options for Dry Cell Waste Batteries

Therefore almost all the generated Dry cell waste batteries are not recycled they are dumped into the environment untreated. In total 17284 pieces of dry cell waste batteries are generated in three years (5761 per year) within 38 household. Various reports, Panasonic Energy Tanzania LTD, 2015 in particular pointed out that the total demand country wide is 625million pieces of dry batteries per year, which usually turn into waste and direct, disposed to environment. From that fact one can calculate the amount of lead, mercury, cadmium or arsenic being dumped to the environment annually.

Figure 4.3: DCWB being Mixed and Burned with other Domestic Waste

Report stresses out that some brands of batteries imported in Tanzania have more heavy metals compared to allowable standards (*ISO 14001 Environmental Management standards and European Directive on Batteries and Accumulators*). Example Eveready and tiger heads were found to have 0.0037% Hg, 0.0048% Cd,

0.08% Pb, and 0.0038% Hg, 0.0078% Cd, 0.14% Pb respectively (Panasonic *Energy-Tanzania, 2010*).

4.8.2 Disposal Options for Cell Phone Batteries

The study findings shows that 52.6% of generated waste cell phone batteries are just dumped anywhere, 18.4% are just stored in houses not yet disposed, 2.6% are dumped to pit latrine and 13.2% are dumped within the solid waste pit within their household grounds. This indicates that cell phone batteries are not attended hence may lead to environmental pollution.

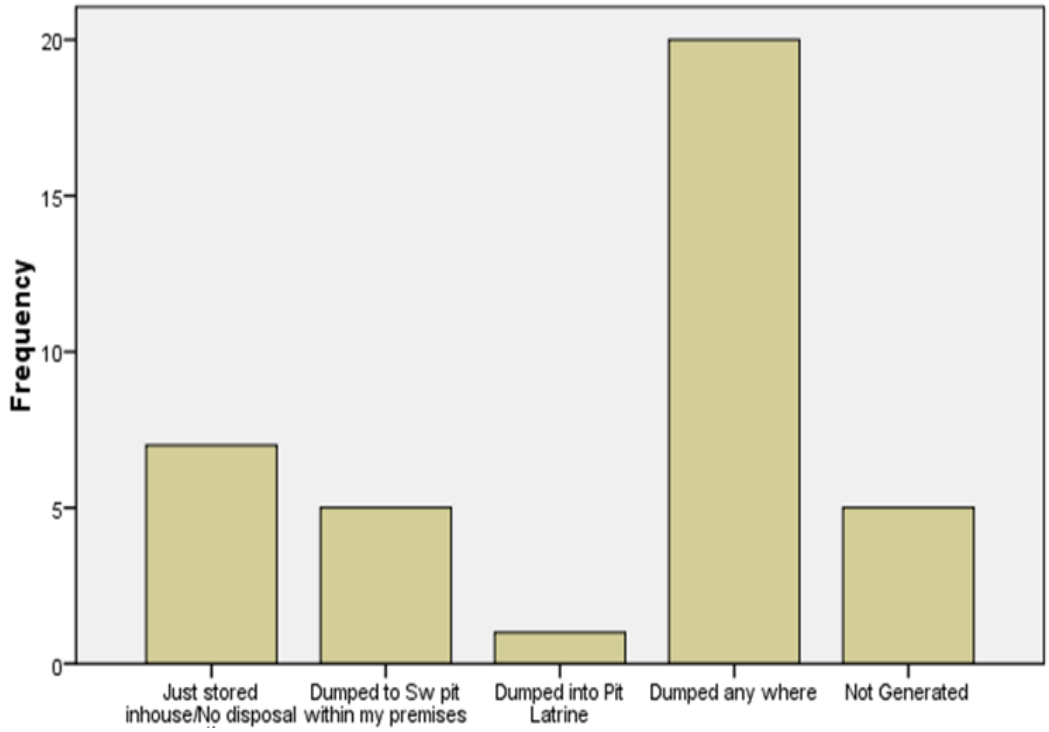

Figure 4.4: Disposal Options for Cell Phone Waste Batteries (CPWB)

In this aspect, again there is no option of treating waste batteries before being disposed of to environment. All cell phone waste batteries are disposed of untreated hence contributing to heavy metal pollution to environment. The TCRA 2015 shows

an exponential increase of subscribers in the country and they reached to 39,808,419 subscribers by December 2015.

Figure 4.5: Cell Phone Waste Batteries Stored at Household Level

Storing of CPWB is due to lack of disposal options among the waste batteries generators, however storing isn't commanded by awareness of threat polluting the environment, it is just driven by personal will and judgement.

4.8.3 Disposal Option for Waste Lead Acid Batteries

The research have revealed that 63.2% are collected to recycling plants through selling them to scrap mental vendors, 21.1% of batteries are just stored in house waiting for disposal options and 10.5% are just dumped haphazardly.

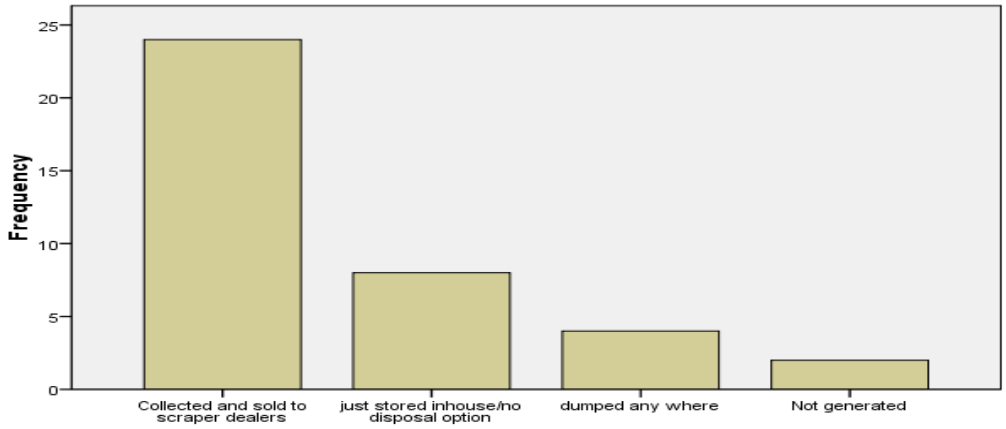

Figure 4.6: Disposal Optional for Used Lead Acid Batteries (ULAB)

The findings from government officials have pointed that ULAB are collected and vended to Lead acid battery recycler, even these waste are mixed up with domestic waste, scavengers at dump site at Pugu Kinyamwezi recollect them and sell to scrap metals traders. The comments captured from NEMC reveals that there are companies and individuals seeks for permit of collecting Lead acid waste batteries only not other type of batteries.

Also there are only two waste battery recycling industries country wide and both deals with recycling on lead acid waste batteries. This indicates that at least there is option for handling ULAB in the country

Figure 4.7: Some ULAB Stored at Household Level

Apart of having the option for recycling batteries some Users of LAB still keep the ULAB at household level, this is due to lack of awareness on the option of treatment of the used batteries.

CHAPTER FIVE

SUMMARY CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter presents a summary of findings, conclusion and recommendations of the study, as per research questions: What types of waste batteries generated in the study area?, The waste batteries generation rate is assumed to be insignificant so does its effects to environment and life forms? There is no waste batteries handling/management strategy in the area prior final disposal? And the community members are not aware of the best option/practices to manage waste batteries?

5.2 Summary

5.2.1 Study Population, Research objectives & Methodology

The overall objective of the study was assessment of Waste Battery Management in Peri-Urban Settlement, Case study of Kigamboni Temeke district. In carrying out this research study, the research process was guided by research objectives which were accompanied with questions; and the study was mainly quantitative with some elements of qualitative for description purposes.

The sample comprised fifty seven, among them 38 being households from Kigamboni District previously Temeke District specifically at Kichangani and Tumaini Mtaa Jurisdiction areas. In addition 19 respondents were from government Authorities namely, Temeke Municipal, Dar es Salaam city council and National Environment Management Council (NEMC).

Data were collected through questionnaires, focus group discussion and field observation to obtain important information about solid waste management in the study area. Each item in the questionnaire was developed to capture important data with respect to study objectives. Open/structured or closed ended questionnaires were formulated for the purpose of this study whereas Waste Battery management was the major area of deliberation.

Also, secondary data were collected through documentary information collected and compiled by various researchers and national and international organisations as well as legal provisions and guidelines. Among others included, African development bank group (2015).

The renewable Energy in Africa Tanzania profile report, Agenda (2016) Lead recycling Africa project-Used lead acid batteries recycling in Tanzania, URT (2015) TCRA quarterly report, URT (2004) Environmental Management Act 2004, Cap 191 etc. Both descriptive and inferential statistics were used for data analysis and SPSS, Chi-square was applied were deemed necessary.

5.2.2 Waste Batteries Generated in the Study Area

The findings revealed that there are major three types of waste batteries produced in the study area, which are Dry cell, Cell phone and Lead acid batteries. Among them dry cell batteries are non-rechargeable are of single use batteries while the Lead acid and cell phone batteries are rechargeable batteries. Hence the generation rate of Dry cell batteries is high as compared to Lead acid and cell phone batteries.

5.2.3 Waste Battery Generation Rates

The study has revealed that there is a high quantity of dry cell waste batteries produced 17,285 pc in three years followed by Lead acid batteries where 84 pc were generated and 80 pc Cell phone batteries were generated in three years' time frame. The above generation rates calls for attention for high accumulation of heavy metal in the receiving body like soil and water as well as impacts to living organism and natural set up of natural environment in general.

5.2.4 Handling of Waste Batteries at Household Level

The waste batteries are not sorted from other domestic waste except for Lead acid batteries which are sold to scrap metal vendors. The waste batteries (Dry cell and

Cell phone) generated are just dumped anywhere, very few are dumped into waste pit dug within the household premises. This indicates that the handling of waste batteries has not given high priority by the government. The residents are not aware of the threat (heavy metal) composed within the batteries like Mercury, Lead, cadmium, Arsenic, Manganese etc.

5.2.5 Disposal Option of Waste Batteries

It was revealed from the findings that there two a company/ industry dealing with recycling of used lead acid batteries (ULAB) namely Ok Plast and Gaiya solution recycling industry country wise. Henceforth there is option for recycling ULAB only while the DCWB and CPWB are left on environment unattended. The ULAB are collected through scrap metal vendors from the household level to recycling industry, however the ULAB producers sell the used batteries for intention of gaining income and not for safeguarding the environment.

5.3 Conclusion

Based on the above study findings the generation rates for waste batteries is alarming such that a total of 17,285 of used dry cell batteries, 84 of used lead acid batteries and 80 of used cell-phone batteries are produced within three years for only 38 households.

There is a direct link between availability of power (grid or off grid power supply) and increased use of batteries as alternative sources of energy. It should be noted that use of batteries is inevitable but availability of power can decrease the rate of using batteries substantially.

Also the country has not invested much on handling waste batteries except only two used lead acid batteries (ULAB) recycling industry are available country wide. The used dry cell and cell phone batteries are left unattended; hence all are poorly dumped on the environment.

The composition of batteries includes heavy metal (Mercury, Lead, Cadmium and Arsenic) which are lethal to most of life forms and environment in general hence are categorised as hazardous waste.

The major challenges are most of waste batteries producers are not aware on the composition and nature of elements within waste batteries henceforth are just treated as other normal domestic wastes (just dumped anywhere) and became easily accessible to vulnerable groups like children. The second challenge there is no or very low effort to government towards management of waste batteries country wide, no awareness campaign, no investment on handling waste batteries as hazardous waste in particular.

Generally, despite the presence of policy, legal package and establishment of government department dealing with environmental management and public health, the management of waste batteries at household level has given less attention.

5.4 Recommendations

From the above study findings and conclusions the following are recommended as a way to address the major challenges towards effective and efficiency system of handling waste batteries in the country:

(i) The preliminary study should be done country wide to determine the general trend on waste generation rates and management to places with different social/economic setups hence generate a baseline data on waste batteries management profile,

(ii) Awareness campaign should be done in the country so as to raise awareness with focus to waste batteries generators on hazardous nature of waste batteries and means of handling at household level,

(iii) The government should invest/ or encourage private investors to participate on recycling of waste batteries,

(iv) The government through its agency (NEMC and LGA) should create effective system of handling waste batteries from waste batteries generators to disposal/recycling point,

(v) The government through its agency (NEMC) should ensure effective monitoring of systems created as well as to the existing waste batteries recycling plants,

(vi) The government through its agencies should develop strategy to reduce waste batteries generation through various efforts like distribution of power from national grid and encouraging use of rechargeable batteries.

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APPENDICES

Appendix 1: Questionnaire for Research Topic of Waste Batteries Management in Peri-Urban Settlement, Case Study at Kigamboni/Temeke District

PART A: PERSONAL PARTICULARS

1. House holds No……

2. Age: ……

3. Sex: Male ☐ Female ☐

4. Level of education: (a) Primary education (b) Secondary education (c) tertiary education

5. Do you own solar energy system? Yes ☐ No ☐

6. Do you own motorcycle? Yes ☐ No ☐

7. If yes how many? …….

PART B: DRY CELL BATTERIES

1. Do you have any appliances that use dry cell batteries like radio, touch, remote controller, DVD player? Yes ☐ ☐

2. If yes what type of appliance do you own?
   a. Radio …….
   b. Touch …….
   c. DVD player……'……
   d. Mobile phone……
   e. Remote controller…….
   f. Others……

3. What kind of battery you usually use? (Show samples)
   a. Smaller one AAA:- Yes ☐ No ☐
   b. Medium size AA:- Yes ☐ No ☐
   c. Larger size:- Yes ☐ No ☐
   d. Others:- Yes ☐ No ☐

4. In the period of six months how many batteries have you used?
   a. Smaller one AAA…….
   b. Medium size AA……
   c. Larger size…….
   d. Others……

5. Do you separate them from other type of waste? Yes ☐ No ☐

6. Is there any organization or company that deals with collection dry cell batteries in your area? Yes ☐ No ☐

7. If yes, mention it …….

8. If No, where do you usually dispose them?

   a. Collecting with other waste to land fill

   b. Dumping within my solid waste pits

   c. Dumping in pit latrine

   d. No common disposal point for dry cell batteries

   e. Others mention……

9. Do you know any facility dealing with treatment of dry cell waste batteries? Yes ☐ No ☐

10. If yes, what operation does the facility do?

    a. Recycling of dry cell waste batteries

    b. Collection and exporting dry cell waste batteries abroad

    c. Treatment and disposal of dry cell waste batteries

    d. Other activity mention……

PART C: CELLPHONE BATTERIES

1. Do you have a cell phone? Yes ☐ No ☐

2. If yes, have you ever disposed your cell phone batteries for any reason?

   a. Yes ☐ No ☐

3. If yes, how many cellphone batteries have you disposed off in past one year?

   …….....……

4. Are you aware of anyorganization dealing with collection and disposal of cellphone battery in your area? Yes ☐ No ☐

5. If yes, mention it ……..

6. If no, where do you dispose the waste cellphone batteries?

   a. Collecting with other waste to land fill

   b. Dumping within my solid waste pits

   c. Dumping in pit latrine

   d. No common disposal point for dry cell batteries

   e. Others mention……

PART D: LEAD ACID BATTERIES

1. When did you start using lead acid batteries? ……

2. The lead acid battery you have is for what purpose?
    a. Solar energy system
    b. Motor cycle
    c. Vehicle
    d. Others uses (mention)……

3. How many lead acid batteries have you used in the past three years? …..

4. What is the life span of the battery? …….

5. Have you ever disposed of the lead acid battery? Yes ☐ No ☐

6. If Yes, Where did you dispose it?
    a. Collected with other solid waste to dumpsite
    b. Collected and sold to recycling company as scrapes
    c. Just stored at household/no disposal option
    d. Dumped within my yard as other waste
    e. Others (mention)……

7. Is there any company /organization that collect lead acid batteries in your area?

   Yes ☐ No ☐

8. If yes mention it ……

9. Do you know any industry dealing with waste lead acid battery treatment? Yes

   No ☐ ☐

10. If yes, what Operation does the industry do?

    a. Collection & Recycling of Lead acid waste batteries

    b. Collection and exporting Lead acid waste batteries abroad

    c. Treatment and disposal of Lead acid waste batteries

    d. Other activity mention……

Supplement Questionnaire to Government Authorities & Waste Battery Management Companies Workers for Research Topic of Waste Batteries Management in Peri-Urban Settlement, Case Study at Kigamboni/Temeke District

PART A: PERSONAL PARTICULARS:

1. Title/position

   ……

2. Experience in years in the position……

3. Age: …….

4. Gender: Male ☐ Female ☐

5. Level of education: ……

PART B: WASTE BATTERY MANAGEMENT

Is waste battery being sorted and collected separately with other solid waste?

Yes ☐ No ☐

1. If no, what are common types of battery found mixed up with normal solid waste?

   a. Dry cell waste battery

   b. Cellphones waste battery

   c. Lead acid waste battery

d. Other brands (mention) ……

e. I don't know

2. If yes, what type of battery is commonly sorted out from normal solid waste?

a. Dry cell waste battery

b. Cellphones waste battery

c. Lead acid waste battery

d. Other brands (mention)……

e. I don't know

3. What is the usually final disposal of dry cell waste batteries?

a. Disposed with other normal solid waste at dumpsite

b. Treated as hazardous waste and disposed under special procedures

c. Recycled in recycling facilities'

d. Collected and exported abroad for safe disposal

e. Others methods of disposal (mention)…….

4. Is there any facilities/organization dealing with waste battery collection?

Yes ☐ No ☐

5. Name the Facilities/organization dealing with waste battery collection in your area if any;

a) ……

b) …….

c) ……

d) …….

e) …….

6. If yes; what type of battery are usually collected by the organization or industries above?

   a) Lead acid batteries

   b) Dry cell batteries

   c) Cellphone batteries

   d) Others (mention)……

7. Do you issue any permit to those who deal with waste battery collection/management? Yes ☐ No ☐

8. How does your office contribute towards management of the waste batteries in your area of jurisdiction?

   a) Provide education to stakeholders

   b) Compliance and enforcement role

   c) Provision of permit

   d) Monitoring and evaluation

   e) Involved on day to day waste battery management activities

   f) Others (mention)…….

Appendix 2: Dodoso kwa Ajili ya Utafiti wa Udhibiti wa Betri Chakavu Mijini Katika Wilaya ya Temeke/Kigamboni, Kisalawe II

SEHEMU YA KWANZA: TAARIFA BINAFSI

1. Namba ya kaya……..
2. Umri …….
3. Jinsia: Me ☐ Ke ☐
4. Kiwango cha Elimu:-
   a. Elimu ya msingi ☐
   b. Elimu ya sekondari ☐
   c. Elimu ya juu/chuo ☐
5. Je unatumia umeme wa jua?
   a. Ndio ☐
   b. Hapana ☐
   6. Je unamiliki Pikipiki?
   a. Ndio ☐
   b. Hapana ☐

SEHEMU YA PILI: BETRI KAVU

1. Je unakifaa chochote kitumiacho betri kavu mfano redio, tochi, remote, n.k?
   a. Ndio ☐
   b. Hapana ☐
2. Kama jibu ni ndio, je ni vifaa/kifaa kipi kinachotumia betri kavu ulichonacho?
   a. Radio ☐

b. Tochi ☐

c. Rimoti ☐

d. DVD Player ☐

3. Je ni aina gani ya betri ambazo unatumia? (Onyesha sampuli)

a. Ndogo (AAA) ☐

b. Ukubwa wa kati(AA) ☐

c. Kubwa ☐

d. Aina nyingine-(taja) ……..

4. Katika kipindi cha miezi sita iliyopita ni betri ngapi umeshazitumia.

a. Ndogo(AAA) ☐

b. Kubwaza kati (AA) ☐

c. Kubwa ☐

d. Nyinginezo

5. Je betri zikiisha, je huwa unazitenga na aina nyingine ya taka?

a. Ndio ☐

b. Hapana ☐

6. Je kuna kampuni au shirika linalokusanya betri zilizoisha katika eneo lenu

a. Ndio ☐

b. Hapana ☐

7. Kama ndio, taja jina la kampuni au shirika……

8. Kama jibu ni hapana, Je betri zilizoisha huwa mnazitupa wapi?

a. Tunakusanya na taka zingine kwenda dampo ☐

b. Tunatupa na taka zingine kwenye mashimo ya taka. ☐

c. Tunatupa kwenye vyoo vya shimo ☐

d. Hakuna sehemu maalumu ya kutupa/tunatupa sehemu yoyote ☐

e. Njia nyingine (taja)…….

9. Je unafahamu kiwanda/taasisi/shirika linalochakata betri kavu

a. Ndio ☐

b. Hapana ☐

10. Kama ndio, Je kiwanda, taasisi au shirika hilo linajishughulisha na nini?

a. Kukusanya betri na kusafirisha nje ya nchi ☐

b. Kuchakata betri chakavu ☐

c. Kukusanya betri na kutupa salama katika eneo maalumu ☐

d. Kazi zingine (taja)…….

SEHEMU 3: BETRI ZA SIMU ZA MIKONONI

1. Je unamiliki simu ya mikononi?

a. Ndio ☐

b. Hapana ☐

2. Kama ndio, Je umewahi itupa simu au betri ya simu kwa sababu yotote?

a. Ndio ☐

b. Hapana ☐

3. Kama ndio, je ni simu au betri za simu ngapi ushawahi zitupa ndani ya mwaka mmoja uliopita? ……..

4. Je, unalifahamu shirika lolote linalohusika na ukusanyaji/ utupaji wa betri za simu za mkononi?

a. Ndio ☐

b. Hapana ☐

5. Kama ndiyo taja? ……..

6. Kama sio, unatupaje betri chakavu?

a. Tunakusanya na taka zingine kwenda dampo ☐

b. Tunatupa na taka zingine kwenye mashimo ya taka ☐

c. Tunatupa kwenye vyoo vya shimo ☐

d. Hakuna sehemu maalumu ya kutupa/tunatupa sehemu yoyote ☐

e. Njia nyingine (taja)…….

SEHEMU YA NNE: BETRI ZA MAJI /LEAD ACID BETRY

11. Je, umeanza lini kutumia betri la maji? ……

12. Je, betri uliyonayo ni kwa matumizi yapi?

a. Kwa ajili ya mfumo wa Umeme wa jua ☐

b. Kwa ajili ya pikipiki ☐

c. Kwa ajili ya gari ☐

d. Kuendeshea redio, taa, kucharge simu nk ☐

e. Matumizi mengine (taja) ……..

13. Je, ni betri ngapi za maji umesha zitumia ndani ya miaka mitatu? ……..

14. Je, betri zako kwa uzoefu hudumu kwa muda gani? …….

15. Je umewahi tupa betri chakavu?

a. Ndio ☐

b. Hapana ☐

16. Je huwa mnatupaje betri za maji zikiisha matumizi yake?

a. Tunakusanya na taka zingine kwenda dampo ☐

b. Tunatupa na taka zingine kwenye mashimo ya taka ☐

c. Tunatupa kwenye vyoo vya shimo ☐

d. Hakuna sehemu maalumu ya kutupa/tunatupa sehemu yoyote ☐

e. Njia nyingine (taja)…….

17. Je, unafahamu kiwanda chochote kinachochakata betri za maji?

a. Ndio ☐

b. Hapana ☐

18. Kama ndio, Kiwanda hicho kinafanya nini?

a. Kukusanya betri na kusafirisha nje ya nchi ☐

b. Kuchakata betri chakavu ☐

c. Kukusanya betri na kutupa salama katika eneo maalumu ☐

d. Kazi zingine (taja)…….

DODOSO LA ZIADA KWA MAMLAKA ZA SERIKALI NA MASHIRIKA/ KAMPUNI ZINAZOJIHUSISHA NA UDHIBITI WA BETRI CHAKAVU

SEHEMU A: TAARIFA BINAFSI

1. Cheo……..
2. Uzoefu (miaka) katika cheo hiko…….
3. Umri…….
4. Jinsia Me ☐ Ke ☐

   Kiwango cha elimu……

SEHEMU B: UDHIBITI WA BETRI CHAKAVU

1. Je, betri chakavu hutenganishwa na taka zingine wakati wa ukusanywaji?

   a)Ndiyo ☐

   b)Hapana ☐

2. Kama jibu ni hapana je, ni aina gani za betri zinazokutwa zimechanganyika na taka za kawaida?

   a) Betri kavu ☐
   b) Betri za simu ☐
   c) Betri za maji ☐
   d) Aina nyingine (taja)

   ……

   ……

   Sijui ☐

3. Kama jibu ni ndiyo, aina gani za betri huchambuliwa kutoka katika aina nyingine za taka

   a) Betri kavu ☐
   b) Betri za simu ☐
   c) Betri za maji ☐
   d) Aina nyingine (taja)

      ……

      ……

      …….

   e) Sijui ☐

4. Je, betri kavu hutupwaje?

   a. Zinatupwa na aina nyingine ya taka za kawaida ☐
   b. Zinachukuliwa kama taka hatarishi, hivyo hutupwa chininya usimamizi ☐
   c. Zinachakatwa kwenye viwanda vya uchakataji wa betri ☐
   d. Zinakusanywa na kusafirishwa nje ya nchi kwa ajili ya utupaji salama ☐
   e. Njia nyingine (taja)

      ……

      ……

5. Je, kunashirika au kampuni inayojishughulisha na ukusanyaji wa betri chakavu?

   a)Ndiyo ☐

   b) hapana ☐

6. Kama ndiyo, taja kampuni / kiwanda au shirika linalojihusisha na ukusanyaji wa betri chakavu

   a) ……..

   b) ……

   c) ……

   d) …….

   e) ……..

7. Kama ndiyo, je, ni aina gani ya betri ambazo hukusanywa na makampuni/ mashirika au taasisi tajwa hapo juu?

   a) Betri za maji ☐

   b) Betri kavu ☐

   c) Betri za simu ☐

   d) Aina nyingine (taja)

   ……

   ……

8. Je, mnatoa vibali kwa kampuni / mashirika au taasisi zinajihusisha na ukusanyaji na udhibiti wa betri chakavu?

   a) Ndiyo ☐

   b) Hapana ☐

9. Je, ofisi yako inachangia vipi juu ya udhibitiwa betri chakavu katika eneo lako la utendaji?

9. Kutoa elimu kwa wadau ☐

10. Kusimamia utekelezaji na uzingatiaji wa sheria zinazohusu usimamizi wa betri chakavu ☐

11. Kutoa vibali ☐

12. Upelembaji wa zoezi zima la udhibiti wa betri chakavu ☐

13. Inajishughulisha moja kwa moja na kazi za kila siku za udhibiti wa betri chakavu ☐

14. Nyingine (taja)

……

……