# ASSESSING THE EFFECTIVENESS OF MUNICIPAL SOLID WASTE MANAGEMENT SYSTEM, CONSTRAINTS AND OPPORTUNITIES IN LIRA MUNICIPALITY, NORTHERN UGANDA

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# A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF ARTS IN GEOGRAPHY OF KYAMBOGO UNIVERSITY

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### DISCLAIMER

The findings in this dissertation do not carry any opinion what so-ever on the part of Lira Municipal Council and Divisions' administration. The analysis, conclusions and recommendations as well do not reflect the views and policy of Lira Municipality and her Divisions' administration but the Field finding of the researcher who is the author of this document based on his field findings.

### DECLARATION

I, ONGIA JOEL – OWINY (17/U/14407/GMAG/PE) hereby declare that this work is my original production and has not been submitted to any university or institution of higher learning for any academic award.

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ONGIA JOEL-OWINY

# APPROVAL

I confirm that this Dissertation was written by the candidate under my supervision.

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# **DEDICATION**

This work is dedicated to my spouse, Mrs. Jennifer Ongia, who encouraged me all through the period of study. Through her prayers and sacrifice to care for the family, I was able to complete this course successfully.

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### LIST OF ACRONYMS

- APHA: American Public Health Association
- ASEAN: Association of South East Asian Nations
- CBOs: Community Based Organisations.
- DRT: Development Research Training
- ESCAP: Economic and Social Commission for Asian and the Pacific
- IJERPH: International Journal of Education, Research and Public Health.
- IRRC: Integrated Resource Recovery Centre
- ISWA: International Solid Waste Association
- JICA: Japan International Cooperation Agency
- KCCA: Kampala City Council Authority
- LMC: Lira Municipal Council
- MSWM: Municipal Solid Waste Management
- NEMA: National Environment Management Authority.
- NGOs: Non-Governmental Organisations.
- NSUSAP: National slums upgrading strategy action plan
- UBOS: Uganda Bureau of statistics
- UNEP: United Nations Environmental Programme
- UNFCCC: United Nations Frame Work Conference on Climate Change
- UNICEF: United Nation's International Children Emergency Fund.
- WMW: Waste Management World

#### ABSTRACT

Little is known about solid waste characteristics, performance, and determinants for adoption in the management in Lira Municipality. This study was carried out to assess the effectiveness of municipal solid waste management system, constraints and opportunities in Lira Municipality. The objectives of the study were: To characterize the types of solid wastes, collection and disposal system in Lira Municipality. To evaluate the people's perception on efficiency and reliability of solid waste management system. To examine the constraints and opportunities of solid waste management. To determine the factors that influence solid waste collection and disposal in Lira Municipality. Across-sectional research design was used in the study. 200 Households were randomly sampled and interviewed. The data was analysed qualitatively and quantitatively. Information on categories, collection and dumping from interview guides and questionnaires was analysed using SPSS statistical tool package and the data grouped in to descriptive percentages, mean, bar graphs, frequency tables to explain. The study also employed a statistical model (Binary Logistic Regression) to determine the factors influencing collection and dumping of solid waste in Lira municipality. Results of study indicated that Biodegradable/ organic wastes comprise a major fraction of solid waste produced (63.2%). Open dumping is the commonest method of solid waste dumping (37.5%) in Lira municipality. The major constraints in waste management were inadequate transport facility (88%), inadequate space for temporal dumping (84%); and Lack of legal enforcement in matters of solid waste poor handling (62%). Opportunities in waste were: source of earning (38%), employment (31%), saves environment from diseases and pests (25%), and source of revenue (6%). Factors influencing solid waste collection and disposal in Lira municipality were: Age (marginal effect- 3.838), Solid waste containers (marginal effect of 8.883), collection/disposal space (marginal effect of 0.012) and Legal enforcement against poor disposal (marginal effect of 0.006). The study concluded that management system is efficient given the daily collection (77%) and coverage of collection operation (58%) in all originally planned municipal radii and good co-ordination between the Municipal administration and the local people; though with un- reliability inflicted by the constraints identified. The study recommended for Lira municipality to educate / sensitize her residents on how to provide a pollution free environment as well as economically profitable waste handling practices such as source reduction through waste recycling, re-use, composting, bio gas production in a bid to change people's perception in viewing solid waste as useless, but as another form of raw material that demands better packaging for future use.

#### **CHAPTER ONE**

### **INTRODUCTION**

#### 1.1 Background

Municipal waste primarily comes from households, (Hoornweg and Bhada-Tata 2012, ISO, 2016). It includes wastes generated from offices, hotels, shopping complexes/shops, institutions, and from municipal services such as street cleaning and maintenance of recreational areas as put forward by Tai et al. (2011). Chidiebere et al. (2018) also observed that Waste from municipal stream is usually heterogeneous in nature and has variable physical characteristics depending on their sources; which main component comprises the biomass material such as food, paper, wood waste, clothes rags, rubber, plastics and other daily used discarded materials. Summarily, municipal solid waste generation characteristics define the socio-economic structure, income levels of the people and its component portrays their consumption patterns, (Ozcan et al (2016). Municipal solid waste is thus any used product discarded useless after it has lost value in the face of its first user.

Globally, the composition of municipal solid waste (MSW) can be classified according to each country's income level. Hoornweg and Bhada-Tata (2012) for instance provided a review of the global MSW situation and reported that the annual global MSW generation amount was at 1.3 billion tonnes and the global MSW generation rate at 1.2 kg/capita/day. Thus, speculated that by 2025, this will likely increase to about1.42 kg/capita/day (2.2 billion tonnes of MSW per year).

Data from Asia confirms that countries like Japan, Laos and Thailand, have more municipal waste generated per capita as presented by (Lohri et al., (2014). Yeshwanth Kumar (2016), in his study in Bengaluru- India; observed that Urban local bodies tend to perform poor in the service delivery and most of them are not able comply with the benchmarks set up the Urban

Development ministry, Pollution control boards etc., often there could be found the crisis in the management of municipal solid waste, even though it is supposed to be scientific solutions to the management.

The UN Habitat (2015) on the new urban agenda stressed for four dimensions of spatial sustainability to improve urban planning and development; especially intentional planning and development, spatial conditions of life especially social, economic and environmental-value and wellbeing, government need to create access to jobs, housing and social interaction, and encouragement of sustainable relationships to eco systems and natural habitats.

In Africa, the rate of urbanization (estimated at 3.5% annually) has increased Municipal waste generation greatly because of increased industrialization and modernization of agriculture as forwarded by Binswanger-Mkhize and McCalla (2010). However, according to May and Rogerson (1995), indiscriminate disposal of MSW is a major nuisance in urban areas that have contaminated groundwater and degraded the soil quality in sub-Saharan Africa.

Omekwe (2017) contends that socio-economic factors such as income status, educational status and employment status positively relate with solid waste collection and disposal by the residents. The study therefore sought to find out how best solid waste should be collected and disposed of in urban areas including Lira municipality and also identify the factors that relate to its collection and disposal modalities and how or why?

Even though the overall goal of urban solid waste management is to collect, treat and dispose of solid waste generated by all urban dwellers, only 30%–60% of all the urban solid wastes is uncollected, and less than 50% of the population is served as noted by Kinobe et al. (2015). As a result, inefficient municipal solid waste management systems increase disease transmission, contaminate ground and surface water, create greenhouse gas emissions, damage ecosystem services, discourages tourism and other business activities as was observed by (Chinasho, 2015; Fenta, 2017). The study therefore sought to find out how solid waste collection and disposal affects people's life and the environment and realise the cardinal factors that dictate on sustainable management.

Municipal solid waste generation rate increases with an increase in economic development, degree of industrialization, and rate of urbanization as noted by Kaza et al (2018).

In Uganda currently the annual rate of urbanization and population growth rates is at 5.1% and 3.3% respectively; and the increasing infrastructure does not cope with the rate of urbanization and solid waste generation as noted by Ssemugabo, C, (2020). Because of these only 40% of the waste generated in Kampala city and 1/3 of waste generated in slums communities in Kampala is collected and disposed to land fill; and the remainder is indiscriminately disposed. This has resulted into environmental health challenges, water and soil pollution and diarrheal disease spread. Lira Municipality being one of the highly expanding and rapidly growing towns in Uganda (UBOS, 2014), faces the same challenge as other urban areas and cities in Uganda with a likelihood of even worsening if the problem is not addressed; thus, the need for adequate solid waste management is unquestionable (Lohri et al., 2014; Abate &Goshu, 2017). It is against this background that the study chose to characterize the solid waste, assess the collection operations, its efficiency and reliability, and gauge the constraints and opportunities.

### **1.2 Statement of the Problem**

Municipal solid waste problems and effect is globally felt by all nations but at different scales (UNEP, 2015). In Africa, the rate of urbanization (estimated at 3.5% annually) has increased municipal waste generation tremendously due to increased industrialization and modernization of agriculture (Binswanger-Mkhize and McCalla, 2010). However,

indiscriminate disposal is a major nuisance affecting most urban areas due to inadequate collection and sustainable disposal practices.

In Uganda, Lira Municipality is one of the highly expanding and rapidly growing towns with current annual population growth rate of 3.6% (Uganda Bureau of Statistics report, 2012/2014). Increasing amount of municipal solid waste due to population increase coupled with lack of an appropriate solid waste management practices; especially on collection and disposal in Lira municipality has posed a significant health and environmental risks to community in and around the municipality.

Indiscriminate disposal is found in scattered dumps of trashes along streets, in drainage channels, in open sewer lines in the suburbs.

This have resulted into poor sanitation leading to spread of infectious diseases like malaria, typhoid and intestinal disorders etc. Many times, people have suffered from ailments, with many of them originating from the unhygienic conditions (Abdulafatah et al.2019).

Previous studies on waste management in Ugandan cities and East Africa showed that a greater percentage of urban solid waste do not reach the legal disposal points but end up in the environment and open indiscriminate dumping is the most common waste disposal method (Okot-Okumu &Nyenje 2011; Oberlin 2011).

### 1.3 Objectives

### 1.3.1 General Objective

To contribute to the proper management of solid wastes in the developing cities and municipalities of Uganda such as Lira Municipality.

## 1.3.2 Specific Objectives

• To characterize the types of solid wastes generated and examine their collection and dumping system in Lira Municipality.

- To determine the factors that influence collection and dumping of solid wastes in Lira municipality.
- To examine the perception of people on the efficiency and reliability of Municipal solid waste management system.
- To examine the constraints and opportunities of solid waste management in Lira municipality.

## 1.4 Research Question

- What are the major types of solid wastes generated in Lira Municipality and how are these solid wastes collected and dumped?
- What are the factors that influence solid waste collection and dumping in Lira Municipality?
- How do people perceive on the efficiency and reliability of solid waste management system in Lira Municipality?
- What are the constraints and opportunities existing in solid waste management in Lira Municipality?

### 1.5 Scope of the study

The study was carried out in Lira Municipality in Northern Uganda; within the four clearly marked Administrative Divisions of Adyel Division, Railways Division, Ojwina Division, and Central Division. It was conducted between the months of January, 2019 and March, 2019.

The study focused on the characterization of municipal solid waste, the management system, its perceived state of efficiency and reliability, examination of the constraints and opportunities of solid waste management in Lira Municipality.

### **1.6 Significance of the study**

Successful accomplishment of the study means that its findings can be used in the following ways:

Help policy makers in the environmental sectors to formulate practical solid waste management policies for urban centres. For example, the US Resource Recovery Act of 1970 which promotes better management of solid waste and support recovery of resources; Hazardous waste management Act that gives directives on disposal of hazardous waste in landfill.

Guide local leaders in Lira Municipality and other municipalities to provide course of action on how to promote a pollution free environment through proper handling of Municipal solid waste; for example, by-laws on indiscriminate disposal and penalties attached.

Inform the public on proper waste disposal and management such as use of compost pits for bio degradable solid wastes that can again be a useful source of fertilizer to restore soil fertility, use of incineration for combustible non-hazardous waste and land filling for hazardous waste.

Provide more information to the public health officers and direct them in sensitising the public on proper solid waste disposal and management in order to prevent diseases, Safe hygiene and sanitation practices such as disposal of human faeces in latrine pits, not disposing solid waste in drainage, swamps or near protected springs which will avoid leachate seepage contaminating drinking waters.

The result from its findings will task the community to think in line with zero waste sustainability and realize a circulatory economy waste management strategy geared towards effective use of all resources and protect the eco system as well.

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### **1.7. Conceptual Frame work**

**Figure 1.7** shows the conceptual framework which guides the scope of the study. The characteristics of bio-degradable and non-bio degradable waste impacts on the collection operations such as at source sorting and packaging in the different collection containers. Age of waste generators determines their personal conviction in waste packaging and collection and disposal. The availability of disposal space, collection containers and strict waste by-laws will ensure disciplined collection and disposal and collection. Adequacy in transport mechanisms ensures regularity, efficiency in collection and disposal. Efficient and reliable collection and disposal will lead to waste opportunities; while inefficient and un reliable collection and disposal will lead to constraints. Frequent collection will discourage indiscriminate dumping or throwing openly anywhere; thus, sustainable management realised.

### **1.7.** Conceptual framework



### **1.8 Operational Definitions**

**Municipal waste:** organic and inorganic fractions such as kitchen refuse, product packaging, grass clippings, cloth, bottles, paper, paint cans, batteries, etc., produced in a society, which do not generally carry any value to the first user.

**Solid waste:** Solid wastes are any non-liquid wastes that arise from human and animal activities that are normally solid, comprising organic and inorganic waste materials such as product packaging, grass clippings, furniture, clothing, bottles, kitchen refuse, paper,

appliances, paint cans, batteries, etc. produced in a society, which do not generally carry any economic benefits (Ramachandra, 2009; Ramachandra, 2011; Getahun et al., 2012)

**'System'** is an organized collection of parts (or sub units) that are highly integrated to accomplish an overall goal. **System** has various inputs, which go through certain processes to produce certain outputs, which together, accomplish the overall desired goal.

**Municipal solid waste management system (MSWM):** is associated with the control of waste generation, its storage, collection, transfer and transport, processing and disposal in a manner that is in accordance with the best principles of public health, economics, engineering, conservation, aesthetics, public attitude and other environmental considerations.

Efficiency: The degree of performance of any given task/operation.

**Reliability:** An act of a substance bearing high level of trust and dependability towards meeting with successful outcome on its utilization in a given operation.

**Waste:** useless remains or by- products arising from domestic, trade, commercial, industrial, agricultural and mining activities and from the public services.

Effectiveness: The best way of dealing with waste both economically and environmentally to avoid creating it in the first place. It is determined in terms of waste re-use, recycling and reprocessing, waste to energy transfer like bio gas making, waste minimization and reduction.

#### **CHAPTER TWO**

### LITERATURE REVIEW

#### **2.1 Introduction**

This chapter reviews literature from different sources such as textbooks, web sites, newspapers, journals, and other publications related to the topic of study. It involves in-depth examination of the wastes accumulation in urban centres and their characteristics, the dumping and collection system, factors that influence the system. It further looks at the efficiency and reliability of Municipal solid waste collection system; examines the constraints and opportunities of municipal solid waste management.

### 2.2 Municipal Wastes and its Characterization

Ramachandra, 2009 and 2011; Getahun et al., 2012 defines municipal solid wastes as any non-liquid wastes that arise from human and animal activities that are normally solid, comprising organic and inorganic waste materials. They assert that such materials may comprise product packaging, grass clippings, furniture, clothing, bottles, kitchen refuse, paper, appliances, paint cans, batteries, among others; produced in a community, which does not generally carry any economic benefits to the user.

According to Craig spelch (2016), solid waste could be classified into biodegradable and nonbiodegradable wastes basing on their decay ability within a short time period. This study therefore characterised municipal solid waste according to their decay or degradability status.

### 2.2.1 Biodegradable Municipal Wastes

'Biodegradable' is used for those things that could be easily decomposed by natural agents like water, oxygen, sun rays and heat, acid rains, micro-organisms, among others. (Surbhi, 2014). These wastes include organic matter which could be broken down into carbon dioxide, water, methane, or simple organic molecules by micro-organisms and other living things by composting, aerobic digestion, anaerobic digestion or simpler processes (Ehlert, 2017). It includes substances food waste like vegetable and fruit peels, dead plants and animals, chicken egg shells, paper materials, garden waste among others, (Surbhi,2014).

### 2.2.2 Non-Biodegradable Municipal Wastes

Non-biodegradable substances are those that are never broken down or decomposed by environmental factors like rainfall, water, sun heat, soil organisms, as among others but instead contribute to the bulk of municipal solid waste (Hughes, 2017; Rachna, 2017). Nonbiodegradable wastes consist of items such as plastics, polythene, metals scraps, plastic cans, aluminium cans, tyres, glass bottles, among others (Singare, 2012). The study thus tried to establish the types of non-biodegradable items found in the waste stream of Lira municipality.

Non-biodegradable wastes are of two types. These are: the recyclable wastes that have economic values but destined for disposal which can be recovered and reused along with their energy value, for example: plastics, synthetic paper, metal scraps, plastic bottles, among others and Non-recyclable waste which does not have economic value of recovery such as carbon paper, thermos coal, and tetra packs, among others (Bharadwaj et al, 2015). This study thus helped to establish whether the solid wastes realised have any economic values which make them recyclable.

#### 2.3 Municipal solid Waste Collection system

Municipal waste collection and disposal are the most cardinal operations that require careful handling to ensure sanity in any urban setting. The following operations have been put forward for this.

#### **2.3.1** Door to Door collections

Allen (2002) indicates this as a situation where small waste collection bins are provided at the door post of every house hold for waste collection and emptied at specified time intervals. According to Wegedie (2018), households in the low and medium density zones receive solid waste collection bins provided by the Municipal authorities and door to door collection, transportation and final disposal of their waste to landfills. He asserts that this normally arises from the willingness of residents to pay some fees to the government for financing waste management to improve their conditions. This study thus wished to point out any kind of socio-economic discrimination observed that plays any big role in municipal waste collection and disposal in Lira municipality.

### 2.3.2 Communal Container Collection

According to Amoah, and Kosoe (2014), the communal containers are provided at some specified place to serve a bigger area within the low-income high-density populated suburbs where the infrastructural facilities are in very poor state due to clustered un planned settlements. They further asserted that residents in these areas have low willingness to pay for the services by private waste collection firms and their settlements lack proper structural planning which makes it difficult to access using garbage trucks. This study therefore wanted to establish whether there are determinants for the placement of communal container in municipal waste collection services in Lira municipality.

#### 2.3.3 Burning, Burying or Throwing

According to Wegeddie (2018), households that do not receive door to door services or communal container collection would use two options of either simply burning, burying or dumping of solid waste in compounds, or throwing waste indiscriminately at road sides, open fields, nearby rivers, bridges or gullies as was also observed by (Igoni et al,2007). This

method of waste collection is a prominent practice in the high -density zones which comprise of not only poor, but also people of very low educational status and social background, and having negative perception regarding solid waste handling as a welfare service; hence reluctance to pay for the waste disposal services (Zurbrugg ,2003). It has been in the interest of this study to establish the extent and why some community could resort to simply burning, burying, or throwing waste indiscriminately in Lira municipality.

### 2.4 Municipal Waste Disposal

Waste disposal refers to all actions and activities required to manage waste from its inception to its final discard. It comprises collection, transport, treatment and disposal together with monitoring and regulation.

According to the National-physical-planning -standards and guide lines (2011), on waste disposal any refuse must be sorted and stored in proper containers for collection and appropriate disposal by the respective Local Authority, to the approval of the local authority. Hazardous wastes will require special treatment.

However, several solid waste disposal methods have been exposed by different authors among which are the following:

#### 2.4.1 Open Indiscriminate Dumping

Waste dumping is defined as the disposal or discard of waste without any environmental and hygiene control. It comprises of open dump site.

According to Kassahun, 2018, open dumping is the most widespread method of solid waste disposal in most urban centres in developing countries within which Uganda also belongs. It typically involves the uncontrolled disposal of waste without measures to control leachate, dust, odours (Kassahun, 2018 and Tassie (2019)). In some cities, open burning of waste is practised at dump sites (Mukama et al, 2016).

Ssemugabo, et al. (2020) cited that currently in most cities and municipalities in Uganda; especially Kampala capital city and her surbab municipality of Mukono; significant percentages of solid waste are dumped in un authorised sites including drainage channels. This arose due to few designated communal collection points created by the unwillingness of the land lords to give away portion for their land for allocation of solid waste collection points. The current study intended to establish whether this disposal modality exist in Lira municipality, its extent and causative factors.

### 2.4.2 Land filling

A landfill also known as a dump or rubbish dump is a site for disposal of waste materials by burial (Lokesh, 2013; UNEP, 2017). In modern terms it is called a sanitary land fill since the waste disposal here is done in a manner that protects the environment by spreading the waste in thin layers, compacted to the smallest practical volume and covering it with compacted soil by the end of each working day. This method is used in urban places where waste is collected by municipal waste crew or private waste collectors contracted by the municipal authorities as is the case with KCCA (Okot-Okumu and Nyenje, 2011). The study thus endeavoured to establish if land filling is in use in Lira municipality waste management.

### 2.4.3 Incineration

According to Braxton, 2010; Rajendra, 2015; this is the process of burning waste at high temperatures of over  $900^{0}$  C in large furnaces known as incinerators. In these plants the recyclable material is segregated and the rest of the material is burnt leaving behind ash. They observed that during this process some of the ash retreats up the sky with the hot air in a form referred to as fly-ash. Both the fly-ash and the other residue that is left in the furnace after burning usually contain high concentrations of dangerous toxins such as dioxins and heavy metals which at the end when inhaled cause respiratory tract infections to the urban populace.

### 2.4.4 Composting

Ahsan, 2014; Yadav et al, 2016 submitted that composting involves the decomposition of refuse through bacterial action into humus material similar to peat moss in appearance and application, but the end product is useful as a soil conditioner and fertilizer.

According to Drescher and Zurbrugg (2006), composting requires segregation of organic biodegradable wastes and inorganic non-biodegradables from the waste streams though clear knowledge of waste fermentation. The current study therefore endeavoured to establish whether municipal dwellers value their organic solid wastes and had prior knowledge in the practice of segregating, fermenting and utilising them for soil conditioning in their gardens.

#### 2.4.5 Recycling and Re-Use

Mukama et al, 2016, observed that recycling and re-use involves the recovery of products such as plastics, paper and metals and food peelings. Food materials such as banana peelings, cassava and potato peelings are collected to feed animals (Tukahirwa et al, 2011). The recovery of re-usable materials is performed by people working in informal sector driven by poverty and this activity acts as source of income to many poor communities as observed by (Shyam et al., 2017) in India. In Democratic Republic of Congo and many cities in the country, solid waste recycling and scavenging has been a traditional norm associated with the low -income groups; many of whom survive on it directly or indirectly (Simatele et al, 2015). This shows the useful roles played by the urban poor in maintaining urban sanity indirectly as their acts help to reduce on the waste volume which in most cases is not directly recognized by the Municipal authorities.

### 2.5 Factors that influence Municipal solid waste collection and dumping

Several factors have been cited by different authors to influence collection and dumping of solid waste in most urban areas among which are the following

According to Kinobe (2015) there is usually marked variation in waste packaging and collection in municipal settlements where residents in the more affluent zones store their waste in containers always put near their yards from where the waste collectors empty to take to secondary destinations, but in high density zones the residents store waste in buckets and old sacks where they would carry away on their heads or bicycles to unofficial sites. The availability of collection equipment therefore is a cardinal factor as its absence would lead to littering of waste anywhere by the community. The current study tried to establish whether the condition of the solid waste containers affect the collesction and disposal of solid waste in Lira municipality.

Yukalang et al (2017) pointed out on Willingness to pay for waste collection services as vital in enhancing effective collection and disposal in most urban areas citing India where residential waste collection services such as door to door or house to house services only target high income areas due to their willingness to pay for the services. The study thus wished to prove whether willingness to pay for solid waste management services has any gross effect on solid waste management in Lira municipality.

Sallwey et al (2017) pointed that gross effect on solid waste collection and dumping service stem from number of collection vehicle and in their mechanical conditions. Here municipal collection team take long to pick the waste from temporal dumps due to few trucks which many times are in poor mechanical conditions. The current study endeavoured to establish the extent to which waste vehicular number and their mechanical conditions affect solid waste collection and disposal in Lira municipality.

Al-Khatib et al., 2010 cited lack of enforcement of policies and laws as a major institutional issue that greatly contributes to the mismanagement of solid waste in the developing world. Citing an example of this to be seen in Kenya; although there is sufficient legislation

covering waste management, local authorities lack the capacity to implement them. Henry et al., 2006 also noted failure by local the leaders in Kenya to mount laws against littering by community as social pressure to prevent littering, absence of realistic penalties or consistent enforcement, and lack of knowledge of the environmental effects of littering. The study intended to establish the extent to which the existence and enforcement of policies and laws on solid waste management has affected solid waste collection and disposal in Lira municipality.

Keita Mamady (2016) cited that knowledge on waste risk in regard to management practices like throwing waste in open grounds usually associated with young people was one great factor. Here, he noted lack of the most adequate safety behaviours lacking in people between ages 25-25 years as many usually throw their waste in open grounds provided its away from the inside of the house. This makes age to be considered a cardinal factor. The study thus endeavoured to establish the extent to which age of solid waste generators impact on solid waste management in Lira municipality.

Mrayyan and Hamdi, 2006 cited that low level of awareness regarding the health and environmental impacts of improper management of solid waste as quite disastrous in waste management since it makes it difficult to implement recycling and disposal programs in many developing countries. They noted that recycling requires community involvement and social awareness to be successful. In recognition of the importance of public participation in the success of recycling programs, recycling policy and legislation need to be geared toward promoting people centred approaches to recycling with public education as the main driver towards increasing public participation (Bolaane, 2006). The study thus strove to establish effectiveness of Public sensitization on enhancing community participation on solid waste recycling and disposal programs in Lira municipality.

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Yukalang et al (2017) cited inadequate disposal ground as a factor arising from infrastructural challenges in waste management in developing nations. Here, unlike developed nations, third world countries lack sanitary landfills and often times disposal sites are located at a considerable distance from communities which generate indiscriminate waste dumping. Asase and colleagues (2009) in Ghana noted that there was a lack of proper disposal sites in the country and temporal dump sites has always led to indiscriminate waste dumping. The study tried to establish the extent to which temporal disposal ground and their distance impact on effectiveness of solid waste management in Lira municipality.

#### **Source Sorting and Separation**

This involves the segregation of solid waste at either the generation or temporal dump point to get re-usable items from the waste stream. Shyam et al., (2017) says the recovery of re-usable materials is performed by people working in informal sector driven by poverty and the activity act as source of income to these communities. The recycled and re-used wastes include plastics, metal scraps, food waste, polythene bags and sludge. In Mexico, Beijing and many cities in south East Asia solid waste collecting, recycling and scavenging is a traditional norm associated with the low- income groups many of whom Survive on it directly or indirectly as was noted by Medina (2010) and Tedde (2014). The study wished to establish the major back-up factors that dictate on the source sorting and storage of these items in terms of firms that utilises them apart from poverty as observed by those other authors as even economically stable people in the municipality have shown interest in such business.

### 2.6 Perception of people on Municipal Solid Waste Collection Systems

This area focuses on the performance of solid waste collection systems in Lira municipality and generally other urban centre. It uses the terms of efficiency and reliability as measure of performance. The efficiency of the solid waste collection systems relates to how successfully the collection systems are applied in the solid waste collection process in the municipality and other urban centres. Reliability on the other hand focuses on the ability of the collection and disposal system bearing high level of trust and dependability towards meeting with successful outcome on its utilization; their ability to be used for a long period of time with similar results being obtained.

#### 2.6.1 Source Storage and Collection

According to Kinobe (2015) there is usually marked variation in waste packaging and collection in municipal settlements. Residents in the more affluent zones store their waste in containers always put near their yards from where the waste collectors would empty to take to secondary destinations. In high density zones the residents store waste in buckets and old sacks where they would carry away on their heads or bicycles to unofficial sites next to main roads for secondary collection sites as was also noted by Ahsan et al (2014). Effective waste services would require collecting directly from each household every day but this would mean much higher costs, but would require an alternative operation service as observed by UN-Habitat (2010) for efficiency and effectiveness. The study thus endeavoured to establish the extent to which variation in solid waste storage containers in the various residential zones impact on the efficiency and reliability of waste collection operations in Lira municipality.

### 2.6.2 Residential Zonal collection

Ahsan et al (2014) asserts that residential waste collection services such as door to door or house to house services only target high income areas due to their willingness to pay for the services. He also pointed that the un- planned city settlements make it difficult to reach other areas of the city residents due to inaccessibility. This same situation was cited by Kinobe (2015) in Kampala city. The study thus to wished to establish whether perceived inefficiency and un reliability in municipal solid waste zonal collection services in Lira municipality
should not be blamed on economic factor of willingness to pay for the waste collection services and poor structural residential planning since most parts are accessible.

#### 2.6.3 Transportation

Ahsan et al (2014) observed that the functional element of waste collection includes not only gathering but also transportation to their final location. Sallwey et al (2017) noted that in India where CBOs and NGOs were noted to carry collected wastes from households to secondary disposal sites it takes long for Municipal authorities to collect and take it to final disposal points; hence inefficiency and non-reliability in the service. Ahsan et al (2014) still noted that in most cities of Ghana most solid waste collection operation is not clearly time tabled.

The current study has been interested in finding out how Lira Municipality reliability and efficiency in solid waste management arise from transportation system that ensures sanity.

Mugweri and Oonyu (2019) further noted perceived ineffectiveness and unreliability in collection in the number of vehicles used by urban waste management departments; citing Kampala city council Authority which operates with only 5 garbage trucks across the five Divisions of the City but would require additional support of 50 garbage trucks to achieve the required level of operation This statement is a clear indication of perceived ineffectiveness and defaulting in transportation operations.

#### 2.7 Constraints and Opportunities in Municipal Solid Waste Management

The statement of constraints focused on challenges or undermining factors encountered from collection, transportation, and disposal. Opportunities focused basically on positive economic, social, health, and environmental related matters.

#### 2.7.1 Constraints

Solid waste management systems in developing countries are usually confronted with a number of challenges, such as low collection coverage and irregular collection services, crude open dumping and burning without air and water pollution controls and the reluctance in handling and controlling of informal waste picking or scavenging by Municipal dwellers as had been observed by Mukama et al (2016) in East Africa and Ahsan et al (2014) in Ghana.

These environmental, and management problems are caused by various factors which distract the development of effective solid waste management system and have been categorized into technical, financial, institutional, economic, and social constraints as has been observed by Igbinomwanhia and Ideho (2014) in Benin Metropolis in West Africa and by Aryampa (2019) in Uganda.

#### 2.7.1.1 Technical constraints

UN Habitat (2009) in Ghana and Benin observed inadequate human resource for waste management at both national and local Municipal levels. In most instance officials without technical training in waste management are assigned to handle the complex solid waste engineering issues particularly at municipal levels leading to failures of many solid waste projects as also observed by Ahsan et al (2014) in India.

Zavodska (2003) cited that there is no formal training program for waste collection crew in using modern waste management strategies and communication is poor. Without adequately trained personnel for solid waste policy making and implementation, sustainable solid waste management planning is thus not realizable. It has been therefore in the interest of this study to establish the credibility of solid waste management personnel in Lira municipality in handling their tasks and how they relate at various levels.

Ramachandra (2011) and Getahun et al. (2012) cited on inadequate research studies in environmental and developmental activities in solid waste management which leads to the selection of inappropriate technology in terms of the local climatic and physical conditions, financial and human resource capabilities, and social or cultural acceptability. As a result, the technology selected can never be used, wasting the resources spent and making the project unsustainable. In light of this, in their studies in Africa found out that, in most countries solid waste has a high organic content; for example, studies conducted in the region estimated that in Juba South Sudan, organic waste constituted about 31% of all waste by weight, 61% in Ghana, and 54% by weight in an Ethiopian town of Jimma. There is thus need for research in the organic content as it has implications for waste management strategy selection which many times isn't considered leading to failures of many solid waste management projects and financial losses. The study therefore laboured to establish any new variation in the organic content of solid waste in Lira Municipality.

#### **2.7.1.2 Financial Constraints**

Okot- Okumu and Nyenje (2011) in their studies on waste management in East Africa cited of it being generally a low-priority item in government budget allocations; thus, the financial base for these activities is weak.

In Uganda UN HABITAT (2018), noted that KCCA currently operates Kiteezi land fill at UGX 3.32 Billion which is inadequate and it requires additional UGX 13 Billion to procure necessary equipment and leachate treatment materials, yet the budget allocation for it in the Uganda National Budget was only UGX 4 Billion. Mugweri and Oonyu (2019) cited that Kampala city council Authority which operates with only 5 garbage trucks across the five Divisions of the City but would require additional support of 50 garbage trucks to achieve the required level of operation.

Yukalang et al (2017) observed low households' willingness to pay for waste collection services leading to failures in funding many important projects. The current study intended to establish how Lira Municipality meets remedies on her solid waste management financial deficit given the inadequate national budget allocation.

#### 2.7.1.3 Institutional Constraints

Public Health Act, 1964 of the Republic of Uganda and the Local Government Act, 1997 of the Republic of Uganda like other countries in East Africa clearly state that the responsibility of Municipal solid waste management lies with the local governments and the districts. The Engineering department within the local government of each district or Municipality is thus held responsible for provision of transport and collection facilities while NEMA and Public Health Department bears responsibility over environmental protection. Kinobe (2015) and Nyakaana (2012), however, observed no clear coordination and integrations in the work plan of these two units as they all work in isolation citing example in Kampala City where KCCA management and NEMA are always in tension over gazetting wetlands for waste disposal and industrial establishment. Akpoborie (2011) in Benin Metropolitan City also noted that the legal provisions related to solid waste management are often incorporated as fragmented elements in disparate laws, such as laws for public hygiene, local administration, and environment protection. This lack of binding legal framework has always led to confusions and conflicts resulting into a setback in Municipal waste management programs. In developing countries therefore, due to inappropriate coordination between regulatory authorities addressing environment and industries, the waste management process gets affected. The problem arises due to the legal constraints affecting waste management including inadequate enabling laws, regulations, standards, policies and inadequate enforcement of the existing laws, political interference and weak penalty as was even noted by Okot-Okumu and Nyenje (2011) in their study in solid waste management in East African

cities. The current study was interested in identifying the strategy used by Lira Municipality in harmonising and co-ordinating the regulatory authorities in achieving a quell working environment.

#### 2.7.1.4 Social Constraints

Singh et al, (2014) in their studies on solid waste management in India noted that lack of community participation in solid waste management services stems from people's negative perception of waste collection business to be for poor and poverty rocked people. Akpoborie (2011) in Benin Metropolitan City and Okot-Okumu and Nyenje (2011) during their studies in waste management in the cities of East Africa noted that there is reluctance in broadcasting safe environmental messages and environmental education by the legal management department, lack of coherent enforcement of waste management law and strict penalties that make the masses unaware of their positive concern. The current study wanted to establish why most municipal dweller do not disregard participation in solid waste management services and how safe environmental massages get spread to community.

#### 2.7.2 Waste management opportunities

Leblance (2018) defined solid waste management as a planned system of effectively controlling the production, storage, collection, transportation, processing and disposal or utilization of solid waste in a sanitary, aesthetically acceptable and economic manner. The statement opportunities by the researcher focused basically on positive economic, social, health, and environmental related matters.

#### 2.7.2.1 Source of earning

According to Nyakaana (2012) the practice is a very lucrative business citing that in Kenya many practical wastes re use projects are being implemented example in Nairobi a CBO in the city's biggest slum called Kibera is using Poo (human waste) to generate energy in form

of bio gas and in Bangalore. The Waste management world (2017) also cited that in India the Tera firm uses a variety of compost from municipal waste and sell to farmers as organic fertilizer. This confirm the statement by the UN HABITAT (2010) that resource value of waste is used provide source of livelihood for the urban poor in most developing countries today. The current study thus wished to establish if there are some local organisations or firms in Lira municipality that survive on products from solid waste management as their sales items.

#### 2.7.2.2 Employment creation

UN Habitat (2015) stated that every phase of solid waste management need man power right from the collection to the final step of segregation; ultimately a large number of employment opportunities get opened up citing from the labour statistics provided by the US government in which around 3.1 million new jobs are produced due to the waste management factor.

Ali, 2001 also pointed out that in North Africa; especially in Egypt the Zabbalean religious sect dominates waste scavenging to get food leftovers and peelings to feed animals and in South East Asia; especially in Karachi, Pakistan, the unemployed and low- income people dominate waste scavenging and recycling as a traditional norm from which they earn their survival. The current study wished to find out the various solid waste management phases and the kind of employments it provides the urban dwellers of Lira municipality.

# 2.7.2.3 Saves the Earth and conserves energy

According to Hettiarachchi and Hülsmann (2017) apart from composting, organic waste can also be used for bio energy production; citing a project implemented in Mozambique since 2013 and successfully tested in South Africa where residues from timber-processing (biomass) are a promising source for bio energy production. The study was interested in establishing how or if the Lira Municipality dwellers use solid wastes to produce energy or fuel for their daily activities.

#### 2.7.2.4 The Practice is highly lucrative

Seadon (2006) in the journal of Waste management among European, south East Asian and pacific countries indicates that the revenues generated by the waste management through recycling and composting would top by \$60 million by 2018; citing that now many companies are looking forward to associate themselves with this industry and are ready for a long- term investment. The study wished to find out firms that are involved in solid waste management in Lira Municipality and what motivates them to get involved.

#### 2.7.2.5 Keeps the Environment clean and Fresh

Lonel (2010) observes that wastes represent an important environmental pollutant not only for soil but also air, so the general management for waste should be re–evaluation and purification. Berry (2008) observes that waste management protects health and life as it reduces exposure to hazardous matter while contributing sanity and removing the unwanted by-products and pollutants providing for disease free and fresh environment. The current study wanted to find out benefits of solid waste management to the quality of environment in Lira municipality.

#### 2.7. Gaps identified in the Literature

Waste characteristics; The study characterized the waste generated into biodegradable and non-biodegradable giving their types, but did not point out their ranking in generation in most households as would be best expected. On waste collection the literature looked onto collection operations such as door to door, communal collection containers, but did not consider the conditions and types of those containers in relation to waste transportation to temporal dumps.

On municipal waste disposal the cited literature stressed on the various disposal methods used, but did not stress on the availability of the space for temporal dumps and their security in terms of ownership.

On the factors influencing waste dumping all the literatures did not consider how the intensity of law enforcement, adequacy of temporal dump sites, container conditions, age brackets and personal conviction would impact on waste packaging and sanity.

The study also employed a scientific model to get the actual and specific factors in Lira municipality which other the literatures did not address.

On constraints the literature spelt out in adequacy in transport vehicle, but did not stress on their mechanical conditions, did not explore much on extent of and severity of waste law enforcement, attitude of generators and collectors.

On opportunities not much concern was given to organization and municipal investments on tapping waste resources and other risks that could be erased as a result of sustainable management practices such as waste sorting etc.

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#### **CHAPTER THREE**

#### **RESEARCH METHODOLOGY**

#### **3.1Introduction**

This chapter explains the research methodology which was used to conduct the study. It covers a description of the study area, study approach, data collection tools and data analysis techniques and presentation.

#### 3.2 Description of Area of Study

#### 3.2.1 Location

Lira Municipality is located in Lira District in Northern Uganda. It is geographically located at latitude  $20^0$  17' north of the equator and longitude  $32^0$  56' east of the principal meridian (State of Environmental Report, 2011/2012). It lies along the highway between Gulu and Soroti and is the main municipal, administrative, and commercial Centre of Lira district and the whole of Lango region. The choice of Lira municipality as area of study was based on the fact that it is one of the fast-growing urban centers in northern Uganda experiencing a greater influx of different peoples even from within countries bordering with Uganda and others outside African continent such as Asia. Solid waste management issues thus become cardinal given the great congregation of people of varied cultures and origin.



Fig.3. 1 Location of Lira Municipality in Uganda

# 3.2.2 Climate and Temperature

Lira Municipality exhibits a uni-modal rainfall pattern with a single rainfall maximum. The rainy season stretches from March to November with a short dry spell in June and July. The dry season stretches from December to March. Ngetta Meteorological Station figures indicate that the amount of rainfall ranges from 1000mm to 1600mm per annum. (Agea et al., 2007).

The mean temperature does not show great variations. The average temperature of Lira Municipality ranges from  $22^{0}$ C and  $26^{0}$ C but the diurnal temperature range is high in the dry season and may reach  $40^{0}$ C. This climatic type encourages quick decay of solid waste organic

matter which dissolves to form garbage soup which contaminates drinking water in the springs through seepage and provides conducive atmosphere to vices of health hazards multiplication.

#### 3.2.3 Relief (Topography)

The relief of Lira Municipality is generally flat, and gently undulating. The altitude is between 1075 and 1100 meters above sea level (Ongoma et al., 2018). This kind of terrain promotes the carriage of solid waste by running water to low land areas usually pronounced causing health problem.

#### 3.2.4 Soil

The soils of Lira Central Division are categorized as ferruginous sandy loam. The soil has a high percentage of sandy soil and therefore it is vulnerable to erosion. Since the soil is sandy in nature, it has a low water retention capacity and a high rate of water infiltration (DSOER, 2007) and this implies that the infiltration of decayed indiscriminately discarded wastes soup into the underground spring flow lines is very high making the study eminent.

#### 3.2.5 Vegetation

The original vegetation of Lira Municipal Divisions was intermediate savanna grassland with scattered trees, (Uganda Bureau of Statistics, 2011). Today the original vegetation of Lira municipality has been destroyed in many places and replaced with exotic species of trees, shrubs and grasses like elephant grass for grazing livestock. This vegetation types to the study produce leaves that fall and add to the organic matter in the waste stream that pollutes the environment when not well attended to in solid waste management programs.

#### 3.2.6 Socio-Economic Activities

The Municipal council is a Centre for economic and industrial activities, with better social services and this has attracted a large population. The dwellers carry out trade, industrial manufacturing mainly of medium size and small-scale agro-processing, informal sector ranging from metal fabrication, timber works to commercial shops (UBOS, 2012/2014).

These activities contribute a bigger amount of solid waste into the waste streams that attract attention for effective management.

#### 3.2.7 Lira Municipality Extent, population and administrative structure

The Municipality covers a land area of 7745 hectares. According to UBOS (2014) National population and housing census, Lira municipality had a population of 99,511 and household population of 25,396 in total for all the four divisions. Lira Municipal Council is a lower local Government under Lira District Local Government. A Mayor heads the political wing and the Town Clerk heads the technical wing. The Municipality comprises four Division Councils namely: - Adyel Division, Lira Central, Ojwina Division and Railways Division as lower local governments under the Municipal Council. Each Division is headed by a Chairman who heads the political wing and Assistant Town Clerk who heads the technical wing. Under these Divisions are lower Councils numbering twenty-five parishes or wards (LC II) and sixty-six villages. This administrative set-up was of concern to the study because all officers in the respective positions have a hand in the general welfare and sanitation hygiene matters in the municipality.

### 3.3 Study Approach

The study employed an investigative approach within the municipality. All the four divisions were selected to collect clear opinion from all the divisions' representatives to avoid bias assumptions for detailed information and findings.

#### **3.3.1 Basic Assumptions**

The study was based on assumption that solid waste management system in Lira municipality has never been effective. This idea was rooted on the paradigm of Urban sustainability theory and practice (James, 2014) that; 'Cities are at the heart of the problems facing this planet, but developing a positive and sustainable mode of urban living is the only way that we will be able to sustain social life as we know'. It was thus under taken to give a clear understanding on solid waste management in Lira municipality and document its constraints, opportunities and factors affecting it.

#### 3.3.2 Sample Design

Across-sectional research design was used in the study. Households were randomly sampled to avoid biasness and the sampled ones provide the information that would be representative of what the other non-selected ones would provide since they are on the same locality and getting the same management services. Lira municipality comprises four divisions. All the divisions were visited and were purposively selected 5 parishes each. However, in Adyel division was selected 6 parishes because Railways division which it shared boundary with has only 4 parishes provided an advantage to select one other parish from Adyel division due to its wide area coverage and bigger population of households (sampling by replacement mode). Each of the 5 parishes was purposively selected and within these parishes five villages were selected on condition that they fall within the radius of municipal waste management operation since other areas had just been newly brought under municipal administration but had not yet been put in the waste management system by the waste management authority due to infrastructure and planning in which they had not been into; making a total of 20 parishes. From each parish was randomly selected five villages based on probability choice that any would fall within the cording of between 1 to 5 as written and

picked by the researcher and his work force of the research assistants. From each village the researcher chose ten households at random as the results would give the real painting which could still be realized from others not selected as they all fell in the same location. The household target was on household heads irrespective of whether male or female. This made the total population of 200 households as proposed by the study.



3.3.3 Sampling frame work

# villages

#### **3.3.4** Sample size and target population

Basing on UBOS (2014) household population of 25,396 in all the four divisions the researcher employed Multi stage household sampling formula (Kish and Hess, 1959) stated below;

$$n = \frac{NZ^2 PQ}{d^2(N-1) + Z^2 PQ}$$

Where: -

n = sample size of housing units

P = Housing unit (residential houses)

Q = Non-residential houses (offices, schools, etc.) = 1-P

N = Total number of housing (living homes)

Z = Standardized normal variable and its value that corresponds to 95 % confidence interval=1.96

d = Allowable marginal error (+/-0.05)

From the current data on municipal survey, there are about 25,396 housing (N): from these about 92% (P) are households and 8% (Q) are non-residential.

Using the given formula;

 $n=\frac{25396(1.96)^2 x (0.92) (0.08)}{(0.08)} = 112.6$  i.e., 113 Households

 $(0.05)^2 (25395) + (1.96)^2 (0.92) (0.08)$ 

To ensure adequate sample an addition of 77 households was made to realize 200 households in expectation for more radiates of households. The study chose to use multi stage sampling because it divides the population in to distinct groups in a way that allows the researcher to act within his means on the desired information as programmed in both time and financial issues. It also allows for flexibility by the study to employ random sampling after determination of the groups.

140 Household heads in total were purposively selected from all the four divisions because they are in charge of waste collection and disposal in their households and provided informed consent to their household members to participate in waste management practices given their knowledge in waste hazards. 36 heads of business units were purposively selected whether Male or Female since they are in charge of waste packaging, collection and disposal in their areas of operation and any ineffective waste management impact negatively on regular customer visits.

20 waste collection crew were included in the study as they provided valid and dependable information on waste constraints, managerial constraints and any other knowledge on collection and disposal effectiveness.

Lastly, the municipal and division officials; especially the 4 assistant town clerks in the divisions were included. This is because they are the spear heads of municipal planning, and are technical supervisors and advisors in case of any technical fault in the municipality.

#### **3.4 Data Collection Tools**

The study used structured questionnaire sheets, direct interview guides, direct observation check lists, camera, focus group discussion guides, and weighting scale.

#### 3.4.1 Survey questionnaires

Two sets of structured questions were designed for the households and business units (solid waste generators) and for solid waste collectors - **Appendix 1 and Appendix 2**. The questions were grouped into sections based on the study objectives such as: bio data of the respondent followed by characteristics of solid wastes generated, collection and dumping system, examination of efficiency and reliability of the management system, constraints and opportunities in solid waste management. The questions were a mixture of open and closed ended. The questionnaire was pre-tested in the near- by villages before actual implementation in the field. The questionnaires were carried by the people administering the study to each of the households identified in the sampling. Direct questions would be asked to the solid waste generators and collectors in a way of sharing views on waste collection, disposal practices and would write down the responses in a note book as the sharing would be carried out. This

would give time to both the waste generator respondents, solid waste collector respondents and the researcher to seek for clarification on issues not well perceived in the course of the face-to-face sharing.

#### 3.4.2 Interviews with key informants

Interview guide was used in the study to collect detailed data from the key informants namely the 4 municipal division assistant town clerks in the four divisions and the 4 purposively sampled leaders of Lira main market, Atat market and Kakoge market; all within the municipality - **Appendix 3**. The study administered interviews using interview guide in order to gather information on managerial processes of waste like waste segregation, temporal dumps, and transportation to final disposal sites, waste carriage vehicles, and waste security wares. The interviews were office based in the respective work stations for technical staffs such as the assistant town clerks while the leaders of business units were interviewed in their work places. The study chose key informants because technical persons such as the assistant town clerks are technical planning personnel who have clear information on what is lacking and the available ones and leaders of business units have basic information on actual management practices in use.

#### 3.4.3 Direct observation

The study used direct visualization to prove waste packaging system such as waste storage items like sacks, old cans or collection bins or even back yard storage in homesteads. Direct field observations were made to ascertain whether the wastes were sorted and stored differently in containers or not. It was also used in waste dump site analysis. This helped to prove the actual practices on ground, view the waste composition and gauge both household and waste collectors' knowledge as pertains waste management from physically visualized practices.

#### **3.4.4 Documentation**

The digital camera was used to take photographs of the existing setting in the field; especially collection points, illegal dumpsites, temporal street side dumps and refuse bins, illegal waste dumps in water trenches. The method was used to expose to the public what others do in managing waste in their areas.

#### **3.4.5** Focus group discussion

Focus group discussions were convened by the researcher after consultation with the assistant town clerk of Ojwina division, leader of Lira municipal main market venders and central division waste collection crew. The discussions were scheduled on two different days.

The one for central division took place at 10:00 am and that of Ojwina took place on the second day at mid-day. The discussions comprised of 12 members of which 1/3 were female representatives; having 4 representatives from business persons from Lira main market, 4 local council representative, 2 leaders of waste collection crew and 2 representatives from the technical team of the divisions.

The strategy was used in data collection because it enables the researcher to get in-depth information about the study in question – **Appendix 4.** It is flexible and therefore allowed the researcher to apply mind probing questions so as to realize the required information from the respondents.

#### 3.4.6 Household solid waste weighing

The researcher used 2 pieces of medium single sided glass face reading weighing scale of 100-kilogram net weight. Empty sacks of 50kg weight were provided to the sampled homes. sack was labeled using marker pens with writing such as vegetable matter, food waste, plastic, glass etc. depending on what they wanted the home dwellers to put the particular type

of waste and this would be checked and measured by the researcher and his assistants after every two days for at least three times in two weeks in a particular household and results recorded for each computation. This was done in all the sampled households and business units to establish the type of waste usually generated in the municipality with weighted amounts to avoid assumptions.

The weighing scale was first checked, tested and stamped by the Uganda bureau of standards Lira municipality office for its efficiency and reliability.

#### 3.5 Data Analysis

The collected data was analyzed using two different strategies. This was the descriptive strategy and inferential mode.

#### **3.5.1** Descriptive strategy

In this case information on socio-demographic characteristics of the respondents, solid waste categories, collection and dumping operations from interview guides and questionnaires, focus group discussions, and key informants was coded using numerical values (1, 2, 3...) and their computed response sums analyzed using SPSS(**IBM**,**2009**) statistical tool package and the data grouped in to descriptive percentages, frequency tables and pie charts to explain.

Direct visualization from observation check lists and photography information were analyzed using personal judgment by the researcher. Descriptive narratives and quotes supported by illustrations was also be used to present some result.

#### 3.5.2 Inferential mode

The study used this strategy to establish the cardinal factors that influence the ways the wastes were being collected and dumped in the various divisions of the municipality.

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In this case the study employed a statistical model (Binary Logistic Regression by Berkson, J.C,2002) which was appropriate, as it took only one of two possible values. The study chose to use the model from experience that most scholars have ever applied it in determining such phenomena and ever yielded best and the expected out comes. The formula for the analysis is: Y=B0+Bx1+Bx2+Bx3.....; where X—independent variables influencing the collection and dumping of municipal solid waste and Y—dependent variables is the result to be measured.

The variables measured in the study were age, duration lived in the place(years), presence of waste collection services, who is in charge of the provision, types and states of waste packaging containers, adequacy of dumping space, presence of waste by-laws and its enforcement etc.

The variables named were coded and assigned numerical values (1or 2) to stand for either 'Yes' or 'No' for the asserted question being tested as shown in **table 3.1**.

**Table 3.1**: Showing variables used in testing the asserted question

VARIABLE	CODE	DATA ENTRY
Personal factors		
Age bracket	Age	(18-25) =1, (26-ABOVE) =2
• Year lived in community	Duration	(1-5  yrs.) = 1, (6-above) = 2
Education level	Education	Primary =I, secondary-above =2
• What is use for carrying waste?	Container	Old bucket/sacks =1, waste bins=2
Waste Management Factors		
• Availability of waste collection services	Waste services	Yes =1, No =2
• Who is in charge of collection?	In charge	Municipal government=1, private collectors =2
• Presence of adequate collection space	Space	Yes =1, No =2
Sensitization on waste problems	Sensitization	Yes = 1, No=2
• Availability of waste dumping by- laws	By-laws	Yes=1, No=2
• Who enforces the waste By-laws?	Enforcement	Local councilors=1, health workers=2
• Has Legal steps been taken against illegal disposal?	Legal steps	Yes=1, No=2
Attitudinal factors		
• Are you willing to pay for collection?	WTP	Yes=1, No=2
• Are there any gains in solid waste?	Gains	Yes=1, No=2

However, before using the Logistic Regression Model to analyze the collected binary data, suitability tests to the Model was carried to ascertain the following;

(1) Multi-collinearity: Multivariate correlation analysis was used to determine the correlation among independent variables, so that if the Pearson correlation was more than 0.5, then there would be multi-collinearity and when the correlation coefficients are less than 0.5, then the model would not be affected by the multi-collinearity among the predictors. The variance inflation factor was also used in this study and it was less than two in all predictor variables, confirming that there was no multi-collinearity problem. (2) Chi-square and R-square values: Chi-square was used to test the null hypothesis ( $H_o$ ). The logistic regression model achieves a goodness of fit when the Chi-square test statistics are highly significant at 1.0% (p < 0.00001). In this study, the R-square value of the Cox and Snell test, and the Nagelkerke test would be between 0 and 1 which supports the goodness of fit of the model.

(3) Percentage: When the value of the Percent Correction Prediction is high, this means that the ability or the accuracy of the prediction is high.

#### **CHAPTER FOUR**

#### PRESENTATION, ANALYSIS AND DISCUSSION OF FINDINGS

### **4.1 Introduction**

This chapter presents analyses and interprets and discusses the study findings on solid waste management system, constraints and opportunities in Lira Municipality, Northern Uganda. It is done according to themes and sub themes derived from the study objectives based on field findings from the study questionnaire and interviews, focus group discussions, photography, direct observation, household solid waste weighing and interaction with key informants.

The socio-demographic information of respondents and response rates are also considered.

#### **4.2 Demographic characteristics of respondents**

The demographic characteristics of respondents that were analyzed included gender, age bracket, level of education, occupation, and time lived in the place by the respondent as displayed in **table 4.1**.

Variable	Description	Frequency(N=200)	Percentage
	-		(%)
Gender	Male	71	35.5
	Female	129	64.5
Age bracket	(20-35)	102	51.0
	(36-60)	42	21.0
	(60-above).	36	18.0
Education	None	21	10.5
	Primary	49	24.5
	Secondary	96	48.0
	Tertiary	34	17.0
Occupation	Farmer	53	26.5
	Public servant	33	16.5
	Driver	10	5.0
	Teacher	28	14.0
	Business man	76	38.0
Duration of stay.	Less than 1 year	9	4.5
	1-5 years	21	10.5
	5-10 years	45	22.5
	10 years-above	125	62.5

Table 4. 1: Der	nographic	characteristics	of	responde	ents
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Source: Primary data march 2019

#### 4.2.1 Gender

**Table 4.1** indicates that the population of female household heads, which was 64.5% of the study respondents, was greater than the male population which was 35.5%. This depicts that women in all areas of the municipality are the most available care givers in homes and business units followed by men. This finding is consistent with a previous study by Abanyie et al (2017) in Bawku municipality in Ghana which established that in solid waste management, especially in developing countries, women play a decisive role; and that waste management in households is basically a woman's job in these countries because they are directly concerned with household chores.

# 4.2.2 Age

The findings show that Lira municipality is highly comprised of young people aged 20-34 representing 51.0% of the study respondents, and few people at late ages of 60 years and above representing 18% - (table 4.1).

This indicates that strong and able-bodied active people form the biggest part of the population than elderly dependant age group. Lira is thus a municipality of active and productive dwellers expected to uphold high level of sanity. This age range comprise active hard -working people who also generate more solid waste as they usually consume more as they work. This finding is consistent with a report of the international conference on sustainable solid waste management held in Cyprus (2016) which observed that waste generation per capita increases highly as people in medium age bracket consume more as they work.

#### 4.2.3 Education

The study shows that Lira municipality is dominated by mostly literate people who received secular education (89.5%). Also, a greater number of municipal occupants received secondary education level (48%), followed by primary level (24.5%), tertiary level (17%) and very few (10.5%) that never went to school (**table 4.1**).. This reveals that Lira municipality has mostly literate occupants who have good knowledge scope to up hold sanity in their environment but could be handicapped by some other factors that the study endeavored to find out. This finding is in line with the observation made by Juma and Miraji (2018) in East Africa while comparing environmental challenges of economic development with that of China saying that Education is crucial for effective environmental management because it significantly affects the economy and the livelihood choices of people. To this finding therefore, absence of improved access to formal education in consideration of the reduction

of illiteracy rates, environment-friendly-related issues and practical education, as well as the continuation of few opportunities available to most people negatively impact the environment.

#### 4.2.4 Occupation

**Table 4.1** indicates that most household occupants in the municipality were found to be business people (38%), followed by farmers (26.5%), public servants (16.5%), teachers (14%) and those employed in the transport sector (5%). People in high profit maximization sectors; especially business/trade and progressive agricultural ventures were able to acquire many homes in the municipality than people employed in non-profit maximization and service delivery; and public servants. It was established that all these categories generate solid waste that has to be managed at both household and municipal level. This arises from the fact that urban places welcome people of various categories with varied economic and social interest.

#### 4.2.5 Duration of stay

**Table 4.1** depicts that the municipality is highly settled by those born there and emigrants who had spent more than a decade there (62.5%), and those who had spent less than one year (4.5%). However, all these categories of people contribute to solid waste generation in their sustenance in the municipal setting since they had spent there a fairly longer duration in terms of years which calls for waste management for endowment of sanity in the municipality. They therefore gave reliable information pertaining to status of solid waste management in Lira municipality given the duration they had spent and had seen all on the municipal solid waste management sector.

Findings from focus group discussion and key informants revealed that period of stay doesn't matter much on solid waste issues in the municipality since all who either stay or just call

briefly in the municipality contribute to generation of solid waste in the waste streams that require management to provide sustainable sanity in the municipality.

# 4.3 Characterization of solid waste and analysis of collection operations and disposal system

#### 4.3.1 Solid waste types

The study characterized the solid wastes into two broad categories of Bio degradable and Non bio degradable wastes on the basis of their ability to decompose. Solid waste that can decompose was categorized as Bio degradable while that which cannot decompose was characterized as Non-biodegradable as summarized in **table 4.2** 

Table 4. 2: Weighted solid waste characteristics per divisions in Lira municipality

`Waste	Waste	Adyel	Central	Ojwina	Railways		% age	Cumulativ
characteristics	Types	Division	Division	Division	Division	Totals		e %age
(kgs)								
Bio	Vegetation	46	42	60	38	186	31.9	31.9
degradable	matter							
	Food waste	36	40	44	16	136	23.4	55.3
	Papers	06	08	07	04	25	4.3	59.6
	Saw dust	-	03	93	15	21	3.6	63.2
Non Bio	Plastic	20	38	42	05	105	18.0	81.2
degradable	Polythene	17	21	39	12	89	15.3	96.5
	Street debris	02	08	06	01	17	2.9	99.4
	Glass	-	03	-	-	03	0.5	99.9
Total quantity		127	163	201	91	582	100	100
Total %age		21.8	28	34.5	15.6	100	100	

Source: Primary data march 2019

**Table 4.2** indicates that organic bio degradable solid wastes accounting for 63.2% of all solid wastes weighted are the most common type of solid wastes in the waste stream; and are composed of vegetation matter (31.9%), food waste (23.4%), saw dust (4.3%) and paper (3.6%) in each of the division in the municipality respectively. This is indicated to be followed by in-organic non bio degradable solid wastes accounting for 36.7% of the weighted

wastes which is in turn comprised of plastic (18.0%), polythene (15.3%), street debris (2.9%) and glass (0.5%). Organic bio degradable matter is thus in greater use in Lira municipality than in-organic non bio degradable matter as seen from the findings.

This finding is in agreement with a report from the study by Franca et al. (2018) which revealed that much of the solid waste produced in African cities has high percentage of organic waste which was estimated at 57%, while 13% was plastic, 9% paper,4% glass, 4% metals and 13% was other materials which are usually with high moisture content. This pattern of organic bio degradable wastes was observed to arise as a result of being located within the tropical belt which supports growth of many herbages that constitute larger percentage of people's diet. Plastic could be from use of packed bottle water in fear of pipe water which many people believe is contaminated by leachates from garbage soup into the springs and pipe perforations.

The current study however shows a unique pattern in that on any type of waste generated, vegetation matter and plastic would be most generated with street debris always inclusive. But the greatest pattern of usage is generally bio degradable matter. Another unique finding from the study shows that street debris which would be neglected from waste classification is gaining prominence in the waste streams as opposed to glass in all the four divisions of the municipality (**table 4.2**). The study finally reveals that the most generated waste in the solid waste streams in Lira municipality comprise organic bio degradable matter.

**Table 4.2** further reveals that the largest amount of solid wastes weighted were from Ojwina division (34.5%), followed by Central division (28.5%), Adyel division (21.8%) and Railway division (15.6%) respectively. The pattern of distribution of the collected forms of solid wastes in the different divisions of the municipality is depicted in **figure 4.1**.



# Figure 4. 1: Showing Distribution of solid waste characteristics identified per Division in the municipality

Source: Primary data march 2019

# 4.3.2 Solid waste collection and disposal

Solid waste collection and dumping operation in Lira Municipality was established to follow a number of stages ranging from source or household storage, collection to the temporary point, final collection to the dumping site and finally disposal itself. Results about the collection and dumping operations are summarized in **Table 4.3**.

Variable	Description	Adyel Division	Central Division	Ojwina Division	Railways Division	Totals	% age
Storage	Backyard/ throw any where	21	7	19	22	69	34.5%
	Polythene bags	6	17	13	14	50	25%
	Waste bin	15	14	10	6	45	22.5%
	Refuge sacks / old cans	8	12	8	8	36	18%
Collection entity	Lira municipal council	37	46	41	42	166	83%
	Private waste collectors	13	4	9	8	34	17%
Dumping	Open dumping	26	20	13	16	75	37.5%
	Land fill	12	18	12	12	54	27%
	Open burning	5	6	10	10	31	15.5%
	Composting	2	2	7	8	19	9.5%
	Sell to users	5	4	8	4	21	10.5%
Who collects	Children	7	2	10	14	33	16.5%
and takes	Wife	11	5	6	8	30	15%
temporal collection	House keeper	9	6	8	5	28	14%
points	Hired labor	23	37	26	23	109	54.5%

 Table 4. 3: Solid waste storage, collection and disposal operations by divisions.

Source: Primary data march 2019.

# 4.3.2.1 Household storage

Table 4.3 indicates that source/ house hold storage is done inform of back yard/ throw anywhere, polythene bags, refuse sacks or old cans and waste bin. It is indicated that the

traditional back yard mode is still high (34.5%) though at a close range with polythene bag (25%). This finding is in conformity with what Tassie- Wegeddie (2018) established in Bahir City-Ethiopia that households without communal collection container or personal collection containers use two options namely; simply burning, burying or dumping of solid waste in compounds, or throwing waste indiscriminately at road sides and open fields. The current study established that household areas most contaminated with solid waste heaps had no waste packaging containers in their households and the descent surroundings' households had personal containers or would be nearer to community collection container sites. This study clearly reveals that solid waste collection container is a function of household sanity in any municipal setting.

#### 4.3.2.2 Solid wastes collection to temporal collection point

Most households use hired labor (54.5%) to take their solid waste wastes to temporal collection points. (**Table 4.3**). This finding is in agreement with an earlier study by Tassie-Wegedie (2018) in Ethiopia who observed that households in the low and medium density zones receive door to door solid waste collection due to their willingness to pay some fees to the collectors for financing waste management to improve their conditions. Since a greater number of municipal dwellers in Lira Municipality are business people and civil servants, they would prefer to use hired labor in the form of door-to-door collection due to their willingness to pay. Household heads would not mind where the waste would end up be it on the road side or at the designated points provided it has left their home stead.

#### 4.3.2.3 Solid waste collection to disposal site

**Table 4.3** indicates that Lira municipal council takes greater responsibility in solid waste collection in the whole municipality (83%). This finding is in conformity to the Public Health Act, 1964; Local Government Act, 1997 which stipulates that the Engineering department within the local government of each district or Municipality is held responsible for provision of transport and collection facilities for solid waste while NEMA and Public Health Department bears responsibility over environmental protection. This means that for any private organization to be involved in waste collection it should be mandated by the municipal council authority with clearly endorsed mutual agreement. This explains why Private waste collectors are not so much recognized in solid waste management making most people not involve in it as a business enterprise.

#### 4.3.2.4 Solid waste disposal

**Table 4.3** shows that solid waste in Lira municipality is disposed off mainly by open dumping (37.5%) followed by land fill (27%). This finding is consistent with earlier study findings by Kassahun (2018) and Tassie (2019) which reported that open dumping is the most widespread method of solid waste disposal in most urban centers in developing countries and it typically involves the uncontrolled disposal of waste without measures to control leachate, dust, and odors. This shows that people yet don't clearly distinguish between land fill and open dump making them not feel bad whether waste are dumped in the open provided it has left their court yard - **figure.4.2**. The study revealed that very few people in the municipality look at solid waste with monetary face value a reason as to why few responses were realized on waste composting and sale to users or recyclers.





#### 4.4 Factors influencing solid waste collection and disposal in Lira municipality

After considering the coefficient of the independent variables (**Table 3.1**) and the level of significance of such coefficients (**Appendix 5**), the factors influencing collection and dumping of solid waste in Lira municipality were established as shown in **Table 4.4**.

Variables	В	S.E.	Wald	Df	Sig.	Exp(B)
Age _Bracket	1.564	.393	15.861	1	***.000	3.838
Duration in the community	1.151	.600	3.680	1	.055	3.162
Level of Education	801	.424	3.561	1	.059	.449
Types of Container for carrying waste	2.220	.526	17.827	1	***.000	8.883
Availability of Waste collection service	-21.441	4.938E3	.000	1	.997	.000
Responsibility of waste collection	2.257	4.101E4	.000	1	1.000	9.554
Willingness to pay for wastes collection	-15.318	4.142E4	.000	1	1.000	.000
Waste by-laws existence	.357	.569	.393	1	.531	1.428
Enforcement of waste by- laws	.662	.570	1.351	1	.245	1.939
Availability of Bylaws	545	.400	1.856	1	.173	.580
High benefits of waste re use	957	.723	1.754	1	.185	.384
Availability of Adequate disposal Space	-4.403	1.077	14.737	1	***.000	.012
Sensitization on waste management	2.589	1.310	3.903	1	.048	13.311
Evidence of Legal steps taken on indiscriminate dumping	-5.156	2.078	7.600	1	***.008	.006
Constant	37.846	7.633E3	.000	1	.996	2.731E16

 Table 4. 4: Results of analysis of factors influencing collection and dumping solid waste

Source: computed field data march 2019

#### 4.4.1 Age bracket of solid waste generators

**Table 4.4** indicates that age bracket of solid waste generators was established to be very cardinal: This variable had a coefficient of 1.564 and significance level of 0.000 which is below 0. 001, with marginal effect of 3.838. This implies that any increase in age would raise effective waste collection and dumping by 38.38% due to their safe environmental awareness and concern. This is because the greatest age range involved in the study comprised people below 30years of age.

This finding is consistent with an earlier study by Keita Mamady (2016) in West Africa where people aged between15-25years were found to be the ones that dispose solid waste in open land spaces. This means that with increase in age people become more aware of their surrounding hygiene and solid waste packaging in their area. The study reveals that increase in age generates personal conviction and love for descent surrounding. This explains why homes settled by elderly people are more descent because they package their solid waste carefully.

#### 4.4.2 Type and condition of waste containers

Containers used to carry waste to the central collection point were also revealed to be an important factor in solid waste collection and dumping. **Table 4.4** indicates that this variable had a coefficient of 2.220 and a significance level of 0.000 which is below 0.001 and also giving a marginal effect of 8.883. This implies that any improvement in solid waste packaging and carrying items would give conducive condition while taking waste to the central dump by 88.83%. Issues of spillage or soup dirtying the taker will not arise.

This finding is in agreement with observation by Felice, (2014) who noted that Containers should be durable, easy to handle, economical and resistant to corrosion, should be seated in the proper location of distance, convenient, compatible and safe. Keita Mamady (2016) in his

earlier study in Guinea also observed that tall containers may be difficult for children to use, so that more waste ends up dumped outside the container. The study thus reveals that solid waste storage and carrying container to the dump site matter a lot. Issues of spillage or garbage soup dirtying the garbage collector will not arise if it the container does not have perforations. If it has a lead/ cover the stench will not disturb or attract flies that would irritate the person taking it to the dump site.

#### 4.4.3 Presence of adequate disposal space

Adequate dumping space had a coefficient value of -4.403 and significance level of 0.000 which is below 0.001 and a marginal effect of 0.012 (**table 4.4**). This is really absurd state. Such a marginal effect of 0.012 implies that failure to secure some more and adequate temporal dumping spaces will always increase indiscriminate dumping by 1.2% as opposed to effective collection and disposal practices.

This finding agrees with Awumbila (2017) who established that increasing per capita generation of solid waste and the lack of land conveniently situated for waste disposal, point to a rapid further aggravation of the already acute problems of solid waste management. The study reveals that in areas without adequate solid waste dump space people don't feel the shame of defiling the surrounding with waste because they would have rooms for excuses unlike in areas with enough space where one would have no explanation for indiscriminately throwing their wastes.

#### 4.4.4 Legal enforcement/ step against illegal disposal

This variable had a coefficient of -5.156 and significance level of 0.008 which is quite below 0.001 and a marginal effect of 0.006 (**table 4.4**). With the marginal effect of 0.006 means that failure to prosecute any caught practitioners of indiscriminate disposal will lead to degeneration in effective waste collection and proper dumping by 6%. This means that those

dwellers that have personal conviction to maintain good hygiene will package and dump their solid waste in designated central collection point without any forceful reminders and fears. This finding agrees with earlier observation by Yukalang et al (2017) who noted that lack of enforcement of policies and laws is a major institutional issue that greatly contributes to the mismanagement of solid waste in the developing world. The study reveals that transforming written by-laws into real practice is very important since it creates self-awareness as people will always believe in reality and not hear says. Those convicted in the court of laws or punished against indiscriminate / illegal dumping would act as live reference to the others.

The current study however established that factors such as Education, attitude, sensitization, willingness to pay, and budgetary constraints do not affect solid waste collection and dumping in Lira municipality although they may still be prominent factors in other municipalities. For instance, socio-cultural factors among the people of Mbale municipality or Moroto town may be considered eminent and would need to be sensitized on dangers of coping with solid waste in their environment in order to embrace effective collection and dumping to avoid indiscriminate disposal of solid waste and have environmental sanity.

# 4.5 Households' perception on efficiency and reliability of solid waste management system.

The statement of efficiency and reliability was used to bring out the household perceived performance of solid waste management system in Lira municipality. The current study used the terms efficiency and reliability as indicators to measure the performance.
	Variable	Description	Adyel	Central	Ojwina	Railways		%
			Division	Division	Division	Division	Total	age
EFFICIEN	Collection	Daily	30	46	42	36	154	77
CY	frequency							
		Weekly	20	04	08	14	46	23
	Time of	Day time	46	42	44	48	180	90
	collection	Day and night	04	08	06	02	20	10
	Transport	Yes	12	26	12	17	67	33.5
	adequacy	No	22	16	27	20	85	42.5
		I don't know	16	08	11	13	48	24
RELIABI	Mechanica	Poor	36	40	42	44	162	81
LITY	l condition	Good	14	10	08	06	38	19
	of vehicles							
	collection	Not availed	28	06	14	36	84	42
	Coverage							
		Availed	22	44	36	14	116	58
								•••
	Existence	Aware	14	10	16	36	76	38
	of waste			-	-			
	by-laws	Not Aware	36	40	34	14	124	62
	•							
	Entity that	Local councils	26	30	31	20	107	53.5
	enforces							
	the	Environmental	06	04	03	12	25	12.5
	by-laws	scouts						
	-							
		Hygiene	08	06	06	12	32	16
		officers						
		All the above	10	10	10	06	36	18

 Table 4. 5: Perception on Efficiency and Reliability

Source: Computed field data, (March 2019)

# 4.5.1 Perception on efficiency of solid waste management operation

Focus here was on the collection frequency, collection entity, time at which collection operation takes place, and transport mechanism adequacy as summarized in **table 4.5**.

# **4.5.1.1 Collection frequency**

**Table** 4.5 indicates that solid waste collection frequency in Lira municipality is on both daily

 and weekly basis. However, more collection was indicated to be done on a daily basis (77%).

 Findings from focus group discussion with waste collection crew revealed that the collection

 done on daily basis was mainly in the heart of the municipality; especially within the central

business district which covers parts of Ojwina division, and Adyel division. Daily waste collection in these areas is usually higher than the peri-urban household areas whose collection is quite minimal and can be done once in a week. Waste collection pattern is therefore determined by the accumulation quantity and its regularity. This finding disagrees with study reports by Mukama et al, (2016) in some East African cities and by Arogndade (2018) in the Horn of Africa which cited irregular collection services and low collection coverage.

The unique issue with Lira municipal solid waste collection strategy is that waste collection pattern is determined by the generation quantity and its regularity. Uniqueness is also in the high level of co-ordination and collaboration between the Municipal/ Local government leaders, Lira media houses, the health and environment department and the municipal dwellers who report missing links that are sorted immediately.

#### 4.5.1.2 Time of collection operation

**Table 4.5** indicates that solid waste is collected mainly during day time as reported by 30% of respondents. Interview with the town clerks of the four divisions, and solid waste collection crew indicated that solid waste operation in the municipality takes place only during day time; especially in the early morning, afternoon, and late evening hours.

# 4.5.1.3 Transport mechanisms adequacy

**Table 4.5** indicates that there is inadequate number of solid waste collection vehicles to manage services in the whole municipality as represented by 42.5% of responses. Interview with the municipal technical staff also revealed that there is inadequate number of vehicles to manage the whole municipality waste collection services. This finding agrees with that of Aryampa (2019) who reported that most cities in Uganda would require additional garbage trucks; citing that Kampala city authority would require support of 50 garbage trucks to

achieve the required level of operation. Inadequate number of garbage trucks therefore presents handicap to Lira municipal council to effectively manage solid waste works.

#### 4.5.2 Perception on reliability of solid waste management operation

The perception of reliability of solid waste management system was established to be related to the mechanical condition of garbage trucks, solid waste collection coverage, existence of waste by-laws, and their enforcing entity (**table 4.5**)

#### 4.5.2.1 Mechanical condition of garbage trucks

**Table 4.5** indicates that the garbage trucks in use are in very poor mechanical condition as depicted by 81% of the respondents and would constantly break down and could not meet the desired out- come. This finding revealed a state of unreliability. This finding agrees with an earlier study finding by Ma and Hipel (2016) in Ghana and by Mugweri and Oonyu (2019) in Kampala city which established that the garbage trucks were in poor condition causing constant breakdowns on the roads rendering collection processes unreliable and ineffective.

# 4.5.2.2 Coverage of collection operations

It was established that all areas in the municipality are not yet covered by solid waste collection operations of the municipal council as depicted by 58% of the respondents (**table 4.5**). This reveals that only areas within a closer range from the originally planned locations receive municipal solid waste management services. This finding is also consistent with an earlier study by Ahsan et al (2014) in India which stated that the unplanned city settlements make it difficult for Solid waste collection services to reach all the areas.

# 4.5.2.3 Existence of solid waste by-laws

**Table 4.6** further indicates that 62% of the respondents revealed that they were not aware that solid waste by-laws were in existence in Lira Municipality. Focus group discussion also

indicated that solid waste by-laws do exist but its advocacy and implementation is not strictly adhered to by the implementers and the community as well. The study thus noted that waste management by-laws do exist but they aren't being implemented. This finding is in agreement with earlier studies by Akpoborie (2011) in Benin Metropolitan City and also with Okot-Okumu and Nyenje (2011) in the cities of East Africa which revealed that legal constraints affecting waste management such as inadequate enabling laws, regulations, standards, policies and enforcement of the existing laws, political interference and weak penalty.

#### **4.5.2.4 Entity that enforces the by-laws**

Implementation of solid waste management by-laws has been left in the hands of lower local council leaders (Lc.1 and Lc.2) and village health team as depicted by 53.2% of the respondents (**table 4.5**). Focus group discussion revealed that Local council leaders are supposed to implement solid waste management by-laws together with municipal health officers and municipal environmental scouts but the latter have neglected their duties. This indicates a state of unreliability in the operation.

# 4.6 Constraints and Opportunities of Municipal solid waste management in Lira municipality

The statement of constraints and opportunities of solid waste management was used to bring out the challenges and benefits of solid waste management in Lira municipality. Constraints refer to the challenges or problems usually met in solid waste management while opportunities refer to gains that accrue out of sustainable solid waste management practices.

# 4.6.1 Constraints

The study focused on challenges encountered in collection, transportation, and disposal of solid wastes and categorized the solid waste management constraints into collection

constraints, sorting constraints, transporting constraints, and disposal constraints as depicted

in table 4.6.

Constraints	Operation	Descriptio	Adyel	Central	Ojwina	Railways	Total	%
	-	n	Division	Division	Division	Division		age
Collection	Collection point	Adequate	9	9	8	22	48	24
Concetion	Concetion point	Not	41	42	42	$\frac{22}{28}$	153	76
	Peoples'	Good	18	26	20	22	86	43
	attitude	Poor	32	25	30	29	116	58
	Waste bins	Adequate	20	26	18	20	84	42
		Not	30	24	32	30	116	58
Sorting	Waste sorted	Yes	10	17	18	11	56	28
		Not	40	33	32	39	144	72
	Safety gears	Yes	10	12	14	10	46	23
	used	No	40	39	36	39	158	77
	Storage	Adequate	16	33	17	20	86	43
	facilities	No	34	17	32	30	114	57
Transport	Collection	Adequate	8	4	4	8	24	12
	trucks	Not	42	46	46	42	176	88
	Area	Yes	32	30	28	30	120	60
	accessibility	No	18	20	22	20	80	40
	D' 1		0	4	6	1.4	20	1.0
Disposal	Disposal space	Adequate	8	4	6	14	32	16
	A	NO 1	42	46	44	36	168	84
	Attitude	Good	18	22	12	24	/6	31
	<b>T</b> 1	Poor	32	28	31	34	125	03
	Legal	Yes		22	19	18	/6	38
	enforcement	NO	33	28	30	33	124	62
Opportunities	used							
Opportunities	Source of		12	26	21	17	76	38
	earnings	-	12	20	21	17	70	50
	Source of	_	11	19	17	15	62	31
	employment		11	17	17	15	02	51
	Saves	_	10	15	13	12	50	25
	environment							
	from flies							
	Source of	_	2	5	3	2	12	06
	revenue from		-			-		
	composting							

 Table 4. 6: Constraints and Opportunities in waste management in Lira municipality.

Source: Computed field data; (March 2019)

#### **4.6.1.1 Collection constraints**

**Table 4.6** indicates that the biggest problem in solid waste collection is inadequate space for collection; especially for temporal dumping to await final disposal collection as indicated by 76% of the study respondents. It is because of this that some less busy streets are were temporarily dumped with wastes at road sides during late evenings to be picked very early in the mornings by the municipal waste crew (**fig. 4.3**). This was revealed to be a result of lack of government owned land in the Municipality.



Figure 4. 3: A Road side solid waste dump. Source: Field photograph; Rwot Aler road (March 2019)

Lack of safety precautions at collection point was indicated to be another solid waste collection constraint accounted for by 77% of the respondents (**table 4.6**). Solid waste crew does not wear protective gears such as nose masks, mouth masks, over rolls, gum boots, and rubber gloves during collection, and also at sorting. This shows that their health as well as safety is therefore not so much considered thus exposing them to respiratory tract infections and other skin infections. This finding is consistent with a report by Okot-Okumu (2012) in

East Africa which noted that most solid waste workers do not use protective gears during their work which render them vulnerable to health problems.

The poor attitude of workers ranked at 58% (**table 4.6**) was identified to undermine the solid waste collection operation. This is largely responsible for the workers' failure to sort waste collected from households and from temporal dumps sites.

Lastly, inadequate storage facilities were also registered among constraints here and ranked at 57% of the respondents through household survey –**table 4.6**. Commonly used were old sacks, old buckets which would easily break up during waste transportation to temporal collection points as generators usually put all wastes in the same container. No any other container was provided for waste sorting/ separation.

#### 4.6.1.2 Sorting constraints

Lack of sensitization of people on solid waste handling was identified here. Here people are not given precautionary measures to take when handling wastes yet they lack knowledge in chemical content of certain wastes in the waste streams which render many people vulnerable to skin and respiratory problems arising from improper waste handling.

**Table 4.6** indicates that people not sorting or poorly sorting wastes collected is a constraint depicted by 57% of respondents from the survey. This arises from either attitudinal problems or inadequacy of storage items. This renders problems in waste composting practices.

**Table** 4.6 further indicates that lack of safety gears to use during waste sorting was a constraint. This is a clear indication that waste handlers have high risk of injuries from sharp items or chemically corrosive substances in waste streams they handle. The issue of poor wastes handling such as not sorting wastes, not being conscious of waste dangers by waste crew and household people goes hand in hand with inadequate sensitization on solid waste

handling techniques. This finding agrees with prior study by Mrayyan and Hamdi, (2006) who held that the low level of awareness regarding the health and environmental impacts of improper management of solid waste makes it difficult to implement recycling and disposal programs in many developing countries. This knowledge gap affects success of activities like composting and recycling.

**Table** 4.6 further indicates that lack of storage facilities undermines solid waste management as depicted by 57% respondents at sorting stage and at collection stage. This could explain why most household wastes are all stored in only one container. Commonly used were old sacks, old buckets which would even break during transportation to temporal dump sites. This finding is in agreement with what Hazra and Goel, (2009) established in India that poor conditions of containers and inadequate maintenance and replacement of worn-out collection containers contributed to behaviors such as littering and illegal dumping by citizens who felt they could not properly dispose of trash because trash bins and waste services were not properly maintained. It was however noted that households in Lira municipality with waste collection containers were descent while those without them had waste littered all around.

#### 4.6.1.3 Transportation constraints

**Table 4.6** indicates that there are few garbage trucks that are moreover not in good state depicted by 88% of respondents during the study survey. This explains why delayed schedules have arisen under collection constraints. This finding matches an earlier study finding by Sallwey et al (2017) who established that inefficiency and non-reliability in the solid waste collection and dumping service stem from inadequate collection vehicle and in their poor mechanical conditions.

#### **4.6.1.4 Disposal constraints**

**Table** 4.6 indicates that indiscriminate dumping of wastes arising from poor attitude by the community as depicted by 63% of the responses is a constraint to solid waste disposal in Lira Municipality. This is the reason as to why some people in the community still indiscriminately dump wastes in trenches (**figure 4.4**), at road sides and behind isolated unfinished buildings.



Figure 4. 4:Solid waste disposed in a water trench.

# Source: Field photograph; Jinja Camp-Ojwina Division (March 2019)

**Table 4.6** also stresses inadequate space due to land tenure system depicted by 84% of respondents. The findings of inadequate space at-disposal stages is consistent with a previous study by Yukalang et al (2017) in India who found that inadequate disposal ground is a factor that contributes to infrastructural challenges in waste management in developing nations.

Another earlier study by Asase and colleagues (2009) in Ghana had also noted that lack of proper disposal sites in the country resulted into unprotected and uncontrolled dumps, which posed danger to public health, environmental health, waste renewable resources, and jeopardized residential development in these areas. For the case of Lira municipality, it has led to a unique invention in that the municipal waste crew would decide to identify some less busy streets and use the sides as temporal dumps in the evenings pending collection very early in the morning daily (**fig. 4.3**). This explains why some less busy streets are temporally dumped with wastes at road sides during late evenings to be picked very early in the morning by the municipal waste crew. No sensitization on dangers of indiscriminate dumping was also identified. This explains why such scenario of indiscriminately dumping wastes in trenches, at road sides and behind isolated un-finished buildings would arise.

Lack of legal enforcement by government on illegal dumping was also identified at dumping stage depicted by 62% of respondents (**table 4.6**). This means that if solid waste by-laws were being strictly enforced by all stake holders at all levels, indiscriminate dumping of solid waste would be curbed down. The findings are consistent with earlier submissions by (Al-Khatib et al., 2010) who pointed out that lack of enforcement of policies and laws is a major institutional issue that greatly contributes to the mismanagement of solid waste in the developing world. A case he cited was Kenya that although she had sufficient legislation covering waste management, local authorities lacked the capacity to implement them. Similarly, Henry et al., (2006) also noted that failure by local leaders to mount laws against littering by the community, absence of realistic penalties or consistent enforcement, and lack of knowledge of the environmental effects of littering has had no impact but aggravated solid waste littering. Local leaders in Lira municipality were found to be adamant to sensitization and punishing people against illegal and indiscriminate dumping which to the study is the genesis of these vices.

# 4.6.2 Opportunities

On solid waste management opportunities, the study focused on economic, social, health, and environmental related matters which findings were presented in **table 4.6**.

### 4.6.2.1 Source of earnings

As indicated in **table 4.6**, 38% of respondents revealed that recyclables sorted from solid wastes are a source of earnings for some urban dwellers. It was revealed that recyclables like discarded pieces of iron, plastic water bottles, broken plastic items and metallic scraps such as broken metallic chairs and metallic bars, old discarded car parts are collected by jobless people and later sold to dealers who take them to factories for modification. This is an earning avenue for these unemployed people - (**figs. 4.5** and **4.6**),



Figure 4. 5:A Metallic Wastes buying store

Source: Field photo; Jinja road, Ojwina division (March 2019)



Figure 4. 6: Plastic and Synthetic wastes packed at the buying center.

Source: Field photo; Jinja Road, Ojwina division (March2019)

This finding is in line with previous study reports by Shyam et al, (2017) in India and Simatele et al (2015) in Democratic Republic of Congo who indicated that the recovery of reusable materials as plastics, paper and metals is performed by people working in informal sector driven by poverty. This activity is depicted as a source of income to many poor communities. In Lira municipality metallic and plastic/synthetic product waste of all categories are indeed collected for sale by jobless people and even the municipal waste crews sort these recyclables from the waste streams they collect and again sell to the scrap dealers for survival.

#### 4.6.2.2 Source of Employment

**Table 4.6** indicates that municipal solid waste management is an employment entity as depicted by 31% of respondents. Lira municipal waste crew confirmed that solid waste management has provided them stable and salaried job as street sweepers, waste loaders, and waste truck drivers that some had never hoped to get with their low level of education during focus group discussion. This finding is consistent with a report by UN Habitat (2015) which submitted that every phase of solid waste management right from collection to the final step

of segregation needs man power and ultimately a large number of employment opportunities get opened up. They cited this from the labour statistics provided by the United States government that around 3.1million new jobs are produced due to waste management factors.

#### 4.6.2.3 Health and Life Protection

**Table 4.6** further reveals that solid waste management also saves the environment from flies, mosquitoes and diseases as depicted by 25% of respondents. Waste management activities thus provide a disease and vector free environment when solid wastes are collected and disposed properly as items that would act as their breeding grounds will have been removed. This finding agrees with a documentation by Al-Khatib et al. (2010) who observed that waste management reduces exposure to hazardous matter while contributing sanity and removing the unwanted by-products and pollutants hence providing for a disease free and fresh environment.

#### 4.6.2.4 Source of Revenue to Lira Municipal council

It is also indicated that solid waste provides a revenue stream to Lira municipal council government as depicted by 6% of the respondents (**table 4.6**); especially from sale of compost manure from Aler solid waste composting plant. In this case Lira municipal council receives some revenue from people engaged in manufacture and sale of compost manure to farmers from solid waste at Aler compost yard owned by Lira Municipal Council. This finding agrees with Seadon (2006) which says that the revenues generated by the waste management through recycling and composting would top by \$60 million by 2018. In Lira compost manure is made from sorted biodegradable solid waste from Aler solid waste composting plant. This is usually sold to needy progressive farmers and the revenue goes to Lira municipal local government account. Thus, confirms that it a lucrative investment to the government.

The strength of the opportunities arising out of solid waste management in Lira Municipality is clearly depicted in **figure 4.7**.





Source: Primary data (March 2019)

**Figure 4.7** indicates that the most significant opportunities associated with solid waste management in the municipality are serving as a source of income to some people (38%), employment provision (31%), saving the people from disease carrying pest (28%) and composting of manure for sale by the Local Municipal Council respectively (3%).

#### **CHAPTER FIVE**

#### SUMMARY, CONCLUSION AND RECOMMENDATIONS

#### **5.1 Introduction**

This chapter presents a summary of the major findings established by the study on assessment of the effectiveness of municipal solid waste management system, constraints and opportunities in Lira municipality. The findings are summarized according to the objectives that guided the study. The chapter also makes conclusive remarks concerning the overall achievements of conducting this study in view of the overriding purpose. It highlights the significance of the study in terms of providing a way forward to the problem of solid waste management in Lira Municipality. Finally, policy implications and recommendations that should be undertaken to address the problem of Solid waste management in Lira Municipality presented.

#### 5.2 Summary of major findings

Organic bio degradable solid wastes were established to be the dominant type in the waste stream (63.2%); and also, street debris which would be neglected from waste classification is gaining prominence in the waste streams (2.9%). Traditional back yard solid waste packaging mode was found to be the highly practiced mode of solid waste collection (34.5%). Open dumping was established to be the commonest method of solid waste dumping being practiced in Lira Municipality (37.5%) followed by land fill. Most households in Lira municipality use hired labour (54.5%) to take their household wastes to temporal collection points.

Cardinal factor influencing solid waste collection and dumping were; Legal enforcement/ step against illegal and indiscriminate dumping (coefficient of -5.156 and marginal effect of 0.006), temporal collection/dumping space (coefficient of -4.403 and marginal effect of 0.012), Age of waste generators /municipal dwellers (coefficient of 1.564 and marginal effect of 3.838), and lastly Solid waste packaging and carrying containers (coefficient of 2.220 and marginal effect of 8.883).

Solid waste collection in Lira municipality is done on daily basis in the heart of the municipality and weekly at the peripherals (77.0%) and it is carried out during day time only (90%). The mechanical conditions of the transport mechanisms in use are un- dependable (81%). Solid waste management service in Lira municipality covers all areas (58.0%). There is no any clear statement and implementation of enabling by-laws in waste management in Lira municipality (62.0%).

The constraints established to undermine solid waste management system in the municipality were; inadequate number of waste trucks which cause delay in transportation schedules (84%). Poor attitude by the community towards waste management such as not sorting waste at household levels (72%), inadequate space for temporal dumping to await final disposal collection (76%) leading to temporal road side packing of waste, Lack of protective gears such as; nose masks, mouth masks, over rolls, gum boots, and rubber gloves (77%) to use at work by solid waste crew exposes them to health risks, lack of sensitization and enforcement of solid waste by-laws on indiscriminate disposals by the municipal leaders which increases bad practices of indiscriminate disposal.

Opportunities identified were; Solid wastes; especially recyclables and scraps provide a source of earnings (38%), Source of employment (31%), activities of good collection and good dumping practices provide for a disease and vector free environment (25%) and also provide a revenue stream to the government from composting firms (6%).

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#### **5.3** Conclusion

Organic biodegradable items form greatest percentage of items in the solid waste stream of Lira municipality. This is believed to be due to its location within the tropical belt with very fertile soils which favours agriculture and growth of herbages which constitute much of peoples' diet. Lira municipality people use mainly locally produced items and import packed items which gives little content of non-biodegradables such as synthetic, polythene, rubber, glass, metallic and plastic fibres arising from packaging in the waste stream. The occupants of the municipality highly practice open dumping followed by land filling. This scenario is presumed to be as a result of people not being able to clearly differentiate between landfill and open dump as well as their human and environmental effects. Willingness to pay for waste collection services is high in households in Lira municipality as most household use hired labour to take their wastes to temporal dump sites.

Solid waste management in Lira municipality is perceived to be efficient as a result of the daily collection in all originally planned municipal radii. However, the management experiences unreliability due to having garbage trucks in poor mechanical conditions, laxity and less adherence to implementing solid waste management by –laws by the municipal administration, inadequate storage facilities and temporal dumping space due to no government owned land in Lira municipality

The study confirmed solid waste as a very vital economic item in terms of earning to people, vital in health and environmental sector in provision of disease free and pollution free environment through practices of recycling, re-use, solid waste composting, and bio gas production leading to circular economy of waste management.

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#### 5.4. Recommendations

The following are the recommendations made towards improvement of solid waste management in Lira Municipality and other urban areas at large. These can be addressed by policy makers, scientists, environmentalists and government.

- People should be sensitized to be able to clearly differentiate between landfill and open dump as well as their human and environmental effects.
- The solid waste constituents identified also calls for a course of action by Lira municipality to educate / sensitize her residents on how to provide a pollution free environment as well as economically profitable waste handling practices such as source reduction through waste recycling, re-use, composting, bio gas production in a bid to change people's perception in viewing solid waste as useless, but as another form of raw material that demands better packaging for future use.
- Possession of solid waste collection containers should be made 'a must' in all households in the municipalities
- More research should be carried out to ascertain the organic and inorganic solid wastes content as it has implications for waste management strategy selection which many times isn't considered. This leads to failures of many solid waste management projects and financial losses; reason as to why there is increase in street debris content now.
- Indiscriminate solid waste disposal 'Act' should be amended and treated as real crime with high penalties to motivate compliance and curb down environmental challenges arising from indiscriminate waste disposal.
- Environmental hygiene policies should be clearly spelt out and enforced to encourage compliance and waste containers be made a must for all households and penalties be inflicted on offenders.

Necessary technical waste handling equipment and tools should be provided and more government owned spaces be solicited, bought and planned.

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# **APPENDICES**

# **APPENDIX 1: QUESTIONNAIRE TO SOLID WASTE GENERATORS**

I'm Ongia Joel- Owiny, a student of Kyambogo University pursuing a Master Degree of Arts in Geography and in my second year.

I am carrying out a research on Solid Waste management for academic purpose. I would like to ask you questions about issues related to solid waste generation, collection, storage and disposal. The research is intended to improve on solid management of this Municipality. The information you give will be treated as confidential.

Thank you.

Division: ......Parish: .....Zone/Village.....

Date: .....

1. To characterize the types of solid waste, collection operations and dumping systems.

# Section A: Socio economic characteristics of the respondents

- 1. Sex of the Respondents
- (i). Male
- (ii). Female
- 2. Age of the Respondent.....
- 3. Highest level of education attained.
- (i). none (iii). Upper Primary (P.5 –P.7)
- (ii). Lower Primary (P.1 P.4) (IV). Secondary

(v). Institution/Tertiary education

4. Major occupation of the respondent.

(i). farmer

Teacher	(v). House wife (not occupation)
(ii). Public Servant	(vi). Community Leader
(iii). Driver	(vii). Shop attendant/Business person
(iv). Religious leader	(viii). Others (Specify)

5. What is your average monthly income?

6. How long have you lived in this place?

7. How many people live in this household or share this premise?

8. On average, how much money do you spend daily on basic necessities like food, water, clothing and domestic utensils?

# B) Characteristics of waste, collection operations and dumping systems.

10. What type of waste do you generate? (Data Collector: estimate the amount of each: Kg)

1. Vegetable matter						
2. Tree cuttings	7. Food waste					
3. Paper	8. Glass					
4. Street debris	9. Saw					
5. Plastic	10. Saw Dust					
6. Polyethene	11. Others (specify					
11. How do you store your solid waste (refuse) at your	premises?					
1. Throw anywhere (behind the	3. Refuse sack					
backyard)	4. Dustbin					
2. Polyethene bag/sack	5. Others (specify)					
12. Do you sort out (separate) your refuse before storage?						
1. Yes						
2. No						
If Yes, Why?						
13. Do you have a central collection facility for refuse	in your area?					
1. Yes						
2. No						
If NO, Why?						
14. If yes, what type of central collection facility for re	fuse is in use?					
1. Open dump	4. Compost yard					
2. Landfill	5. Others (Specify)					
3. Incinerator						

15. What is the distance from your premise to the nearest facility?

# 2. Evaluation of perception of people on Efficiency and Reliability of solid waste management systems.

1. How often do you dispose your waste? .....

- a). Daily c). After two weeks.
- b). Weekly
- 2. Who normally takes the refuse to the central collection facility?
  - a) Children c) House keeper
  - b) Wife d) Hired Labors
- 3. What do you use for carrying refuse to the central collection facility?
- i. Refuse sack/bins
- ii. Old containers (Jerri cans).
- iii. Local authority collection system
- iv. Others (Specify).....

- 4. If hired Labor how much do you pay per trip? .....
- 5. Does your area have a waste collection service?
  - 1. Yes
  - 2. No
- 6. Who is in charge of the collection service?
  - 1. Local authority
  - 2. Private waste collector
- 7. Do you pay for disposal of your premises waste?
  - 1. Yes
  - 2. No
- 8. Do you feel you should pay to dispose off waste?
  - 1. Yes
  - 2. No
- 9. Give reasons for your answer in (8 above) .....
- 10. If you have a central solid waste collection facility, who maintains the area around it?
- a) Local authority b) Municipal Council
- c) Private Company d) User community
- e) Community based organization (CBO)

f) Non-Governmental organization (NGO)

g) Others (specify)....

11. If you don't have a central collection waste facility, how do you dispose off the waste after accumulating?

a) Backyard and burn

b) Open dump and burn

c) Landfill

d) Nearby swamp

e) Refuse pit

f) Other (specify) .....

12. Does your local government /municipality have some by-laws that try to restrain poor solid waste management practices by the occupants?

a) Yes. b). No. c). I don't know.

13. If yes, verbally mention some of them.

14. Who normally enforces these by-laws on the municipal dwellers?

a) Local councilors, and VHTs. b) Environmental scouts. c) Health and hygiene officers. d)All the above mentioned staff.

# 3. Examination of Constraints and opportunities of municipal solid waste management.

1. What problems do you encounter when managing you refuse (Solid waste) during;

1.	Collec	tion
	a.	
	b.	
	c.	
	d.	
2.	Sortin	g
	a.	
	b.	
	c.	
	d.	
3.	Transp	porting
	a.	
	b.	
	c.	
	d.	
4.	Dispos	sal
	a.	
	b.	
	c.	
	d.	

2. Has anything been done to ensure safe and proper management of solid waste in this area?

- 1. Yes
- 2. No
- 3. I don't know
- 3. If No, give reasons for your answer in (2 above).
- 4. If yes, what was done?
  - a) Privatization of waste collection and disposal
  - b) Legal enforcement
  - c) Regular removal of accumulated waste
  - d) Others (Specify) .....

# 5. Who did it?

- a) Lira Municipal Council
- b) Local Authority
- c) Private company
- d) Community Based organization (CBO)
- e) Non-governmental Organization (NGO)
- F) Lira District health department
- g) Others (Specify) .....

6 (i) what do you think are the major limitations or constraints in improving solid waste management in this area?

Constraints							
House / municipal	Transportation stage	Dumping stage	Disposal	system			
level Collection			e.g. burning				

a) Inadequate funding

b) Poor attitude of community towards solid waste management

c) Lack of any legal enforcement by government

d) Ignorance and lack of awareness on general effects of solid waste disamenities

e) Negligence of Lira Municipal Council Ministry of works

f) Inadequate space and land tenure system.

g) Others (specify...)

6. (ii) In your opinion, could something better be done to improve on solid management in this area?

Explain using the table below;

Management levels							
House / municipal	Transportation stage	Dumping stage	Disposal s	ystem			
level Collection			e.g. burning				

7. Do you know of any good thing that can accrue out of solid waste management practices to either the community or even to an individual?

a) Yes. b) No

- 8. If yes, outline them....
- a) Disease free environment.
- b) Source of earning from recyclables.
- c) Employment in waste collection.
- d) Others (specify...)
- 9. Do you know of any dangers of indiscriminate dumping of solid waste in surroundings?
  - 1. Yes
  - 2. No
- 10. If yes, which dangers are these?
  - 1. Diseases 3. Bad smell
  - 2. Breeds vectors that cause diseases 4. Others (Specify).....
- 11. What disease vectors are associated with solid waste in your area?
  - 1. Mosquitoes3. Flies2. Rats4. Others (Specify) .....
- 12. Do you know any disease that may be transmitted by those vectors?
  - 1. Yes
  - 2. No
- 13. If yes, which diseases?
| 2.     | Typhoid  | 6. | Cholera                                |
|--------|--|----|--|
| 3.     | Diarrhea                                       | 7. | Others (Specify)                       |
| 4.     | Intestinal worms                               |    |  |
| 14. H  | as any member of your family suffered from any | of | those above diseases within the last 3 |
| month  | ns?  |    |  |
| 1. Yes |  |    |  |
| 2. No  |  |    |  |
|        |  |    |  |

- 15. If Yes, which one(s)
  - 1. Malaria

1. Malaria

- 2. Intestinal worms
- 3. Typhoid
- 4. Diarrhea
- 16. What age was the person?
  - 1. Child below one year
  - 2. Child between 1 4 years
  - 3. Between 5 10 years
  - 4. 10 18 years
  - 5. Person between 18 35 years
  - 6. Above 35 years.

5. Cholera

5. Asthma

6. Others (specify)

3

17. Are you impressed by the ways solid waste is handled (managed) in your area?

- 1. Yes
- 2. No

18. Give reasons for your answer in (18 above) .....

19. How can problems encountered in solid waste management be solved in your area?

.....

20. Would you be willing to pay some fee for solid waste collection, transportation and disposal from your area?

- 1. Yes
- 2. No

b). Give reasons for your choice.

.....

#### **APPENDIX 2: QUESTIONNAIRE TO SOLID WASTE COLLECTORS**

#### **1.** To characterize the types of solid waste, collection operations and dumping systems.

#### A) Socio economic characteristics of respondents

- 1. Sex
  - 1. Male
  - 2. Female
- 2. What is your age? ..... Years

3. When did you join Lira Municipal Council? ..... Under what terms of employment?

- 1. Contract3. Permanent2. Casual4. Others (Specify).....
- 4. How long have you worked in Lira Municipal Council? ...... years.

#### 5. What is your marital Status?

- 1. Married3. Single
- 2. Divorced 4. Widowed

6. If married, what is your family size? (Number of peoples) .....

- 7. What is your level of education?
  - 1. Primary2. Secondary

3. Tertiary

4. Not Educated.

## B) Characteristic types of wastes, collection operations and dumping systems

- 8. Are there other members of your family involved in waste recovery?
  - 1. Yes. 2. No.

### 9. Where do they collect most of the materials from?

	1.	Dumpsite	5.	Institutions	
	2.	Commercial areas	6.	Industrial areas	
	3.	Streets	7.	Others	(Specify)
	4.	Water sources			
10.	At	what time of the day do you operate?			
	1.	Only day time			
	2.	Both day and night			
	3.	Only night time			
11. Why do you operate at this time?					
12. Do you operate in recovery of recyclables?					
	1.	Yes			
	2.	No			

13. If yes, how do you recover?

- 1. As an individual
- 2. As a group
- 3. Both individual and group.
- 14. What is the major composition of the solid waste you collect every day?

1. Vegetable matters	5. Glass		
2. Plastics	6. Paper		
3. Polyethene bags/materials	7. Others (Specify)		
4. Metals			

- 15. In settlement/residential areas where do you collect most solid waste?
  - 1. Upscale residential & medium scale
  - 2. Clustered slum settlements.
- 16. What kinds of wastes do you find there?
  - 1. Food wastes
  - 2. Household sweeping/kitchen wastes
  - 3. Packing materials (used ones)
  - 4. Polyethene and paper materials.
- 17. Do you find the wastes already sorted separately?
  - 1. Yes
  - 2. No
- 18. Where do you dump these wastes usually?

a) Land fill

b) Compost pits

c) Incineration ground

d) To the swamp.

19. What is the distance of the disposal ground from the municipal Centre?

a) 5 km. b) 8km. c) 12km, d) 15 km.

# 2. Evaluation of collectors' perception on Efficiency and Reliability of municipal waste management systems.

1. Estimate the average distance (Km) you move per working day in collecting materials.

.....

2. What means of transport do you use? .....

4. Estimate the number of people engaged in waste collection in your area of operation.

.....

5. Are the waste sorted out before transporting to the disposal sites?

- 1. Yes
- 2. No

6. What is the major composition of the solid waste you collect every day?

1. Vegetable matters 2. Plastics

- 3. Polyethene bags/materials
  4. Metals
  5. Glass
  5. Glass
- 7. Are the transport mechanisms in use adequate in number to cover the municipality effectively?
- a) Yes. b) No. c) I don't know.
- 8. Are these transport mechanisms always in good mechanical conditions?
- a) No. b) Yes
- 9. If no give reasons to explain.....
- 10. In settlement/residential areas where do you collect most solid waste?
  - 1. Upscale residential & medium scale
  - 2. Clustered slum settlements.
- 11. How regular do you collect waste from an area?
- a) After two weeks. b) After one week. c) After three days. d) When informed.
- 12. Where are the waste kept in the residential places before collection?
- a) In metallic bins. b) In sacks. c) In community collection bins. d) In old plastic containers.
- 13. Are the number of storage bins and their width sufficient to their area of service?
  - a) Yes. b) No.
- 14. Give reasons for your answer in (13 above).
- 15. Does your waste collection operations cover all areas of the municipality?
- a) Yes. b) No.
- 16. Give reasons for your answers in (13 above)

17. Does your local government /municipality have some by-laws that try to restrain poor solid waste management practices by the occupants?

a) Yes. b). No. c). I don't know.

18. If yes, verbally mention some of them.

19. Who normally enforces these by-laws on the municipal dwellers?

a) Local councilors and VHT's., b) Environmental scouts. c) Health Assistants and hygiene officers. d) All the above-mentioned staff.

#### 3. Examination of constraints and opportunities of municipal solid waste management.

1. What problems do you face during the following waste processing stages?

i.	Collection
ii.	Sorting
iii.	Transportation
iv.	Disposal

2. Which of the following problems do you face in relation to waste management?

as). Rainy season/bad weather	g) Lack of waste management collection
b). Inadequate equipment for sorting	material
c). Transportation of materials	h) Harassment/insecurity
d) Lack of cooperation/coordination	i) Others (Specify)
e) Health hazards	

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- 3. Are all areas accessible?
  - 1. Yes
  - 2. No

#### 4. If no, why?

- 1. Poor roads
- 2. Squeezed houses
- 3. Swampy areas
- 5. In settlement/residential areas where do you collect most solid waste?
  - a). Upscale residential & medium scale
  - b). Clustered slum settlements.
- 6. What kinds of wastes do you find there?
  - a) Food wastes
  - b) Household sweeping/kitchen wastes
  - c) Packing materials (used ones)
  - d) Polyethene and paper materials.
- 7. Do you take any health precautionary measures?
  - 1. Yes
  - 2. No
- 8. If Yes, Specify
  - a) Use gumboots
  - b) Use gloves
  - c) Use overalls.

9. Do you find the wastes already sorted separately?

- 3. Yes
- 4. No
- 10. Do you like your occupation?
  - 1. Yes
  - 2. No
- 11. Give reasons for your answer
- 12. Has there been any remarkable gain this activity has made in your life and family?
- a). Yes. b). No. c). I can't tell.
- 13. Give reason for your answer in (12 above).

14. What environmental changes (positive and negative) have you observed in your area of work

since you started collecting materials?

.....

15. What suggestions do you make in order to improve on solid waste management in Lira Municipal Council?

.....

Thank

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very

## **APPENDIX 3:** The guides to the focus group discussion:

- What major characteristic of solid waste are usually generated and collected in Lira municipality?
- What constraints are usually associated with waste management in Lira municipality?
- Are there any gain or opportunity people get in waste handling?
- How would you rate efficiency and reliability of waste collection and dumping in Lira municipality?

#### **APPENDIX 4: Interview Guide**

1.(a) Does solid waste collection services cover all areas of this division?

(i.) Yes

(ii). No

(b) Give reasons for your answer.....

2.(a) Are the solid wastes collected normally sorted?

(i) Yes

(ii) No

(b) Give reasons for your answer.....

3.(a) Does the Municipal solid waste management sector provide regular transport /collection services to all parts of the four divisions?

(i) Yes

(ii) No

(b) Why is it so? .....

4.(a) Does the waste management sector have temporal dump sites in all the four divisions of the Municipality?

(i) Yes

(ii) No

(b) Give reasons that fostered this.....

5.(a)Is there anything of benefit the local people in the Municipality get from solid waste management?

(i)Yes (ii) No

(b) Give reasons for your answer.....

6. What major problems do see being faced in the solid waste management sector in your division? (Outline them.....)

7. (a) According to your own observation how do you rate the performance of waste management in your division/area of work?.....

(b) Give reasons for your answers.....

Thank you for your co-operation

Test Statistics	Value	Significance
Number of		
Observations	200	
-2 Log-Likelihood	142.636	
Cox & Snell R2	0.388	
Nagelkerke R2	0.554	
Chi-square	98.225	*** 0.0000
Percent Correct		
Prediction	88.0	

# **APPENDIX 5: Statistical test for Suitability of the model**

Note: \*\*\* Level of significance at 0.001.

# **Model Summary**

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	142.636 <sup>a</sup>	.388	.554

Note: \*\* Level of significance at 0.01; \*\*\* Level of significance at 0.001\*\*\*