Addis Ababa University
College of Natural and Computational Sciences
Department of Zoological Sciences

A Survey Study on Metal Waste Collections, Processing and Its Ecological, Economic and Social importance: the case of 10 selected sub cities of Addis Ababa

By

Haftu Kahsay

(ID: GSK/1118/07)

A MSC Thesis

Submitted to the Department of Zoological Sciences in partial fulfilment for the requirement of the Degree of Masters of Science in General Biology

Advisor: Dr. Sutuma Edessa
Addis Ababa University
Addis Ababa, Ethiopia
November 2023

Declaration

This is to certify that Thesis prepared by Haftu Kahsay entitled as "**A Survey Study on Metal Waste Collections, Processing and Its Ecological, Economic and Social importance: the case of 10 selected sub cities of Addis Ababa"** and submitted to the Department of Zoological Sciences in partial fulfilment for the requirement of Degree of Masters of Sciences in **General Biology** complies with the regulation of the University and meets the accepted standards with respect to originality and quality.

Candidate

Haftu Kahsay

Signature _____ Date _____

Advisor

Dr. Sutuma Edessa (Associate Professor) _____ _____

Signature Date

Board of Examiners

Examiner	**Signature**	**Date**
_____	_____	_____

Chairperson	**Signature**	**Date**
_____	_____	_____

Acknowledgments

Primarily, I would like to express my deepest gratitude and indebtedness to my advisor Dr. Sutuma Edessa (Associate Professor) for his scientific guidance and ceaseless support starting from the early stage of the research proposal to final write-up of the thesis that enabled me to finalize the study.

I would like to thank the Addis Ababa City administration Education Bureau for sponsoring this postgraduate education.

I appreciate the Department of Zoological Sciences, pertinent staff and the coordinator of postgraduate studies for admitting as a postgraduate student and facilitating my learning throughout my study time and Addis Ababa University.

My genuine appreciation is also extended to Sanitation Beautification and Parks Development Department in Addis Ababa for their assistance during data collection by giving a genuine response during interview.

I would like to extend my appreciation and thanks to Bereket Hailay who helped me write up of the research paper and also to all my families and friends who support me in providing the necessary information for this study.

Table of Contents

List of Tables

Table Page

List of figures

Abstract

*The survey study was conducted in Addis Ababa sub cities on metal waste collection, processing and its ecological and economic importance. The main objective of the study was to make survey on waste metal collection and processing and find its economic and ecological advantages for practitioners and the society. Research design was random selection of all old 10 sub cities as collection stations of metals wastes excluding the newer sub city Lemi Kura. Research populations were 10 quorales randomly selected (found) at each sub city while collecting and processing metal wastes. Data collection method was a survey based observations of quorales collecting metal wastes for five consecutive days (Thursday to Monday) in each station. The processes of collecting metal wastes from 10 ten station, processing (sorting, transporting and presenting for sale at Minalesh Tera (Markato) to seven whole sellers was surveyed. Data collectors were 100 individuals (ten collector from each sub city or station) and seven whole purchasers at Markato that totally make the population 107. The study focused on types of collected metal wastes including Steel, Iron and copper, Aluminum, Lead and others from each station by quorales, transportation were set in tabular forms with illustration of the types and quantity in kg, prices on sale and profits. Interviews were made with the seven respondents (whole purchaser) focusing on the importance of the metal waste collection, selling, economic and ecological importance. Data evaluation was through descriptive method for both quantitative data collected using observation checklist and qualitative data found using interview questions. As a result **4291** Kgs within five days or **858.2** kg per day were collected from which a quorale earns **2122.3** birr per five days and **424.5** birr per day. Metal waste collection ecologically advanced cleansing the environment, made free of pollution and pleasant living and working environment whereby it contributed various social and societal benefits.*

The study of metal waste collection was concluded with the source economic generation, ecological importance and social benefits.

Keywords: Aspects, Ferrous metals, Metal waste, Quorale, Recycle and Scrap

Acronyms used in this text

CSA: Central statistics Agency

ILO: International Labor Organization

IMWM: Integrated Metal Wastes Management

MSEs: Micro and Small Enterprises

MW: Metal Wastes

MWM: Metal Wastes Management

NGO: Non-Governmental Organizations

MWDs: Metal waste dealers

MWCs: Metal waste collectors

SPSS: Statistical Package for Social Sciences

HU NCH: Habitat: United Nations Commission on Human Settlements

UNEP: United Nations Environmental Program

USAID: The United States Agency for International Development

USEPA: United States Environmental Protection Agency

Chapter one

1. Introduction

1.1 Background of the study

Metal wastes are pieces of metals, tins and formed or deformed sheets, woven ferrous iron, coppers, wires of different metals types and sizes, metal wasted nails, old or rusts of different nickels, water pipes, padlocks, keys and others. Metal wastes are becoming big environmental and social issues of concerns in many sub cities of Addis Ababa in view of the increasing population growth related to metal uses.

In Addis Ababa city, private metal waste collectors called Quorales (persons who walk through out the sub cities and collect metal and other wastes) are dealing with the metal waste management. The term quorale is derived from the poem "**quorquoro yaleh or who has the pieces of tin sheet**", given to the people dealing with collecting and processing metal wastes in which they call on to find some pieces of metals or other wastes either by buying or exchange by plastic pots or household **materials.**

According to (2013), the number of Quorales in Addis Ababa was 4864 in 2013 and all of them were young men of ages between 15-34 Years that A quorale man collects on average of commingled wastes weighing 42 kg per day of which 34% (14.3 kg) are metal wastes.

Metal waste management systems could have been the responsibilities of municipalities, but it lacks proper collection, improper planning and coordination (Tadesse Kuma, 2004 and Edmealem Bewuket, 2013).

According to Misrak Workneh (2016), Addis Ababa city has a total area of 540 km^2 (54,000 ha), from which about three million cubic meters per year with the prospect of increases by a constant rate of 2.1 cubic meters per person annually.

Although the volume of metal wastes of Addis Ababa is not well documented at a national level, with an average number of five working days, 1400 tones and 16800 tons of metal waste are produced every year in Addis Ababa only (Maschal and Tefera, 2013).

The problems of metal wastes are aggravated by the growing waste generation rates associated with population growth, rapid urbanization and change of composition of waste and economic condition of population (Degnet Abebaw, 2008; Getahun Tadesse,

2011).

Different approaches are used to manage metal waste in order to prevent its impacts on the environment, which in turn accelerate municipal metal waste generation rate in the urban environment (Hayal Desta, 2014).

The United Nation Environment Program (UNEP, 2005) notes that the management of metal wastes in Africa is often weak due to lack of appropriate planning, inadequate governance, poor technology, weak enforcement of existing legislation and the lack of economic incentives.

Inadequate metal waste management requires introducing a new proclamation No. 513/2007, a law that allows the private sectors to participate in the metal waste collections, transportations, reuse and disposal methods (Public Private Infrastructure Advisory Faculty (PPIAF, 2011).

Quorales collect metal wastes, sort and transaction to sell in Markato at "Minalesh. The market of metal wastes in Minalesh Tera is highly organized with a network of middlemen, shop dealers, wholesalers and recyclers.

The Quorales usually sell their items to middle men and shop dealers and the shop-dealers receive from numbers of quorales and have prior agreements to get the right to buy their collected items without competing with other metal waste dealers while the middle men. The shop dealers on the other hand, sell the items in large quantities to whole sealers, formal recyclers (steel smelters) as well as informal recyclers.

The whole sealers collect larger amounts of metal wastes, sort out similar quality items and sell the larger items to formal metal recyclers and a smaller proportion to the informal recyclers.

Transportation of the metal wastes is through vehicles or trucks with different loading capacity and involving other means to the destination. An integrated and efficient metal wastes management and logistics system can enhance the quality service and expand the coverage. The current metal wastes disposals of the capital city requires research based management on collection, sorting, transportation, ecological and economic aspect of metal wastes to reach at ultimate solutions.

1.2 Statement of the problem

In most Ethiopian cities, the situation of metal wastes management is neglected and now requires solutions.

Metal wastes management problems, inadequate collection strategies, poor transportation and handling systems and improper disposal result in environmental pollution in many areas.

One of the most challenges of urban centers in developing countries is lack of proper waste management (Nigatu Regassa & Bizunesh Bogale, 2011). Despite government's procedural mechanisms to cope with wastes problems, the case of metal waste disposal in Addis Ababa seems far from being resolved.

According to the Addis Ababa sanitation office (2017), 25% of the metal wastes remain uncollected and make the city environment polluted. One of the problems of metal wastes disposals is the lack of reliable and recent data on generation, dispersals and ultimate solutions to get rid of the wastes through converting into usable materials. In view of this, the researcher decided to conduct a survey research on metal waste collection, processing and converting into usable materials considering its importance ecologically as well as economically.

1.3 Objective of the study

1.3.1General objective

The general objective of the study was to conduct a survey study on metal waste collections, processing and find its economic and ecological importance.

1.3.2 Specific objectives

The specific objectives of the study were to:

1. Conduct a survey study on metal wastes collection process
2. Observe collection process by quorales and record data
3. Study the process metal wastes and conversions into usable materials
4. Find out the economic and ecological importance metal waste collection and converting into usable substances.

1.4 Research question

1. What are processes of metal waste collections?
2. What is importance of metal waste collection?
3. What is the ecological importance of metal wastes collection?
4. What is the economic importance of metal wastes?

1.5 Significance of the Study

The neglected state of metal waste management in Ethiopian cities, including Addis Ababa, has given rise to significant environmental pollution and social challenges. Characterized by inadequate collection strategies, poor transportation systems, and improper disposal practices, the city faces the persistent issue of 25% of metal wastes remaining uncollected. Despite government efforts, the problem persists, exacerbated by the lack of reliable and recent data on metal waste generation, dispersal, and potential solutions for conversion into usable materials. This study's significance lies in both practical and theoretical realms, aiming to understand and address current challenges in metal waste collection and processing. The findings hold the potential to influence policy development, guiding improved strategies for metal waste management and aligning with broader waste management initiatives. The study also delves into the social and economic aspects, focusing on the vital role of private collectors known as Quorales, who contribute significantly to metal waste management. By providing updated and reliable data, this research contributes to the existing body of knowledge, bridging gaps in literature and offering valuable insights for future waste management research and practices in urban settings like Addis Ababa. In conclusion, this comprehensive survey on metal waste collection, processing, and its ecological, economic, and social importance serves as a pivotal undertaking, addressing pressing environmental concerns and enriching theoretical frameworks in waste management, with practical implications for policymakers, stakeholders, and the community at large.

1.6 Limitation of the Study

This study has encountered the following limitations and constraints that limited the scope of the study.

- Limited or few literatures (documents) are available for the study on collection and recycling process of metal wastes.
- Inconveniences conditions to survey and unwillingness of some interviewees to respond to questions.

1.7 Delimitation of the Study

Metal wastes management activities significantly vary from place to place regardless of scales of variations related to the increasing socio-economic, financial and legal aspects. The study covers the assessment of waste collection, sorting, recycling process of metal wastes in 10 stations of sub cities only.

1.8 Organization of the study

This study paper is organized into five chapters: chapter one: Introduction (background information of the study, statement of the problem, objectives and research questions). Chapter two (Review of related literatures) and sub contents. Chapter three is about Methodology containing the study site, research design, methods and data sampling techniques).

The fourth chapter is about data evaluation, results and discussion whereby the fifth chapter is summary, conclusion and recommendations.

Chapter two

2. Review of related Literatures

2.1 Definition of metal wastes

Metal wastes are defined as any old metal, broken metal whether wholly or partially manufactured (FCN, 2013), metal wastes are generally waste materials or used Articles made up of metals that are often collected and reprocessed. Those metals can be categorized in to ferrous metal wastes and non-ferrous metal wastes.

2.2 Types of metal wastes

2.2.1 Ferrous Metal wastes

The metals that constitute is iron, such as pig iron, wrought iron, cast iron, steel and their alloys. Iron and steel metal wastes play an important role in the processing and final production of new ferrous products. Recycling ferrous metal wastes prevent the environmental burden of large accumulations of metal wastes building up in land fill sites and other disposal areas. Recycling of Ferrous metals also energy efficient. It is estimated that every tone of steel that is recycled saves approximately 1,000,000 kg of iron ore, 600 kg of coal and 54 kg of lime stone (Emery et al. 2000) this results reduced mining activities for the raw materials, again reducing the environmental burdens.

Other environmental benefits occur in the form of 86% less Air pollution, 76% less water pollution, 40% reduction in water used and a 1.28 tons reduction (Emery et al., 2000).

2.2.2 Non-Ferrous Metal wastes

Non-ferrous metal wastes comprise metals that do not contain iron or iron as base metal. These metals possess low strength at high temperature, generally suffer from hot shortness and have more shrinkage than ferrous metals. New changes in modern technology have reduced guide substantially the amounts of non-ferrous metal wastes generated as products are being made from thinner gauge metal and also with the increased use of other materials such as with the increasing use of other materials such as plastics for products including drink cans and plumbing.

The various non-ferrous metals used in industry are copper, Aluminum, tin, Lead, Zinc, nickel and their alloys etc. Aluminum is the most abundant metal (by volume) found in domestic waste, consisting mainly of drink cans (Emery et al 2000).

2.3 The Concept of Metal Wastes Management

Metal wastes management is systematic managing plan that often includes identification, collection, sorting, storage and disposal of ferrous and non-ferrous metal wastes that could efficiently contributes economic growth, environmental sustainability and resource conservation through effective management processes.

The business of keeping our environment free from the contaminating effects of waste materials is generally termed waste management. Metal wastes management is the process of collecting, storing, recycling and disposal of metal wastes that are harmless to humans, the ecology and the environment generally. The unhealthy disposal of metal wastes is one of the greatest challenges facing on developing countries (Kofoworola, 2007).

Gbekor (2003) for instance indicated that waste management involves "the collection, transport, recycling and disposal of waste including after-care of disposal sites". Similarly, Gilpin (1996) has defined waste management as "purposeful, systematic control of the storage, collection, transportation, sorting, processing, recycling, and disposal of metal wastes in a sanitary, aesthetically acceptable and economical manner ". It can be deduced from these definitions that waste management is the practice of protecting the environment from the polluting effects of waste materials in order to protect public safe and the natural environment.

The priority of a waste management system must always be the provision of a cleaning service which helps to maintain the safety of citizens and their environment (Cooper, 1999).

Waste management therefore, involves a wide range of stakeholders who perform various functions to maintain a clean, safe and pleasant physical environment in human settlements in order to protect the well-being of the population and the environment. However, effective metal wastes management is a growing challenge to all countries especially in developing country like Ethiopia.

2.4 Metal wastes processing steps

2.4.1 Metal wastes Processing

Metal wastes comes from a verified of sources in many different forms and must be processed to facilitate efficient use (Moyers, 2008).

Some parts of the metal waste sheets end up in the informed recycling sector and is transformed in to buckets, coffee and is transformed in to buckets, coffee roasting plates, kettles, sieves, scoops, charcoal stoves and similar items and some of the hard metals are transformed in to farming and other hand tools including hoes, rakes, chisels, shoves, tongs, ploughing blades, hammers, axes, knives and similar tools ornamental souvenirs and religious articles from brass means that Artisans also play a role in the recycling chain, as they use brass and Aluminum to manufacture ornamental souvenirs and religious articles (rings, necklaces, bracelets, earrings, crosses, bells).

The finished metal waste items from the informal recycling sector enter in to the market chain through a network of middle men and shop dealers at Markato, Minalesh Tera to whole sealers which distribute the items in Addis Ababa and throughout the country.

2.4.2 Metal wastes Smelting

Smelting is done in a furnace at high temperature. Smelting is done to fit manufactured metals to specifications of the industry.

2.4.3 Elements of Effective Metal Wastes Collection

The collection and transport of metal wastes take the private sector budgets and have the greatest impact on urban living. Metal wastes collection is taken to include the storage of waste at the household, shop or business premises, and transporting the waste until it reaches its final treatment plant or disposal site (Coffey, M. & Coad, A, 2010).

According to Coffey & Coad (2010), the following issues are considered during waste collection: it is also very desirable that the frequency should not vary so that quorales or users as a whole know when their waste will be collected.

Vehicle type for waste collection and transport: using general purpose vehicles which are inefficient and not suited to a waste collection is a great mistake which is mostly practiced in developing countries. It is also better to take into consideration that old waste collection vehicles are large sources of emissions (Edmealem Bewuket, 2013).

According to observation by the researcher, In Addis Ababa metal wastes is collected in several ways, including door- to -door collection, roadside pick-up, and self-delivery.

2.4.4 Elements of Effective Metal Wastes Transportation

The method of loading waste from the storage material into the collection vehicle must be given careful attention since it has impacts on the health of the workers and the cost of the service. Some methods of loading a waste expose laborers to risks from contacting with the waste, inhaling dust and from traffic accidents (Coffey & Coad, 2010).

2.4.5 Sorting and Reuse

The municipality and waste management agencies role in recycling was absent and mainly focus on collection, storage transportation, and disposal of metal wastes. Most of the collection of recyclable wastes in the city is performed by the informal sector recyclable materials are used by metal factories. (Fikru Tesema, 2010).

2.5 Factors Influencing Metal Wastes Management Practices

2.5.1 Technical Factor

According to Schubeler (1996) and Ansari (2012), technical systems established include the collection, transportation, and disposal system knowledge of metal wastes. The collection comprises the organization and equipment of collection workers, including the provision of protective clothing workers. Transfer system deals with the waste storage, and transfer points, vehicles and equipment for waste transfer, and the procedures for operating and maintaining these facilities and equipment (Schubeler, 1996).

2.5.2 Social Factor

Effective MWM system is influenced by waste handling patterns and underlying attitude of the urban populations, and people's social and cultural context. Programmers to disseminate knowledge and skills or to improve behavior patterns and attitudes regarding waste management require the sound understanding of the social and cultural characteristics (Shubeler, 1996). Social problems encountered include lack of public awareness, poor condition of waste workers, and lack of private sector and social involvement Public awareness-raising and attitudes to waste can affect the whole metal wastes management system.

According to Shubeler (1996) and Un- Habitat (2013) access to social and safety service should be ensured. Proper equipment and protective clothing can reduce health risks. By contributing to the professionalization of the waste worker's role, proper clothing and equipment may also help to alleviate the social stigmatization which is often associated with waste workers.

2.5.3 Institutional Factor

Effective MWM depends on upon the appropriate distribution of functions responsibilities, authority and revenues and requires the integration of many organizations and groups into a partnership (Shubeler, 1996).

Private sector contractors are engaged to provide such services. Small family-based enterprises and informal sector are often very involved with MWM. Non-governmental organizations (NGOs) and community-based organizations (CBOs) can have the important impact in organizing local services, raising awareness and supporting vulnerable individuals (Coffey & Coad, 2010). Local government authorities are generally responsible for the provision of metal wastes collection and disposal services. They become the legal owner of waste once it is collected or put out for collection and the responsibility for MWM is usually specified in bylaws and regulations (Shubeller, 1996).

Therefore, the policy of government regarding the role of the private sector (formal and informal) should be taken into account (Zurbrug, 2002).

Private sector involvement in MWM implies a shift in the principal role of government institutions from service provision to regulation. To effectively regulate and control the enterprises, the appropriate system of monitoring and control need to be established and corresponding skills and capacities developed at both local and central government levels (Shubeller, 1996).

2.6 Economic Assessment in Metal Wastes Management

Eshet et al (2006), the assessment and analysis of pollution of metal wastes, collections and problems found out as a challenging disaster. Shmelev and Powell (2006) proposed methodological supports to metal waste management considering spatial and temporal patterns as well as the economic and environmental impacts on public health and biodiversity. Massarutto (2015) addressed the contribution of economics of metal waste recycling and reuse of energy.

According to the author, from an economic view, recycling and incineration are complementary: recycling is appropriate for materials that can be more easily sorted, and at lower costs, while incineration is more suitable for the others.

2.7 Ecological Aspects of Metal Wastes Management

The impact of metal wastes on the environment is an alarming problem in urban areas. Metal wastes disposal possesses a greater problem as it leads to land pollution because of open dumping, water pollution because of dumping in low lands and air pollution because of burning (Akter et al., 1997). Urban is facing serious environmental problems such as land, water and air pollution and public-health risks.

Addis Ababa is expanding rapidly turning it into a big city with an enormous growth of population at a rate of around 5 percent a year. Metal wastes are being generated at a faster pace, posing a serious management threat. Rapid growth of industries around the city, lack of financial resources, inadequate trained manpower, inappropriate technology and lack of awareness of the community are the major constraints of metal wastes management. A healthy life, cleaner city and Better environment are the logical demands for the city dwellers as the municipality is traditionally funded for metal wastes services from municipal tax system for waste collection and disposal. Due to

limited finances and organizational capacity, it has been really difficult for the municipality to ensure efficient and appropriate delivery of metal wastes collection and disposal services to the entire population.

2.7.1 Metal wastes and Air Pollution

Air pollution is the concentration of air at the presence of various toxic and hazardous substances. The unauthorized and abandoned burning of waste at the existing disposal site causes air pollution. Burning of waste including partly hazardous and creates smoke, which releases toxic compounds and ashes into the air that is threat to the environment. However Burning is also done, at limited scale, in all the sites. As no daily covers are used, dusts as well as unwanted greenhouse gases mixes with the atmosphere and pollute the air (Islam, N. and Shafi, 2004).

2.8 Conceptual Frame Work

The metal wastes industry is characterized by many independent actors involved at different points in the supply and demand of metal wastes.

The Actors of the industry are metal waste dealers, borders, dismantlers and smelters. Three actors were however identified by moneys (2005) as metal waste collectors, brokers and metal wastes processors. Most of the stake holders are small collecting companies which are supplying the larger companies for the processing, treatment and trading these larger companies are delivering metal wastes to the steel works or foundries.

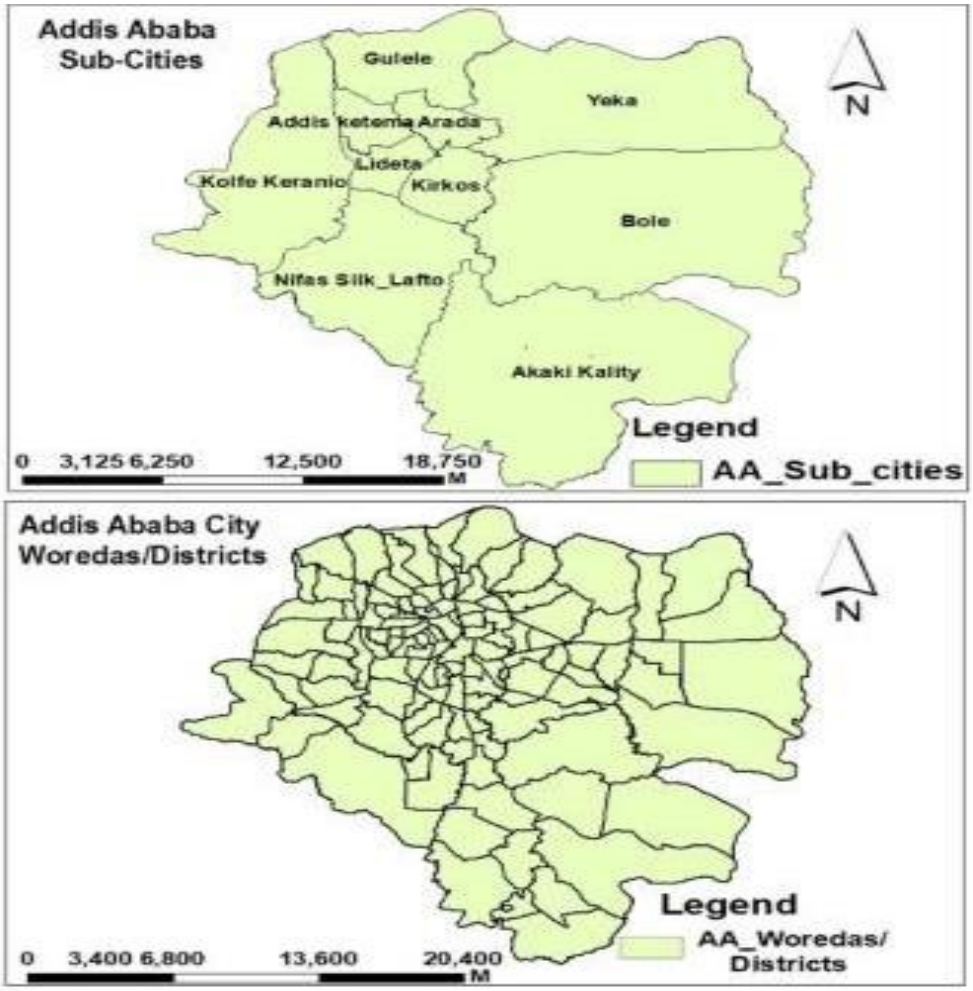
Chapter three

3. Methodology of the Study

3.1 The Study Site

The capital Addis Ababa is the largest city composing of 11 sub cities with populations of 5,461,000 (2023) and each sub city divides into different districts.

The study was conducted in 10 randomly selected sub cities considered as survey stations excluding Lemmi Kura sub-city.



Map 1 Map of Addis Ababa city

Source: Ethio GIS (2023)

3.2 Research design

The survey study was planned to be conducted in randomly selected 10 sub cities of Addis Ababa excluding the sub city Lemmi Kura since it is a newer and less populated one. The survey study aimed at metal waste collection, processing and find its' economic and ecological advantages for practitioners and the society.

In view of this, all old 10 sub cities were designed to be as collection stations of metals wastes and research populations were 100 quorales randomly taken 10 quorales at each sub city and seven dealers buying metal wastes at Markato (107).

Data collection method was a survey based observations of quorales collecting metal wastes for five consecutive days (Thursday to Monday) in each station and recording the type and the volume of metal wastes.

The processes of collecting metal wastes from each 10 station, processing (sorting, transporting and presenting for sale at Minalesh Tera (Markato) and selling to seven dealers was surveyed and recorded in observation checklists. Data collectors were 100 quorales (ten quorales from each sub city or station) and seven purchasers at Markato that totally make the population 107 practitioners. Data collection tool was through mixed approach using both qualitative for data collected through observation and quantitative approach for data collected using interview questions.

3.3 Methods

The method used to collect data on metal waste collection and processing was conducting a survey study to observe the ways and conditions of data collection for five consecutive days at each station for 50 days.

The researcher planned to observe the quorales collecting metal wastes for five days (Thursday to Monday) at a sub city (station) spending one day at each district and recording the types and amount of metal wastes (Kg) in the observation checklist. In addition, the researcher also interviewed sampled key informants or the seven dealers buying metal wastes from all quorales focusing on the types of metal wastes and the prices of each type of metal wastes in kg. In data analysis and evaluation, descriptive and explanatory methods were used.

3.4 Data Collection Instrument

In order to obtain empirical and reliable primary information, the following data collection tools were used.

3.4.1 Observation

Observation checklist was used to record quorales collecting metal wastes from each five district of each sub city (station) for five consecutive days from Thursday through Monday.

The survey based observation checklist composed of forms containing types and weight of the metal wastes collected by a quorale per day whose daily average quantity by types was recorded. In view of this, the researcher stayed for five days at each station (five districts) and collected empirical data through 100 quorales (practitioners) of the study area and converted checklist data into tabular forms. The method of data collection using observation checklist included discussions with the practitioners (quorales) on how to collect, sort, process, transport and sell at Markato and its economic and ecological importance.

3.4.2 Interviews

Semi-structured interview questions were prepared to gather information as primary data from seven (7) dealers (buyers) of metal wastes at Markato Minalesh Tera. The researcher conducted interviews with the seven selected dealers focusing on the importance of metal waste collections.

3.5 Data sampling techniques

In order to determine the number of station and population sizes for data collection random sampling techniques were employed. The number of quorales traveling throughout Addis Ababa to search for metal and other wastes could be uncountable, unstable and variable that may be difficult to determine using statistical methods, but could between 3100 and 3500.

According to Sarantakos, S. (2005), sampling techniques for social science studies could be a minimum portion of 10% to 30% of the total population.

Hence, the number of quorales (100) taken as data collection practitioners lies between 10% and 30% assumed to be the minimum and maximum sample size for this study.

The number of dealer population for the interview were selected using purposive sampling method focusing on the business they always deal with buying only metal wastes.

Table 1 Data sampling techniques and size (10 sub cities) and 7 dealers

Sub cities of Addis Ababa	Data collection station (with five districts)	Number of Quorales at each station	Number of purchasers at Markato
Addis Ketema	**1**	**10**	
Akaki kality	**2**	**10**	
Arada	**3**	**10**	
Bole	**4**	**10**	
Gulelle	**5**	**10**	
Kirkos	**6**	**10**	
Kolfe Keranyo	**7**	**10**	
Lideta	**8**	**10**	
Nefas silk Lafto	**9**	**10**	
Yeka	**10**	**10**	
Purchasers	**-**	**-**	**7**
Population size		**100**	**7**

Chapter four

4. Data Presentation, Results and Discussion

4.1 Data display

Overt observation checklist was used to collect primary data for five days each (5 days) while 100 metal waste collectors or quorales.

4.1.1 Metal waste types and volumes collected from each station

Table 2 Metal wastes collected from station 1 (Addis Ketema sub city)

Addis K.	**Metal waste types collected and weights in kilograms per five days**									
Quorales	Steel	Tin	Aluminum	Copper	Zinc	Brass	Stainless steel	Others (olds)	Computer parts	Total Kg
1	20	12	6	5	-	-	3	3	6	
2	22	8	10	-	5	9	1	12	18	
3	15	14	7	9	3	7	5	5	-	
4	13	7	9	12	6	-	2	-	5	
5	26	6	15	7	8	10	4	9	-	
6	28	12	8	10	4	8	-	8	10	
7	20	8	12	5	2	10	3	-	15	
8	19	4	8	10	-	3	-	4	-	
9	8	15	4	-	2	12	4	-	8	
10	7	12	3	-	2	5	6	2	3	
Total	178	98	82	58	32	64	28	43	65	648
%	27.5	15.1	12.7	9	4.9	9.9	4.3	6.6	10	

Source: Own survey record (2023)

The above table 2, station 1 above shows the average amount of waste collected by 10 quorales within five days accounting for 648 kg.

Figure 1 Metal wastes at Minalesh Terra

Source: Photo by Haftu Kahsay (2023)

Table 3 Metal wastes collected from station 2 (Akaki kality sub city)

Akaki K.	**Metal waste types collected and weights in kilograms per five days**									
Quorales	Steel	Tin	Aluminum	Copper	Zinc	Brass	Stainless steel	Others (olds)	Computer parts	Total Kg
1	10	6	8	2	-	-	-	2	1	
2	10	5	4	5	-	-	2	1	2	
3	13	10	13	1	-	-	-	3	-	
4	11	13	9	4	-	-	1	5	3	
5	8	-	5	3	-	--	1	6	2	
6	12	8	6	2	-	-	-	3	5	
7	13	-	12	6	-	-	1	2	3	
8	8	5	6	5	-	-	2	5	-	
9	7	5	-	2	-	-	2	1	-	
10	8	6	4	2	-	-	1	-	2	
Total	100	58	67	32	-	-	10	28	18	313
%	31.9	18.5	21.4	10.2	-	-	3.2	8.9	5.8	

Source: Own survey (2023)

According to the table 3 of station 2, the average total amount of metal wastes collected by 10 quorales within five days accounting for 313 kg.

Figure 2 Metal wastes

Source: Photo by Haftu Kahsay (2023)

Table 4 Metal wastes collected from station 3 (Arada sub city)

Arada	Metal waste types collected and weights in kilograms per five days									
Quorales	Steel	Tin	Aluminum	Copper	Zinc	Brass	Stainless steel	Others (olds)	Computer parts	Total Kg
1	17	6	7	4	2	5	1	2	3	
2	22	3	9	-	3	-	2	-	-	
3	15	8	5	-	2	-	3	5	-	
4	13	2	4	8	-	6	4	-	-	
5	18	4	13	5	-	-	1	-	1	
6	10	7	10	3	-	4	5	2	-	
7	12	6	-	2	1	7	2	1	-	
8	14	7	8	5	2	3	2	3	4	
9	-	5	8	6	-	1	2	3	-	
10	7	3	-	3	4	5	-	4	-	
Total	128	51	64	36	14	31	22	20	8	374
%	34.2	13.6	17.1	9.6	3.7	8.3	5.9	5.3	2.1	

Source: Own survey (2023)

The table 4 above station 3 shows the average total amount of metal wastes collected by 10 quorales within five days accounting for 374 kg.

Figure 3 Rusted metal wastes

Source: Photo by Haftu Kahsay (2023)

Table 5 Metal wastes collected from station 4 (Gullelle sub city)

Gullelle	**Metal waste types collected and weights in kg per five days**									
Quorales	Steel	Tin	Aluminum	Copper	zinc	Brass	Stainless steel	Others (olds)	Computer parts	Total Kg
1	18	2	5	3	8	10	-	-	2	
2	24	6	10	5	9	7	-	-	1	
3	12	10	23	6	12	14	-	-	2	
4	11	8	16	-	5	8	-	-	-	
5	17	2	-	-	-	3	-	-	-	
6	20	6	-	8	-	2	-	-	2	
7	8	2	15	5	16	4	-	-	-	
8	13	-	1	4	-	8	-	-	-	
9	8	2	-	-	10	6	-	-	2	
10	7	9	6	5	-	5	-	-	1	
Total	138	47	76	36	60	67	-	-	10	434
%	31.8	10.8	17.5	8.3	13.8	15.4	-	-	2.3	

Source: Own survey (2023)

The above table 5 of station 4 shows the average total amount of metal wastes collected by 10 quorales within five days accounting for 434 kg.

Table 6 Metal wastes collected from station 5 (Bole sub city)

Bole	**Metal waste types collected and weights in kg per five days**									
Quorales	Steel	Tin	Aluminum	Copper	Zinc	Brass	Stainless steel	Others (olds)	Computer parts	Total Kg
1	6	2	8	2	-	3	-	4	-	
2	4	3	9	3	-	-	-	2	-	
3	13	4	12	4	-	-	-	3	-	
4	12	6	16	-	-	2	-	5	-	
5	5	5	14	5	-	2	4	-	-	
6	3	10	-	-	-	5	4	-	-	
7	6	4	-	5	-	2	2	-	-	
8	5	7	23	-	-	1	3	-	-	
9	9	8	1	6	-	1	1	-	-	
10	6	5	-	-	-	2	-	-	-	
Total	69	45	83	25	-	18	13	14	-	267
%	25.8	16.9	31.1	9.4	-	6.7	4.9	5.2	-	

Source: Own survey (2023)

Table 6 of station 5 states that the average amount of metal wastes collected by 10 quorales within five days accounting for 267 Kg.

Table 7 Metal wastes collected from station 6 (Kirkos sub city)

Kirkos	**Metal waste types collected and weights in kg per five days**									
Quorales	Steel	Tin	Aluminum	Copper	Zinc	Brass	Stainless steel	Others (olds)	Computer parts	Total Kg
1	18	12	2	7	1	-	3	1	5	
2	16	13	3	9	2	-	6	2	1	
3	12	8	6	11	4	-	2	4	-	
4	13	7	5	8	-	3	6	2	4	
5	26	6	8	15	2	2	-	3	-	
6	30	16	-	13	1	3	4	3	6	
7	2	10	-	-	-	2	4	2	5	
8	16	11	1	8	3	-	-	1	2	
9	21	10	7	4	-	-	-	1	5	
10	14	5	1	2	5	1	3	1	2	
Total	168	98	33	77	18	13	26	19	30	482
%	34.9	20.3	6.8	16	3.7	2.7	5.4	3.9	6.2	

Source: Own survey (2023)

The above table 7 station 6 shows the average amount of metal wastes collected by 10 quorales within five days accounting for 482kg.

Table 8 Metal wastes collected from station 7 (Kolfe keraniyo sub city)

Kolfe K.	**Metal waste types collected and weights in kg per five days**									
Quorales	Steel	Tin	Aluminum	Copper	zinc	Brass	Stainless steel	Others (olds)	Computer parts	Total KG
1	15	12	6	2	5	1	3	-	-	
2	12	8	7	3	8	6	1	-	-	
3	16	4	10	6	9	6	-	-	2	
4	25	13	12	2	8	-	-	-	-	
5	28	718	8	3	16	-	-	-	-	
6	8	18	9	4	-	-	5	-	2	
7	4	20	2	5	-	-	3	-	3	
8	25	4	13	11	14	3	6	-	2	
9	13	12	6	4	1	2	-	-	1	
10	9	8	15	5	-	4	1	-	2	
Total	155	114	88	44	61	22	19	-	12	515
%	**30.1**	**22.1**	**17.1**	**8.5**	**11.8**	**4.3**	**3.7**	-	**2.3**	

Source: Own survey (2023)

The above table 8, station 7 shows the amount of metal wastes collected by 10 quorales with five days accounting for 515 kg.

Table 9 Metal wastes collected from station 8 (Lideta sub city)

Lideta	**Metal waste types collected and weights in kg per five days**									
Quorales	Steel	Tin	Aluminum	Copper	Zinc	Brass	Stainless steel	Others (olds)	Computer parts	Total KG
1	12	8	4	5	13	3	-	3	-	
2	4	-	13	4	6	5	-	2	-	
3	8	3	-	6	9	4	-	1	-	
4	15	-	12	3	16	2	-	-	-	
5	13	7	8	10	-	-	-	5	-	
6	6	9	5	-	-	2	-	4	-	
7	18	4	8	7	6	3	-	2	-	
8	13	2	6	-	8	2	-	3	-	
9	15	-	10	4	12	4	-	1	-	
10	10	2	9	6	9	-	-	2	-	
Total	114	34	75	44	79	25	-	23	-	394
%	28.9	8.6	19	11.2	20.1	6.3	-	5.8	-	

Source: Own survey (2023)

Table 9 shows the amount of metal wastes collected by 10 quorales from station 8 with five days accounting for 394kg.

Table 10 Metal wastes collected from station 9 (Nefas Silk Lafto sub city)

Nef S.L	**Metal waste types collected and weights in kg per five days**									
Quorales	Steel	Tin	Aluminum	Copper	Zinc	Brass	Stainless steel	Others (olds)	Computer parts	Total Kg
1	6	4	5	1	-	-	-	2	-	
2	7	12	6	-	4	3	-	3	-	
3	9	8	7	2	7	5	-	4	-	
4	8	13	10	-	2	4	-	2	-	
5	12	9	3	2	3	6	-	4	-	
6	6	18	9	-	-	4	-	1	-	
7	5	15	12	6	8	2	-	3	-	
8	20	12	8	-	-	1	-	2	-	
9	12	20	-	2	-	1	-	-	-	
10	13	4	-	5	9	-	-		-	
Total	98	115	60	18	33	26	-	21	-	371
%	26.4	31	16.2	4.9	8.9	7	-	5.7	-	

Source: Own survey (2023)

Table 10 displays the total amount of metal wastes collected by 10 selected quorales from stations 9 within five days that accounts for 371 kg.

Table 11 Metal wastes collected from station 10 (Yeka sub city)

Yeka	**Metal waste types collected and weights in Kg per five days**									
Quorales	Steel	Tin	Aluminum	Copper	Zinc	Brass	Stainless steel	Others (olds)	Computer parts	Total Kg
1	14	12	2	13	5	-	-	-	2	
2	18	16	3	14	9	-	-	-	-	
3	23	5	6	6	2	-	-	-	3	
4	12	2	4	5	3	2	-	-	-	
5	15	8	-	4	3	5	-	-	-	
6	16	4	-	8	5	7	-	-	2	
7	19	7	12	5	10	5	-	-	1	
8	25	13	16	9	8	2	-	-	1	
9	28	15	4	12	2	-	-	-	1	
10	15	3	2	12	4	2	-	-	2	
Total	185	85	49	88	51	23	-	-	12	493
%	37.5	17.2	9.9	17.8	10.3	4.7	-	-	2.4	

Source: Own survey (2023)

Table 11 displays the total amount of metal wastes collected by 10 selected quorales from stations 10 within five days that accounts for 493 kg.

Figure 4 Transportation of metal wastes to Markato

Source: Photo by Haftu Kahsay (2023)

4.2 Data Analysis

4.2.1 Data collected through observation checklist

Table 12 Metal wastes collected from all 10 stations (sub cities)

S. City	**Metal waste types collected and weights in kg per day**									
Station	Steel	Tin	Aluminum	Copper	zinc	Brass	Stainless steel	Others (olds)	Computer parts	Total Kg
1	178	98	82	58	32	64	28	43	65	648
2	100	58	67	32	-	-	10	28	18	313
3	128	51	64	36	14	31	22	20	8	374
4	138	47	76	36	60	67	-	-	10	267
5	69	45	83	25	-	18	13	14	-	434
6	168	98	33	77	18	13	26	19	30	482
7	155	114	88	44	61	22	19	-	12	515
8	114	34	75	44	79	25	-	23	-	394
9	98	115	60	18	33	26	-	21	-	371
10	185	85	49	88	51	23	-	-	12	493
Kg	**1333**	**745**	**677**	**458**	**348**	**289**	**118**	**168**	**155**	**4,291**
%	**31.1**	**17.4**	**15.8**	**10.7**	**8.1**	**6.7**	**2.7**	**3.9**	**3.6**	

Survey based data collections totally took 50 days spending five consecutive days within a station or in five substations of each station (one day for one substation).

Selected quorales collect metal wastes and enable the researcher to record in survey checklists and discusses the types, values and cost prices of each collected metal waste throughout five days that the average number of the weights of wastes recorded at all stations.

Accordingly, the five days metal wastes collection by 100 quorales from all 10 stations is converted into table 12.

In view of this, collected meatal wastes form 10 stations showed: Steel 1333 (31.1%) Kg, Tin 745 Kg (17.4), Aluminum 677 Kg (15.8%), Copper 458 Kg (10.7%), Zinc 348 Kg (8.1%), Brass 289 Kg (6.7%), Stainless steel 118 Kg (2.7%), old materials 168 Kg (3.9%) and Computer parts 155 Kg (3.6%). The total amount of all types of metal wastes

collected within five days from all over 10 stations (sub cities) Addis Ababa was totally **4291** Kg.

4.2.2 Economic and Ecological analysis

4.2.2.1 Economical analysis

Based on data of table 12 above, analysis of the means of income generation by each quorales and its importance as self-employing condition was considered. The economic importance of metal wastes and other wastes collection daily throughout Addis Ababa by quorales is the non-stop activities and still ongoing process.

The method of simplicity was applied to calculate the average income of a quorale man in terms of collecting (buying with low price), transporting to Markato and sell at Minalesh Tera at a higher price to gain profit.

Hence, it is very interesting that a quorale can gain **2122.3** Birr per five days or **424.5** Birr per day on an average that depends on each collector and the availability of the types of metals wastes (table 13).

Table 13 Economic benefits of metal wastes for quorales in five days

Types of metal wastes	Weights in kg	Purchase Price per kg	Sale price per kg at Markato	Profit per kg	Profit per Collector in birr
Steel	1333	60	90	30	1333x30/100 =399.9
Tin	745	50	80	30	745x30/100 = 223.5
Aluminum	677	100	160	60	677x60/100 = 406.2
Copper	458	300	450	150	458x150/100 = 687
Zinc	348	30	60	30	348x30/100 =104.4
Brass	289	20	50	30	289x30/100 = 86.7
Stainless steel	118	30	75	45	118x45/100 = 53.1
Old materials	168	40	90	50	168x50/100 = 84
Computer parts	155	60	110	50	155x50/100 =77.5
Total profit					**2122.3/5=424.5**

4.2.2.2 Ecological benefits analysis

According to table 12, the average amount of metal waste collection with five days from 10 stations is **4291** Kg that shows very significant issues of environmental pollution aspects.

If no one is collecting, metal wastes or and wastes of Addis Ababa, what could happen with a few months?

1. We may find our ways filled with dirt and scrapes or pieces of metals.
2. We may find all around us with landfills of uncomfortable materials.
3. Pollutions cause enormous problems around residences and all over.
4. People cannot walk, work or drive and children cannot play if the land is field with metals wastes or scrapes that cause damages.
5. Metal wastes can spoil the environment during burning metal wastes in any form of mechanical and chemical changes.
6. The quorales and metal dealers are very important figures for removing wastes that cause damages and make our environment safe from pollution by cleansing the environment
7. Quorale are very important workers in avoiding harms or hazardous materials to secure the safety of the society.
8. Metal waste collection and processing to convert into usable materials important for Addis Ababa and the other the society cross-over.

4.3 Data collected from dealers through interviews

Interviews were conducted with seven purchasers (dealers) who buy metal wastes from quorales at Markato Minalesh Tera.

The interview questions focused on the process of collection, types of metal wastes, purchase prices, purposes of purchasing metal wastes and economic and ecological advantages of dealing with metal wastes.

Responses from the respondents:

1. **Economic issue:**

- Metal waste collectors or Quorales are our customers who bring us whatever piece of scraps or metal wastes gathered daily (either bought or found dropped as wastes). Each type of the metal waste has its own value and price and we buy in weighing in kilograms (kg). The price is determined about 96% by the purchasers based on types and demands for the metal waste and we recycle by maintaining (Utensils) or sell to metallurgy companies for remaking similar commodities or goods. We buy, sell and gain profits as self-employing strategy for income generation and survival on which we depend and economical successful. Metal wastes also serve us as sources of raw materials for local users and industries.

2. Ecological issues:

- Scrap Metal wastes are any sharp pieces of metals that can harm humans (children) when come to contact with accidently. Nails can pick tires or human feet and damage. Metal wastes can spoil the environment in any form of mechanical and chemical changes (rusts). Collecting dispersed metal wastes from all around roads, roadsides, residence areas, playing fields, farmlands, rivers, parks and all places free from metal pollutants damage and then makes better our living environment and means of income generating.

3. Societal Issues:

- The metal waste collectors and purchasers are friends of each other; argue while dealing with sell and buy process and further conversion into usable materials.
- Metal wastes (damaged utensils) are maintained at Minalesh Tera and sold on markets at law prices that the society can buy and use such recycled materials. Dealing with metal waste collection and selling made us a societal group that supports each other and cooperative workers to be beneficial to provide societal services including our families. During collection and recycling process of the metal waste harms (100%) like injuries and damages as a result

of contact with sharp edges during collection, sorting ,dismantling, coated burning and packing into sacks or bags. About 88% of injuries arise from falling and partial modifying metal wastes for different uses when striking the hands by heavy metals like hammers.

- **Examples**: spoons, knives, stoves, hammers, ornamental articles etc. are renewed at Minalesh Terra and sold on markets at low prices for the community that can access to buy and uses the goods.

4.4 Results

Metal wastes collections by 100 quorales from all over 10 stations or sub cities of Addis Ababa with five consecutive days showed that Steel (1333kg), Tin (745 Kg), Aluminum 677 (Kg), Copper 458 (Kg), Zinc 348 (Kg), Brass 289 (Kg), Stainless steel 118 (Kg), other old materials 168 (Kg) and Computer parts 155 (Kg) and totally **4291** Kgs or **858.2** kg per day.

Economically, the average net income of a quorale per five days accounts for 2122.3 birr, which is **424.5** birr per day.

Ecologically, it is currently one of the means of cleansing the environment to make free of pollution and pleasant living and working environment for the society.

Socially, metal waste collection and processing contributed wide spectrum in facilitating economic benefits, social advantages, clean living and enjoyable environment for the society as well as awareness of creation of jobs that involves others.

4.5 Discussion

The study explored the types, amount of metal waste collection and processing systems from the view of economic, ecological and environmental aspects.

Majority of the respondents (82.5%) perceived that the environment they live in is not clean and safe while 71.5% of them agreed that the metal waste surrounding the environment made bad odor to the environment. Some degree of variation exhibited with a research done on environmental and economic impact of metal waste disposal at According to Salam Abul, 2010: Leone, et al (2013), the Mangwaneni dump site in Manzini of Swaziland was explored and 32% of the respondents indicated that the waste made the environment dirty and 52% indicated the environment was smelly.

Regarding the storage system of the metal waste, it was also explored that most of the respondents (68.7%) use temporary storage until the waste is taken by the metal waste pickers until they themselves take it to nearby collect site.

In this study, nearly 90% of the study participants used hands for transportation of the wastes and exposed to different injuries.

A study conducted in Bangladesh showed that both public and private sectors are active in management of metal waste in developing countries (Azam and Ali, 2004) whereby in Addis Ababa, lack of awareness on metal wastes is a big issue.

A research conducted by Salam Abul (2010) has shown similar finding of this survey study.

Chapter five

5. Summery, Conclusion and Recommendations

5.1 Summary

The study was conducted on metal wastes collection, processing and its economic, ecological and social aspects.

Collected metal wastes includes steel, iron, copper, aluminum, brass stainless-steel, old tools and computer parts although they are categorized into ferrous and non-ferrous metal wastes.

The recyclable process of metal wastes goes through stages such as collection, sorting, modification and processing at every stage and has a little value that is added to the raw materials for making more productive uses for the society.

5.2 Conclusion

The study was concluded with very good economic advantages for quorales or metal waste collectors as a basic self-employment for income generation, avoiding metal wastes from the environment and making the ecosystems free of metal pollutions and social benefits.

Hence, metal wastes collection and recycling serves as sources of industrial raw materials that economically and ecologically advantageous. It is also important for the health of the society in cleaning the residence and workplaces as well as avoiding hazardous materials to secure the citizens. Cleaning the environment or gathering metal wastes (harmful substances) is making the living and work areas free of waste pollutions for the society.

5.3 Recommendations

Based on the findings and conclusion of the study, the following recommendations are provided.

1. The Sanitation Beautification and Parks Development Department of Addis Ababa city should take measures deals with all waste disposal management and particular with metal waste dispersal management systems by supporting with modern mechanical and technological based collections, processing and recycling methods throughout all cities.

2. The Addis Ababa Municipality should also involve to the modern management of wastes in general and in metal wastes management systems in particular.
3. The society of all city residents (urban dweller association, schools, local and non-government organization and private sectors) must be aware of the side effects of the wastes, engage and collaborate in collecting, transporting, and recycling processes.
4. The municipality should recognize and encourage the role of quorales to recycle metal wastes and clean the environment, organize the hand crafts societies and promote to the level of cottage industries.

As a researcher I recommend that priority should be given for clean environment for the prevention from accidental and unexpected results of metal wastes wide spreads to maintain healthy environment and safety of citizens.

References

Addis Ababa city sanitation, Beautification and Park development Agency (2003). Current management in Addis Ababa unpublished material. Addis Ababa, Ethiopia.

Ansari, M. (2012). Municipal solid waste management in kingdom of Bahrain. International journal of water resource and environmental Engineering.

Coffey, M. and Coad, A. (2010). Collection of municipal solid waste in development countries. UNHABITAT, malta.

Degnet Abebaw (2003). Determinants of Solid Waste Disposal Practices in Urban areas of Ethiopia: A house hold level Analysis. Project muse scholarly journals, Ethiopian Economic Association/Ethiopian Economic Policy Research institute, Vol. xxiv(1). Addis Ababa, Ethiopia.

Edmealem Bewuket (2013). Assessment of the sustainability of solid waste collection and transport service by MSE's case of Bahirdar city, urban management: Rotterdam, the Netherlands.

Emery etal., (2000). Analysis of waste entering a typical small land fill site in the south wales valleys phase 2 , Cardiff university , Report no 2683.

Federal Negarit Gazeta (2007). Solid waste proclamation number 5/3/2007, Ethiopia.

Fikru Tesema (2010). Overview of Addis Ababa city solid waste management. Workshop on solid waste management in Addis Ababa(unpublished), Ethiopia.

Hayal Desta (2014). Assessment of the contemporary municipal waste management in urban environment: the case of Addis Ababa Ethiopia. Environmental science and technology.

Kwasi Broni – sefah (2012). A study of the metal waste trade in the Kumasi metropolitan area. Master of science thesis on material engineering, Kwame Nkrumah university of science and technology, Kuamasi.

Maschal, M. Tefera, (2013). Survey conducted on the informal recycling system in Addis Ababa: city of government of Addis Ababa waste recycling and disposal project office: May 2013, Addis Ababa.

Massarutto, A. (2008). Economic Analysis of waste management systems in Europe. In: Clini, C., Musu , I, Gullino, M.L.(eds) sustainable development and

environment. Springer, Dordrecht. https://doi.org/10.1007/978-1-4020-65989-12.

Misrak Workneh(2016). Cyclic disappointment: Fortune Vol. 16 No, 830.

Moyes, R(2008). Perspectives from Lao PDR: metal wastes, Economics and Risk policy and Research director, Landmine action.

Schubeler Peter(1996). Conceptual frame work for municipal solid waste management in low income countries: urban management program working paper No, 9, Nairobi, Kenya.

Tadesse Kuma(2004). Dry waste management in Addis Ababa city. Ecological and environmental economics program conference(unpublished source).

The World Bank & the International Bank for Reconstruction (1999). What a Waste: Waste Management in Asia; Urban Development Sector Unit East Asia and Pacific Region.

The World Bank, (2006). Waste Management in China: Issues and Recommendations; Urban Development Working Papers East Asia Infrastructure Department World Bank. Working Paper No. 9.

The World Bank (2012). Annual report on environmental protection. Washington DC: World bank.

U.S.EPA (United States Environmental Protection Agency), (2016). Advancing sustainable materials management: fact sheet.

UNEP, (2005). Integrated Waste Management Score board. A Tool to Measure Performance in Municipal Waste Management. Retrieved from: http://www.unep.or.jp/ietc/ Publications/spc/IWM_scoreboard-binder.pdf (Accessed date: 28 January 2018).

UN-HABITAT, (2010). waste management in the world cities. Nairobi: UNHABITAT,2010. Retrieved from: http://www.sswm.info/sites/default/files/reference_attachments /UN%20HABITAT%202010%20%20Waste%20Management%20in%20the%20W orlds%20Cities.pdf (Accessed date:28 January 2021)

USAID, (2004). How to Develop an Effective Waste Collection Program: A Primer for Waste Collection in Manado, North Sulawesi, and Indonesia. Research

Triangle Institute (USA) in association with PT Deserco Development Services. Retrieved from: http://pdf.usaid.gov/pdf_docs/PNACY593.pdf (Accessed date: 25 April 2021).

Zhu. D. Asnani, U.P. Zurbrugg, C. Anapolsky S. and mani, S. (2008). Improving municipal waste management in India: A source for policy makers and practitioners. Available at http :// WWW. Infibeam.com (Accessed date: may 2011).

Zurbrugg, C. (2002). Urban solid waste management in low-income countries of Asia how to cope with the garbage crisis, in: scientific committee on problems of the Environment(scope) urban solid waste management Review session. Durban, South Africa.

Appendices

1. Survey based on observation checklist

Quorales	**Station one survey-based observation checklist**							
	Steel	Tin	Aluminum	Copper	Zinc	Brass	Comp.parts	Others
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Quorales	**Station two survey-based observation checklist**							
	Steel	Tin	Aluminum	Copper	Zinc	Brass	Comp.parts	Others
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Quorales	**Station three survey-based observation checklist**							
	Steel	Tin	Aluminum	Copper	Zinc	Brass	Comp.parts	Others
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Quorales	**Station four survey-based observation checklist**							
	Steel	Tin	Aluminum	Copper	Zinc	Brass	Comp.parts	Others
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Quorales	**Station five survey-based observation checklist**							
	Steel	Tin	Aluminum	Copper	Zinc	Brass	Comp.parts	Others
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Quorales	**Station six survey-based observation checklist**							
	Steel	Tin	Aluminum	Copper	Zinc	Brass	Comp.parts	Others
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Quorales	**Station seven survey-based observation checklist**							
	Steel	Tin	Aluminum	Copper	Zinc	Brass	Comp.parts	Others
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Quorales	**Station eight survey-based observation checklist**							
	Steel	Tin	Aluminum	Copper	Zinc	Brass	Comp.parts	Others
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Quorales	**Station nine survey-based observation checklist**							
	Steel	Tin	Aluminum	Copper	Zinc	Brass	Comp.parts	Others
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Quorales	**Station ten survey-based observation checklist**							
	Steel	Tin	Aluminum	Copper	Zinc	Brass	Comp.parts	Others
1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

2. ቃለ-መጠይቅ

በመርካቶ ምንአለሽ ተራ ላሉት 7 የብረታብረት ቆሻሻ ገዢዎች ጋር የተደረገ የቃለመጠይቅ ጥያቄዎች ዝርዝር

1. የስራ መስክ እና መተዳደሪያችሁ ምንድነው?
2. የብረታብረት ቆሻሻን ከየት እና ከማን ትገዛላችሁ?
3. የብረታብረት ቆሻሻ የዋጋ ተመን እንዴት ይወሰናል?
4. የብረታብረት ቆሻሻን ወደ አገልግሎት መቀየር ሂደት እና ጥቅም ላይ ማዋል የሚቻለው እንዴት ነው?
5. የብረታብረት ቆሻሻን መልቀም እና ወደ አገልግሎት መቀየር የሚሰጠው ጥቅም፡

   ሀ) በገቢ ምንጭ(ኢኮኖሚ) ረገድ

   ለ) በአከባቢ ጥበቃና

   ሐ) በማህበራዊ አገልግሎት የሚሰጠውን ጥቅም ቢዘረዝሩ