FACTORS AFFECTING THE PERFORMANCE OF SOLID WASTE MANAGEMENT PRACTICE IN CASE OF ADDIS ABABA; SOME SELECTED SUB-CITY

BY

ABERAMULATU ANBERBER

ADVISOR

DR. LAKEW ALEMU

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Approved by Board Examination

_____	_____	_____
Advisor	Date	Signature
_____	_____	_____
Internal Examiner	Date	Signature
Temesgen Belayneh (PhD)	05/10/21	
External Examiner	Date	Signature
_____	_____	_____
Chairperson, Department of Graduate Committee	Date	Signature

I declare that this thesis, titled "Factors Affecting the Performance of Solid Waste Management Practice in Addis Ababa Some Selected Sub Cities," is my work and has not been presented by anyone else; and that all source materials utilized in this thesis have been properly acknowledged.

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Signature: _____

Date: _____

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Asserted by: Name: _____ (Thesis Advisor)

Signature: _____

Date: _____

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LIST OF ACRONYMS AND ABBREVIATIONS

AU:	African union
CAA:	Cleaning Administration Agency
CEA:	Central statics Agency
CES:	Code enforcement service
ECA:	Economic Commission for Africa
EPA:	Environmental Protection Authority
MEDC:	Ministry of Economic Development and Cooperation
MSWM:	Municipal solid waste management
SD:	Standard Deviation
SMI:	Small and micro-enterprise
SPSS:	Statistical Package for Social Science
SWM:	Solid waste management
SWSMI:	Solid waste small and micro-enterprise
UN:	United nation

Abstract

This study was focused on the influencing factors of Solid Waste Management (SWM) in Addis Ababa. Its main purpose was to identify the main determinant factors of the poor solid waste management systems to improve the performance of the SWM system as a whole for the benefit of the public. The study had three objectives, which were as follows: (a) to determine the effects of technology on the performance of SWM in Addis Ababa., (b) to establish whether institutional structure significantly affects the performance of SWM in Addis Ababa. (c) To establish the effects of knowledge on the performance of SWM in Addis Ababa. Based on the objectives, three research questions were developed and in addition, a conceptual framework was outlined. The study was used a cross-sectional descriptive survey research design. This enabled the researcher to describe the relationship between the variables identified in the conceptual framework. The sampling procedure was used by dividing the total population into strata and then by using a non-probability convenience and purposive sampling strategy, while a questionnaire and interview were used as the main data collection instrument from a sample of 300 respondents includes political leaders, technical staff, solid waste workers, group leaders, and solid waste small & micro-enterprises. Both descriptive and inferential statistical tools were used in data analysis. The researcher was used the SPSS (Ver.26) computer statistical package for data analysis. When undertaking quantitative data analysis, descriptive statistics were utilized to present mean, frequencies, and percentages. In addition, Pearson correlation was employed for inferential statistics. According to the findings, institution accounts for 59.7% of the change in SWM, technological aspects accounts for 25.3 percent of the change in SWM, and knowledge aspects account for 50.3 percent of the change in SWM. As a result, it was concluded that both institutional, technological, and knowledge have a positive and significant effect on the performance of solid waste management in Addis Ababa city. It is advised that the city administration take more consideration to improve its performance of SWM practice by implementing the recommendations made in this study.

Key words: Addis Ababa city administration, institutional factors, technology, knowledge, the performance of SWM.

CHAPTER ONE

1 INTRODUCTION

This study was centered on factors affecting the performance of SWM practice in Addis Ababa some selected sub-city. The chapter presents the background to the study, Statement of the Problem, research objectives, Research Questions, significance of the study, the scope, and organization of the study.

1.1. Background to the study

Waste is any substance that is discharged, deposited in the environment in such a volume consistently or manner as to cause an alteration in the environment. While solid waste is any solid or semi-solid materials generated from household, business institutions, industries, various organizations, garage, street cleaning, constructions, agriculture, animals, and generally from the activities of the society and dumped as it is useless or unwanted (Addis Negarigazeta, No.100/ 2018).Moreover, SWM means collecting, treating, reusing, recycling and disposing of solid materials that are discarded because it has served its purpose or it is no longer useful.

SWM is strongly influenced by the time of the year, traditions and personal income. Individuals with more income generate more solid waste than lower income earners; equally, people concerned with the environment generate less solid waste ((McAllister, 2015). SWM at both the global level and national level has attracted a lot of concern in some countries. While in others a lot still needs to be done to manage it properly.

Now a day managing solid waste properly and affordable is one of the key challenges of the 21st century, and one of the key responsibilities of the city government(World, 2010). Improper managing of solid waste sacrifices social, economical, and environmental crises to society. A solid waste crisis can significantly undermine the credibility of city governments in the world (Zemena, 2016).

According to (Noufal et al., 2020), appropriate solid waste management remains a critical concern, particularly in economically developing countries. Because of the growing population, rising standards of living and lifestyle, industrial and production, and consumption of new

products are acting in concert to generate increasingly greater quantities of solid wastes and this, in turn, is creating serious problems of their management and proper disposal.

Studies indicate that the solid waste management system in developing countries becomes a critical problem; including poor collection service, illegal dumping, waste burning in open areas, poor waste handling system, and improper management of disposal sites (McAllister, 2015). These causes social, economic, public health, and management problems, which hinder the performance of an effective solid waste management system (N. Ejaz et al, 2010).

Like other developing country cities, our capital city, Addis Ababa has faced the above problems of SWM service. Addis Ababa with more than 100 years of its age and serving as capital city of Ethiopia with great geographical diversity endowed with rich natural and human resource base, and yet it is one of the cities in the world with the sit of many higher international communities and diplomats as well as the head quarter of AU, ECA; has attracted not only domestic and international companies, but also pulling rural and other urban center population towards. As a result, its socioeconomic as well as geophysical environment changes actively. For administrative purpose, the city divides in to three governmental structures. At the top level, city administration, at the middle, 11 sub cities and 117 woreda at local level.

Actually, Addis Ababa has better social, economic, political, and infrastructure services than the other cities of Ethiopia. However, due to both natural growth and urban migration the development is very slow to meet the demands of the increasing population (Regassa et al., 2011). Based on the CSA census (1994), the city is characterized a rapid population growth and urbanization. The estimated population is the fast-growing rate (about 5% per annum) which increases service demand by generating large amounts of solid waste.

The current constitution of Ethiopia under article 44 and the charter of Addis Ababa city have set "all persons have the right to live a clean and healthy environment." From these charters, the city government endorsed SWM policies, laws, rules and regulations. This implies that in Ethiopia SWM has governed by a legal frame.

To implement these policies, laws, rules, and regulations of SWM, the Addis Ababa city government committing to applying the green economy strategy in the city by establishing the beautification and parks development and solid waste management agencies from the city up to

woreda level. Additionally, a Code enforcement service (CES) was also established to control and monitor the illegal dumping of solid waste in the city.

The financial reports of the city also indicate that the city government budgets relatively large amounts of funds for improving the SWM system. To sustain the SWM system the city administration creates monthly cleaning programs and participating with various stakeholders and actors in cleaning and beautifying the city.

Despite all these efforts of the city administration, sub-city, small& micro enterprises, private sectors, and individuals are exerted, the SWM problems persist. The social, environmental and health problems due to solid waste has continued to plague (Hailemriam, 2008). Due to an increment of generated solid waste, environmental pollution becomes increases from time to time. Residents of the city still dispose of solid wastes along the river, ditches, open space, roads and roadsides, even the greenery area of the city illegally. The sensitivity of the residents for air pollution is very less. They burn solid wastes in open space and hazard waste incineration without treatment for gas emissions (Hailemriam, 2008)

The research materials are scarce in the subject area. The existences of these problems are good examples to understand the gap between the performing capacity of the city and the demand of the society. Therefore, the researcher believes that it is the alarming signal for the existence of overall SWM problems that need to be studied.

1.2. Statement of the Problem

In many developing countries, solid waste management is becoming a major public health and environmental concern (Mohsin & Chinyama, 2016). Population growth intensifies the pressure on urban infrastructure in many cities of the developing countries which already are overburdened with the provision of urban services. As noted by (Mohsin & Chinyama, 2016), the explosive growth of cities in the developing world has outpaced municipalities' financial and manpower capabilities to deal with the provision and management of services, the most important of which is solid waste management. Lack of these services greatly affects the urban poor, women, and children who are vulnerable to health hazards. Twenty-two human diseases are related to improper solid waste management ((World Bank, 2010).

Similarly, Addis Ababa, like other developing-country cities, confronts issues related to poorly manage solid waste operations. According to the yearly report of the city solid waste management department, waste is responsible for 80% of communicable diseases. Furthermore, its consequences include decreased productivity, low income, bad quality of life, and a deteriorating environment (UN, 2010).

Currently in Addis Ababa, solid waste is increasing beyond the management capacity of the municipal governors, the volume of waste totals more than three million cubic meters per year with the prospect of an increase by a constant rate of 2.1 cubic meters per person annually. However, the (2010) estimate of UN shows that only 65 percent of the waste generated in the city is collected, disposed of the rest in open sites, drainage channels, and rivers. This fact can be observed by strolling on the street of Addis Ababa city, where residents might not find it strange to see overflowing garbage skips often rendered for their putrid smell. The best remedies, individuals can do in such a scenario is to cover their nose or hold their breaths and walk (Mohsin & Chinyama, 2016).

Concerning the organization of operations and management structure, collection and disposal are parts that are poorly organized. A disposal site situated at one corner of the city is also the main determining factor for the collection and disposal of wastes in the city(Zemena, 2016). This means that it is only those people close to the dumpsites that benefit. Dumpsites and trucks for solid waste disposal are insufficient and not modern. In densely populated woreda, the majority of people live 0.5 –1.00 km from accessible roads where transfer containers are located, when the recommended distance is 150 m from the housing units. Industrial or hazardous waste is not segregated from the source, both types of wastes are dumped in one landfill (Hailemriam, 2008). These the above problems must be solved by researchers.

The past studies found that solid waste management performance factors which are financial constraints, technical problems, and social factors significantly influence solid waste collection, transportation, and disposal (Zemena, 2016). Furthermore, some literature found that lack of material, improper allocation of resource, less community participation, and disposal site have a significant factor that accounts for poor solid waste management service delivery ((Regassa et al., 2011);(Hailemriam, 2008)and (Koyachew, 2016). According to (McAllister, 2015), Planning, administration laws, and monitoring/evaluation are also some of the influencing factors of poor

solid waste management practice.

On the other hand, (Pussadceloor et al, 2017) concluded in their studies that, knowledge was one of the influencing factors on the effectiveness of SWM practice. But (Gunasiri & Senadheera, 2019), by disproving this result he concluded that knowledge has not any significant effects on the performance of SWM. Then to clarify this discrepancy result the researcher selects knowledge as one influencing factor.

Despite the above interventions, solid wastes remain littered all over the city . You can hardly fail to see Solid waste when you approach city administration. Past studies are few and not evident. In addition, the studies were conducted several years ago, and there have been economic, political, and socio-cultural changes since then. Any good policies and strategies need to rely on timely information if they are to improve the performance of solid waste management in the city.

A major gap in the current study on SWM in the city is that the system is rarely investigated in its entirety, and assessments combining modernizing the SWM system and creating a skill full society in SWM(Ramani & Mehra, 2017) practice were still largely absent. Based on its sensitivity and public demand, the practical solutions for the causes of problems of solid waste management service are not still solved and it has remained a good governance issue.

However, there was a dearth of research that examines the effect of knowledge, institutional aspects, and technology on the performance of solid waste management practice. Adequate knowledge education on solid waste management directly affects the performance of the organization, the health, and the hygiene of the society(Laor et al., 2018). Technology is also one of the influencing factors that could affect the strength, efficiency of the solid waste management system in the organization (Ramani & Mehra, 2017). (Naveed et al., 2013) state on his research that, the institutional intervention was significantly affects the improvement of solid waste management performance in the firm.

This study addressed the topic of the influencing factors that affect the performance of solid waste management in Addis Ababa some selected sub-city. Considering this, the recent study examines knowledge, institutional aspects, and technology as the influencing factors of the performance of solid waste management in the city. In this paper, the researcher has reported the

investigation of determinant factors of the poor solid waste management system to improve the performance of the SWM system as a whole for the benefit of society.

1.3. Objective of the Study

1.3.1. General Objective

The general objective of this study was to identify the main determinant factors of the poor solid waste management systems to improve the performance of the SWM system as a whole for the benefit of the public.

1.3.2. The specific objectives of the study include:

1. To establish whether institutional structure significantly affects the performance of solid waste management practice in Addis Ababa city.
2. To determine the effects of technology on the performance of solid waste management practice in Addis Ababa city.
3. To establish the effects of knowledge on the performance of solid waste management practice in Addis Ababa city.

1.4. Research Questions

This section contains questions that guide the focus of the study about what the objectives of the study intend to attain. Therefore the study was guided by the following research questions to answer the research problem.

1. To what extent applying technology to solid waste management influence the performance of solid waste management practice in Addis Ababa city?
2. Does institutional structure significantly affect the performance of solid waste management practice in Addis Ababa city?
3. To what extent does knowledge on solid waste management influence the performance of solid waste management practice in Addis Ababa city?

1.5. Research Hypothesis

A research hypothesis is a tentative answer to a research problem that is advanced so that it can be tested (Klassen et al., 2016)..

This study proceeded from the factors that influence the performance of solid waste management practice positively or negatively. The research was guided the following research hypothesis:-

- The institutional structure significantly affects the performance of SWM practice in Addis Ababa city.
- There is a positive significant effect of applying modern technology on the performance of SWM practice in Addis Ababa city.
- There is a positive significant effect of knowledge on the performance of SWM practice in Addis Ababa city.

1.6. Significance of the study

The result of this study will contribute to the current performance of solid waste management practice and its influencing factors in Addis Ababa city. Practically, the finding of this research will have the following significance:-

- To show the current performance of the solid waste management system.
- To provide a clear understanding of how knowledge, technology, and institutional aspects influence the performance of the SWM system and which could help the government to make plans and policies for municipal solid waste management /MSWM/system through a better understanding of the issue.
- To initiate another researcher for further in-depth study on the solid waste management problems.

1.7. Scope of the study

This study was investigated the influencing factor of the performance of solid waste management practice, Case study of Addis Ababa some selected sub-city. It was particularly focused on the solid waste knowledge, technological and institutional aspects as related to the performance of solid waste management.

Accordingly, data collection was made based on a sample survey to cover more relevant information regarding municipal solid waste reduction, generation, collection, storage, treatment, transportation, and disposal and as well as on the knowledge of stakeholders, application of technology on SWM system and institutional structures.

1.8. Limitation of the study

There is some limitation that was faced in this research. The limitation envisages are, first, the literacy level of the respondents. This was solved by using simple language or translating the questionnaire into the Amharic language. Secondly, the respondents were not volunteered due to the Covid19 epidemic. It is also mitigated by clearly applying the preventing methods of covid 19 during conducting the questionnaire. Thirdly, the research data was collected only by cross-sectional survey; it only shows the current status. Fourthly, the data was collected by interviews and questionnaires excluding field observation. Lastly, the study was localized in only two sub-cities in Addis Ababa. It would have been better to cover the whole region to increase its generalizibility. However, necessary precautions were made so as these limitations not to be affecting the findings of the study.

1.9. Organization of the study

The study was structured into five chapters. The first chapter consists of the information about the introductory part which includes background to the study; statement of the problems, objectives of the study, research questions, hypothesis of the research, the significance of the study, limitation of the study, and organization of the study. The literature review is incorporated in the second chapter. It is concerned with the review of different researchers and related literature about the performance of SWM. The third chapter was contained the methodology part which describes the study area, research design, data source, sample technique and procedure, data collecting methods, and methods of data analysis. The main body of the study result and discussion were practice in chapter four. Chapter five was devoted to the study of summary, conclusion, and recommendation of the study.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Introduction

The literature review chapter will present four sections which are the theoretical review, the knowledge, and solid waste management, the technology and SWM, institutional aspect and SWM, the empirical review of the literature, and lastly the conceptual framework of the study.

2.2 Theoretical review

2.2.1. Solid waste management concept

According to the Ethiopian environmental protection Act (1990),“ waste is any substance which contains scrap materials or any effluent or other unwanted surplus substance arising from the application of process, or any substance which requires to be disposed of as of being broken, worn-out, contaminated otherwise spoiled” .Solid waste is something that has unusable residues in raw materials which are removed from society (Girmay et al., 2019).

In general municipal solid waste management means refuse, nonhazardous from households, commercial center, institution wastes, waste from industries, market, wastes from street sweeping, and all these encompass the function of generation, collection, storage, transportation, recycling, reuse, and final disposal (Town et al., 2017).

Solid waste is directly linked to human activities and development, both technologically and socially (Schübeler, 1996). With the progress of civilization and human development, the population becomes increases and urbanization will expand, then the waste generation becomes more complex since waste generation depends on population (Achi et al., 2012). Based on (Kinnaman, 2009), estimated that the generation rate of global municipal solid waste at 1.3 billion tons per day.

Therefore, the need to manage these solid waste problems is mandatory for each country of the world (Komakech, 2014). Because solid waste management is a crucial public service issue affecting both environment and public health (Girmay et al., 2019). The handling system of solid

waste has its own rule and procedure. The international accepted and recommended solid waste handling system has the following hierarchal order which is; collecting, open burning, dumping, reuse, recycling, reduce and prevent. While dumping and open burning are mostly applied in developing countries but it is the least preferable and not recommended (Jama Farah, 2019).

The problems of solid waste management /SWM/ are more serious, especially in the developing world. (Guerrero et al., 2013) state that, one-third or two-thirds of the solid waste generation is not properly collected which is dumped on the drainage, streets and it contributes to flooding and the spread of diseases.

2.2.2. Current solid waste management practice in Addis Ababa

Waste management systems are a collection of phrases for controlling the movement of materials through a city. It encompasses the movement of materials from the point of origin (source) through the point of final treatment and disposal (Zemena, 2016).

2.2.2.1. Waste generation rate

The daily solid waste generation of Addis Ababa is expected to be 2,297 m3 or 765 tons. The average trash generation rate per person is 0.45 kilogram per day. The generation of solid trash per capita, on the other hand, varies seasonally (world bank, 2017)

In Addis Ababa, 65 percent of daily solid waste is collected, 5 percent recycled, and 5 percent composted. The remainder (25%) is simply dumped on open sites, drainage channels, rivers, and valleys, as well as on the streets (70%) of waste is generated by households, 9% by commercial areas and 6% by street sweeping, 5% by industrial waste, and the remainder by hotels, hospitals (United Nations Environment Programme (UNEP), 2005)

2.2.2.2 Waste source and composition

In Addis Ababa Solid wastes are generated from different sources, 76% from a household, 18% from commercial waste, and only 6% from hotels and streets. The physical composition of solid wastes are 42% vegetables, 2.5% paper,2.9% plastics, 2.3%wood, 1.1% bone , 2.4% textiles , 0.9% metals, 0.5% glass , 15.1% combustibles leaves, 2.5% non-combustible stones and 65% all fines (Zemena, 2016).

The majority of the compositions are biodegradable solid wastes such as leftover food, seed coats, grasses, garden wastes, animal wastes, ash, dust, leaves, paper, wood scraps, bones, straw, dead animals, cardboard, cartons, and paper packaging materials. This can readily be converted into resources such as combustibles and recyclables. However, this possibility is not being taken advantage of, and solid waste management in Addis Ababa continues to be a problem for the environment, health, and ascetics (United Nations Environment Programme (UNEP), 2005)

2.2.2.3. Elements of effective solid waste collection

According to (MacRae & Rodic, 2015) Solid waste collection and transportation place the biggest strain on municipal budgets and have the largest influence on city life. Solid waste collection is defined as the storing of waste at home, shop, or business, as well as the transportation of waste until it reaches a final treatment plant or disposal site.

The following factors should be considered during waste collection. These are the following: **The frequency of waste collection**: is an important metric or criterion for any waste collection system since it concerns the number of times waste is collected each week or more than once per week. Allowing garbage to accumulate for an extended period will result in unpleasant air pollution. The frequency with which waste should be collected is determined by the ambient temperature of the location. Because the reproduction cycle of disease-causing organisms such as flies is faster at high temperatures and results in foul odor, trash should be collected more regularly, at least twice a week in hot climates (Zemena, 2016).

Reliability: It is also important that the frequency does not change so that households and users know when their solid waste will be collected. Unexpected fluctuations in frequency erode trust in the waste collection service (Personal & Archive, 2016).

The point of collection: is where the solid waste goes from the control of the waste generator to the control of the waste collection enterprises. Another determining element is that the generator is responsible for transporting the solid waste to the collection location, and so is worried about the time and effort involved and must be willing to do it (Tadesse, 2003).

Vehicle type for waste collection and transport: Using general-purpose vehicles that are inefficient and unsuited to waste collection is a major blunder that is commonly made in

underdeveloped countries. It's also important to remember that old waste collection vehicles are significant emitters of pollutants (Zemena, 2016).

The municipality is responsible, and it spends a significant percentage of its budget on solid waste collection, transportation, and disposal, which is separated into two sub-systems: primary and secondary collection. The Agency has built Sub-city and Woreda Cleansing branch offices to expand its scope and ensure uniformity of service. Primary collection is now done by private companies, micro, and small businesses, following the establishment of the solid waste management proclamation no.513/2007. Addis Ababa City is currently divided into ten sub-cities and 117 Woredas, each of which has contracted with a different waste management company to collect and dispose of solid garbage (Cleaning Administration Agency (CAA,2015)

The collection of solid garbage from these Woredas has been assigned to 72 SME's and 37 private sector organizations. The Cleansing Administration Agency focuses on giving permits to private companies, associations, and cooperatives, as well as directing and coordinating waste disposal services and encouraging relevant groups to participate in Solid Waste services, among other things (CAA, 2015). The cleansing offices in the sub-cities are primarily responsible for providing technical assistance, such as vehicle assignment. The Woreda Cleaning Administration Offices are responsible for overseeing waste collection, monitoring the public-private cooperation, managing disposal locations, and cleaning main roads.

2.2.2.4. Elements of effective solid waste transportation

These actions are linked to the transfer of waste from public storage facilities to a collection vehicle, as well as the subsequent transportation of waste to a disposal location. The transferring of waste or commodities from a primary collection vehicle to a secondary, larger, and more efficient transport vehicle is referred to as transfer. Transportation, on the other hand, refers to any vehicle that is used to carry solid waste from its source to a transfer station and then to a treatment or disposal facility (Gedefaw, 2015).

According to (MacRae & Rodic, 2015) Specifying and implementing a suitable number of tiny transfer stations is more useful than a single large one. Inefficiencies and waste can result from improper transfer arrangements. The manner of loading waste from storage into the pickup vehicle must be carefully considered because it has an impact on the workers' health as well as

the cost of the service. Some solid waste loading methods put workers at risk of coming into contact with the waste, inhaling dust, and being involved in traffic accidents.

According to, (Tesema, 2010) a final waste disposal site should be carefully chosen and fenced to prevent stray animals from entering and to minimize the impact of garbage on the surrounding environment. Solid waste is transported by City Administration trucks as well as private sector vehicles. The current reality in Addis Ababa, where solid waste hauling roads are not accessible to the level required, and even some of the available trucks do not all work to their full potential daily due to their age, frequent accidents, and maintenance issues (Zemena, 2016).

2.2.2.5. Elements of effective disposal system

In a solid waste management system, this is the final functional component. The final deposit of solid wastes straight to a landfill site is related to disposal activities. All solid wastes, whether they are residential trash or residual materials from materials recovery facilities, are currently disposed of either land filling or land spreading. However, in most modern countries, this approach is officially prohibited, with final disposal limited to hygienic landfills. Because a sanitary landfill is not a dump, but rather an engineered facility for disposing of solid wastes on land without causing public health or environmental hazard (Hocking, 2006).

Waste is collected and disposed of by City Administration trucks and private sector vehicles in Addis Ababa. There was a single open dumpsite where all of the solid waste was dumped. It has been in operation for more than 50 years. The location is known as "Rappi" or "Koshe" and is located in the city's southwest corner. The city center is 13 kilometers away. It covers a total of 25 hectares. The debris was hauled by truck, spread and leveled by a bulldozer, and compacted by compactor or bulldozer in a crude open dumping process. One of the system's identified challenges was the disposal site (Zemena, 2016). The location, which was surrounded by housing areas and institutions, was quickly filling up. Residents in this area face hazardous and health risk.

2.2.2.6. Regulations governing solid waste management

In Addis Ababa today, various laws and rules are governing the management of solid waste. The Environmental Protection Authority (EPA) has primary responsibility for enforcing regulations that safeguard the urban environment and solid waste management at the national level. In 1997, the EPA released an Ethiopian environmental strategy in partnership with the Ministry of Economic Development and Cooperation (MEDC), which covered topics of solid waste management (EPA, 1997). However, it was not until 2007 that the first national solid waste policy was released. The policy's goal was to "improve at all levels capacities to prevent potential negative consequences while developing economically and socially useful assets out of solid waste" (FDRE, 2007: 3525). The policy covers the solid waste collection, transportation, and disposal. It generally refers to the responsibility of municipal governments to provide effective solid waste planning, implementation, and monitoring. The focus is on the city administration's responsibilities and on decentralizing responsibilities to the lowest levels of administration to fulfill the obligations. The proclamation's third section addresses requirements for managing waste glass, plastic bags, used tires, food, household garbage, and construction trash sustainably, with a focus on the correct treatment, segregation, reuse, and recycling. Part four is about solid waste transportation and disposal, with an emphasis on the technical examination of vehicles used to carry solid waste and assuring proper management of disposal sites by environmental rules.

The Waste Management Collection and Disposal Regulation of the Addis Ababa City Government (AACA, 2004) was released by the city administration in 2004 and serves as a framework for how individuals and commercial organizations should manage and dispose of their solid waste in a sustainable manner (Vergara & Tchobanoglous, 2012). According to the proclamation, Private investors' tasks and obligations are to collect solid wastes from hotels, hospitals, government offices, palaces, and other locations utilizing compressors and dump trucks. They must train their personnel on solid waste handling daily, keep their containers and trucks clean, and dispose of abandoned material regularly. Even though all of the regulations are beneficial in theory, the city government and inhabitants rarely follow them, and little is done to enforce them (Vergara & Tchobanoglous, 2012).

2.2.3. Factors influencing the performance of solid waste management practice

2.2.3.1 Institutional factors and SWM

(Schübeler, 1996) state that "Institutional aspects concern the distribution of functions and responsibilities and correspond to organizational structures, procedures, methods, institutional capacities, and private sector involvement."

Most studies state that the performance of solid waste management/SWM/ to be successful it requires integration of many individuals, group and organization into a partnership like the national government, private sectors and other work-related institutes (MacRae & Rodic, 2015).

On the other hand, decentralization is an excellent institutional approach to dealing with SWM (United Nations Environment Programme (UNEP), 2005). And this study states that, to have efficient and effective SWM, equitable distribution of authority and responsibility from national to local managerial level. Especially, Local governments have more responsible for routine activities such as sweeping, collecting, transporting, and disposal service (MacRae & Rodic, 2015). At this level, community-based organizations such as small enterprises have a responsibility to manage the primary collection, which is a door-to-door collection and transport to the transfer station and often initiated by the resident disparately need for collection and also willing to pay monthly collection charge (McAllister, 2015). For example, most African countries like Uganda give more responsibility to local government and small& micro enterprises for solid waste collection and transportation (Naveed et al., 2013).

Additionally, institutional structure and procedures are also one of the institutional factors that affect the performance of the SWM system. According to an article looking at SWM in the developing world, inefficient institutional structure, inefficient organizational procedure, and deficient management capacity of the institution cause inefficient SWM service (JAMA FARAH, 2019).

Moreover, privatization is an alternative to the government to manage the operation of SWM (SHABANI, 2015). To handle SWM operation public-private partnership plays a vital role (Nzeadibe & Ajaero, 2011). In many cities, solid waste collection, transportation, treatment, and disposal activities are mostly operated by private sectors (Nzeadibe & Ajaero, 2011).

According to (Ziraba et al., 2016)description, private sectors play an important role in solid waste reuse and recycles activities. Most countries participate in private sectors, such as in Malaysia private companies are responsible for providing solid waste collection and transportation materials. Similarly in the Philippines hazardous wastes are incinerated with high temperatures by private sectors (Schübeler, 1996). In general, developing public-private partnerships and improving the participation of private sectors have a significant role in supporting local government throughout all SWM systems (Schübeler, 1996).

To sum up, to increase the performance of solid waste management the institution should be well structure, decentralized, private sector involvement such as competitive bidding, regulatory instrument, and monitoring/evaluation system/ (Schübeler, 1996).

2.2.3.2. Technology and SWM

Solid waste management /SWM/ is a complex process because it involves many techniques and disciplines. These include technologies associated with the control of solid waste generation, handling, storage, collection, transportation, processing, and disposal of solid waste(Vergara & Tchobanoglous, 2012). Most developed countries like Italy, Japan, the USA the UK applying zero waste concepts by introducing the modern way of waste generation, collection, and storage, and incineration of solid wastes (Saleem, 2018). Some developing countries such as Nigeria, Bangladesh, Pakistan, and India strictly apply the concept of 3Rs Reduce, Reuse and Recycle (Jibril et al., 2012). The most technological factor indicators are discussed as follows.

2.2.3.2.1 Incineration

Waste incineration means the capacity of heating the solid waste at a high temperature to minimize the waste volume and mass (Kirkeby et al., 2006). Incineration of municipal solid waste is one of the technological solid waste management systems in many countries, such as Japan, Denmark over 65 % of municipal solid waste incinerated (Ramani & Mehra, 2017). During incinerating solid waste there are six outputs. These are air emission, bottom ash, fly ash, sludge, gypsum, and wastewater. Air emissions are used for the basis of total sulfur contents in the incoming wastes. It is relevant for the production of sulfur dioxide (S_2O) and sulfuric acid (H_2S). The bottom ash has treatment for use in constriction but sludge, gypsum, and flies ash can only is landfilled.

2.2.3.2.2. 3R's/ reduce, reuse and recycle/ and SWM

Applying 3Rs skill full technology is important to minimize the volume and mass of solid wastes. The internationally accepted guidelines for waste management practice emphasize reducing waste at the source, where waste can; it can be prevented, reuse should be explored, recycling option will be encouraged if the waste cannot be reused (Jibril et al., 2012).

2.2.3.2.3. Recycle and reuse solid waste

The best solid waste management practice is implementing the concepts of 3Rs, developed countries are well-practiced but developing countries are still trying to apply it (Jibril et al., 2012). Most of the components of municipal solid wastes like glass, plastic, paper, metal can be reused and recycle at certain times. Some studies indicated that 28 to 48 % of municipal solid wastes are composed of such components (Jibril et al., 2012). The latest technologies that we apply in reuse and recycle solid wastes are discussed below.

2.2.3.2.4. Deinking technology for paper recycling

Deinking technology was introduced years ago in developed countries, while still latest in developing countries. It is the process of removed paper ink from the recycled paper slurry. In developed countries like Europe, the annual production rate of the deinked pulp has increased by 15% (Kirkeby et al., 2006). According to (Chu et al., 2016), a study newspaper can be recycled/ deinked/at least five times.

2.2.3.2.5. Biodegradable and degradable plastics

(Kirkeby et al., 2006) describe that, "biodegradable plastics can be introduced to composting or anaerobic digestion along with organic to give productive output." It is a new technology which able to degrade 90% of itself with three months. This process helps to slow and self-degradation due to oxygen and sunlight. And also there is a physical disintegration, which means lose its shape (Saleem, 2018).

2.2.3.2.6. Remanufacturing

This technology has been applied for the remanufacturing of Brocken glass and plastic bottles. This process is done by melting and remanufacturing glass, plastic bottles, and containers (Kirkeby et al., 2006).

2.2.3.3. Collection and transportation

In an integrated solid waste management system modern transportation and collection of solid waste involve many emerging technologies (Wanjau et al., 2016). The modern technologies that we apply in the solid waste transportation and collection process are discussed below.

2.2.3.3.1. Underground collection system

In this technology, solid waste containers are being replaced in underground and semi-underground points (Bogner, 2009). The process is carried out using special trucks. This technology is more appropriate especially in the very hot climate region as the waste would be stored relatively low temperature than the above one. It is applied at a low cost and has more aesthetically acceptable (Ziraba et al., 2016).

2.2.3.3.2 Web-based GIS (geographic information system)

The application of GIS technology for solid waste collection and transportation becomes more popular in developed countries. It is important to manage municipal solid wastes from production sites to the disposal points, by optimizing and automating every step of the cycle (Idowu et al., 2012). Many studies state that applying web-based GIS technologies is 80% efficient for optimizing waste collection and segregation (Idowu et al., 2012). It is important for giving information about several residents, more related routs, several contacts their validation, and the transfer station(Rada, 2013).

2.2.3.3.3. Waste Bin monitoring technology using a global system of mobile/GSM/

This technology is used by a combination of Zigbee technology and a global system of mobile for solid waste collection in the field. To apply this technology sensors are placed inside the garbage to detect the maximum level of solid waste. As the garbage riches at an optimal level,

the sensor will be transferred the massage /SMS/ for collectors and the driver of the collection truck to pick the garbage urgently (Komakech, 2014).

2.2.3.3.4. Compact waste collection trucks

Because of narrow and congested roads, many developing countries use small garbage collection trucks. Nowadays latest technology introduced solid waste compact trucks to increase the collecting capacity of the vehicle. The achievement of this compactor has a high compression rate of ten times that of a flat pile truck (Rada, 2013). This technology is not only increasing the collection capacity of the vehicle but also increases fuel efficiency, which is more economically and environmentally feasible (Management et al., 1994).

2.2.3.4 Knowledge and SWM

Solid waste management is the process of generating, collecting, storing, transporting, processing, and final disposal (Vergara & Tchobanoglous, 2012). All these processes are needed their knowledge, skill, and awareness. Some studies have indicated that if the stakeholders and employees have enough knowledge and awareness about SWM they manage solid waste efficiently and effectively (Tesema, 2010). Therefore, the knowledge of stakeholders on solid waste management systems has an influencing factor on the performance of the organization. (Shahzadi et al., 2018) argued that, solid waste generation and handling is influenced by the level of family and stakeholders' educational background.

(Adeyemo et al., 2013) also state in his study that, every stakeholder needs to have a proper understanding of waste hence waste is the result of human activities. In addition, the performance of SWM practice improved based on the educational level of households, solid waste managers, and employees(Gunasiri & Senadheera, 2019). Moreover, (Yakubu, 2017) hypothesized that "the higher the level of education the more would appreciate the consequences of mishandling of solid waste and the more value the individual would give to avoid the risk of being a victim of the unclean environment".

According to (Lanka & Lanka, 2018) argument in his study, the main challenges of SWM in developing countries are limited human capacity and waste management knowledge. Most staffs of the SWM and environmental protection agencies lack adequate training and they are not

updating in their knowledge in SWM practice. To fill the gaps of knowledge and skills of the community on the handling of solid waste, educating and adequate training of the society is important.

Additionally, (Mamady, 2016) states that public awareness and public education have a key role in changing the SWM practice at the local level. He also concludes that an informed society can do more to improve the effectiveness of the municipal SWM programs. Therefore, public knowledge, attitude, and practice are the key influencing factors for the performance of SWM in developing countries(Gunasiri & Senadheera, 2019).

Moreover, the research conducted at the Philippines University indicates that the awareness and knowledge of the students on SWM have positive effects on performing the SWM program. (Adeyemo et al,2013). This shows that knowledge has a significant association with practice i.e. public who have good knowledge and also have good levels of practice, and they were able to manage solid waste in a good way (Cheru, 2016).

Therefore, for better understanding of the problems of SWM education or/and knowledge is the key factor (MacRae & Rodic, 2015).

Generally, many studies show that the public educational level, knowledge, attitude, and perception of SWM are the critical influencing factors for successful municipal solid waste management in the city, (Bandara, 2008; Hikkaduwa et al, 2015).

2.2.3.5. Financial factors and SWM

Financial aspects for Solid waste Management concern budgeting, cost accounting, capital investment, cost reduction, and cost recovery (Schübeler, 1996). Operating costs for garbage collection, financial costs, cost reduction and management, cost recovery, and operational finance are also covered by financial resources (Coffey& Coad, 2010; (Schübeler, 1996).). Therefore, proper budgeting, cost accounting, financial monitoring, and financial evaluation are critical to the efficiency of solid waste management.

According to (Schübeler, 1996).officials in charge of municipal solid waste management do not have accurate information about the true costs of operations, owing to a lack of capacity to use available financial tools and methods. Furthermore, financial constraints is the main reason for

inadequate collection and disposal of solid waste in most of the third world countries where local councils are weak and lack of finance (Personal & Archive, 2016).

Operating costs are labor cost, fuel, cost and maintenance cost. in addition to that, financial cost includes costs to own vehicle including their depreciation and the cost of recovery includes refuses collection charge, government grants, and littering fines(Hocking, 2006).Sweeping and collection services account for the majority of overall solid waste management expenditures (Hocking, 2006).

The primary causes of inefficient garbage collection and disposal include a lack of money, which results in insufficient capacity to handle solid waste, low morale among waste workers due to low remuneration, a lack of training, and lastly a lack of knowledge and staff to run solid waste operations (MacRae & Rodic, 2015).

Therefore, to improve solid waste management system improving the status of financial resources, operating cost, and management are important.

2.2.3.6. Technical Factors and SWM

Human resources and technical competence are both in short supply in most developing countries at both the national and local levels. There are a lot of officers in charge of municipal solid waste management have little or no technical background or training in engineering, particularly at the local level or administration (Ogawa, 2002). This is a main reason for lack of comprehensive waste management planning in developing countries.

The improper collection, disposal, and transfer of wastes are the result of a lack of technical knowledge (Zemena, 2016). Household containers, primary and secondary collection vehicles, and equipment are all part of the collection (Muche,2016). Lack of suitable modern waste disposal equipment, a lack of regular training, and the inability to obtain spare parts for damaged or broken vehicles and equipment are all problems that have a detrimental impact on proper trash disposal (Muche, 2016).

Furthermore, the collection and analysis of solid waste statistics are frequently overlooked. As a result, waste management administrators have little opportunity to become experts and create and implement waste management plans that are adapted to their country's specific condition.

This in turn makes it extremely difficult to license or develop technologies that are best suited to the local conditions.

If the container is shared by households, there is a risk that waste will be dumped near it and this will discourage others from putting their waste inside the container (Coffey & Coad, 2010).

All kinds of waste are the result of the absence of management and control of waste, the management and control of solid and liquid waste remain major problem in every town (Tesema, 2010).

Therefore, in order for solid waste management to be technically effective, local governments should offer proper waste collecting systems with qualified personnel, as well as the availability of current vehicles and equipment (Muche,2016). Techniques that have proven beneficial in the developed world, on the other hand, are ineffective in developing countries because they lack the necessary infrastructure and skills to properly administer these technology (Lanka & Lanka, 2018).

2.2.3.7. Expected from the government and responsible body

To enlighten the people on the need to manage and dispose of their solid wastes at designated drop-off points the government should all available media resources (MacRae & Rodic, 2015). Omuta (1987) suggested that school curricula should ensure proper environmental habits and also educational programs should be aimed at developing the skill and knowledge for the prevention of environmental degradation. Agunwamba (2003) argues that the particular needs and socio-economic needs of the people's enlightenment program should be sensitive. And he also commented that the "program should be geared towards encouraging a reuse, recycle and reduce and that the impacts of the environment, economy, and health of not engaging in this activities encourage properly."

2.3 Empirical review

2.3.1 Institutional aspects

(Schübeler, 1996) conducted a study on the challenges of SWM and factors influencing its effectiveness in Buroa city; from an institutional perspective. The study confirmed that the main factors influencing the effectiveness of SWM are institutional factors. It had shown that institutional has a positive significant effect on successful solid waste handling, collection, transportation, and disposal. Also, it reveals that inadequate governance and ineffective public participation in the SWM system were the results of weak institutional arrangements.

(MacRae & Rodic, 2015), carried out a study on the assessment of MSWM in Hawassa town. The study revealed that, to build successful municipal solid waste management service the responsible institutions need to have well structured, organized management that functions within an adequate institutional arrangement, skilled manpower, and strong cooperation with their stakeholders. This study also revealed that the institutional arrangement is free from high influencing of the top managers, which have both vertical and horizontal integration and are characterized by decentralization of authority and tasks.

2.3.2. Knowledge aspects

(Vergara & Tchobanoglous, 2012), conducted a study on the impacts of knowledge and attitude on SWM in Srilanka. The study revealed that Knowledge and attitude are some of the influencing factors for SWM practice in Lanka society.

According to (Tesema, 2010) study on SWM in Addis Ababa: improving the waste management system, revealed that, to improve the SWM system the primary investment of the government should be introducing waste and environmental protection education. This study also shows that the peoples in the administrative position who manage the environment and solid waste are not qualified for the position. In addition, she also concludes that to bring sustainable change in SWM educating some of the population does not enough hence; all residents should have the information on how to be environmentally responsible.

2.3.3. Technological aspects

(Jibril et al., 2012) conduct his article entitled, the latest technology of SWM in developing and developed countries. The article concluded that "proper implementation of latest technologies in the sector of MSW management can play an important role in providing pollution-free and sustainable environment".

Most researchers (Adeyemo et al., 2013) carried out studies on factors affecting municipal SWM, indicate that the technological dimension has a significant influence on the effectiveness of Municipal solid waste collection, separation, and transportation. Every factor has a positive influence on the technological dimension, and therefore impacts the effectiveness of MSWM separate collection accordingly.

According to, (Saleem, 2018) study on the model of factors influencing waste management in Phuket. The study found that technology utilization has a direct effect on people's participation in waste management. The responsibility is solely left on the local administrative organization while local people have a minimum role in decision-making, implementation, benefit, or evaluation. In addition, study findings show that waste behavior has a high direct effect on technology utilization. People believe that local administrative organization is responsible for the technology used for waste management

2.4. Conceptual framework

The Conceptual Framework highlights the goals and ideas that generally influence the creation of solid waste management systems and provides brief descriptions of the fundamental ideas of solid waste management practice. This conceptual framework has linked to the problems or the factors that will be studied to an answer. It is based on the three objectives of the research.

In the conceptualization of the variables of the research, factors are the dependent variable, and these included technology, knowledge, and institutional aspects. In the same way, the performance of solid waste management is the dependent variable.

The independent variables will be broken down into indicators that will study to answer the research questions. The factors can cause a change in the performance of solid waste management.

2.4.1. The technological aspects

This study will conceptualize that when there is a proper use of modern technology in solid waste management systems the performance of solid management systems in the organization will high and vice versa (Management et al., 1994). Applying technology is important for solid minimization, resource recovery, reuse and recycle of waste and improve the environmental performance of both the industries and the public (Wanjau et al., 2016). This means if the organization apply technology for reduction, incinerating, re-use, recycle solid waste from the source of production there is a minimization of solid waste it leads to reduce labor and transportation cost for disposal besides a means of income.

Generating power from waste is one of the major innovative technologies in the solid waste management industry. This technology aims to convert waste to energy in place of the accumulation in the landfill. It also minimizes the landfill management cost (Wanjau et al., 2016). Based on the above-described application of modern technology in all aspects of solid waste management will increase the performance of solid waste management practice of the organization, by minimizing labor, transportation, and landfill cost.

2.4.2. Knowledge aspects

According to (Shahzadi et al., 2018); Inadequate and inappropriate knowledge about how to handle household solid waste can have serious health repercussions as well as a huge environmental impact. People who have a good understanding of how to dispose of household waste can protect themselves from infectious diseases and keep their environment clean.

In the solid waste organization, the management, employees, and public knowledge towards SWM can affect the whole solid waste management system. All steps in MSWMS starting from waste generation, segregation, reuse, recycle, treatment, transportation, and final disposal are facilitated based on knowledge and awareness (Adeyemo et al., 2013). Lack of knowledge about the practice and importance of a proper solid management system is a crucial factor for the failure of a solid waste management service (Tesema, 2010). In general, if there is a common understanding of the integrated solid waste management in the organization; it is easy for management to identify and solve each problem. This leads the performance of the management becomes increase.

2.4.3 Institutional aspects

In the case of institutional aspects decentralization and improved waste management capacity normally requires innovations in the organizational structure, staffing plan, and job descriptions of local government bodies. It increases the competence and autonomy at the local level of management. The relationship between the solid waste management office and other related municipal service sectors needs to be clarified within the overall frameworks of urban management. This cooperation can simplify the works and increase the performance of the organization. Therefore, if the institutions are well structured, decentralized, build their capacities governed by organizational plan, and facilitate privatization the overall performance of organizational performance becomes increase (MacRae & Rodic, 2015).

To sum up, from the above description technology, knowledge, and institutional aspects are some of the influencing factors of the performance of solid waste management practice in the organization.

Conceptual framework

Independent variables/ factors/ Dependent variable

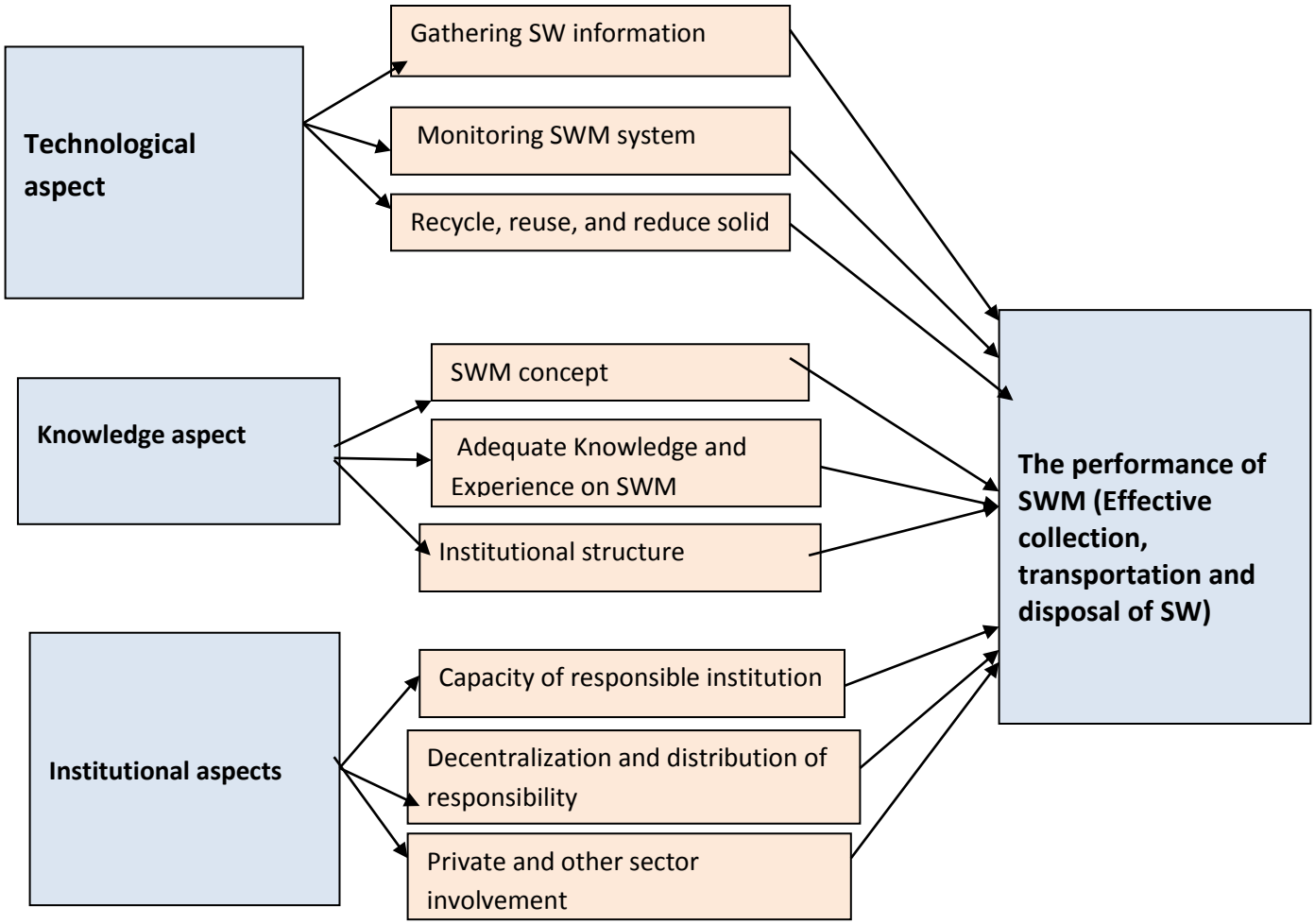

Figure.2.1. the conceptual framework of the performance of solid waste management practices.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research methodologies that were employed to solve the research questions. Moreover, it contains the research design, research approach, research population, study population, data collection methods, sampling size and selection, data analysis methods, reliability, and validity of the study that were used in this research.

3.2. Research Design

The researcher has used a descriptive cross-sectional survey research design which involves observing and describing the behavior of the research variables without influencing it in any way. According to (Ebrahim,2018), this design is used when the study is aimed at collecting data from respondents without the need to make a follow-up of the same respondents thus enabling the researcher to save time in collecting the necessary information.

This study adopted in survey research design which is quantitative and qualitative research in which the researcher administers a survey to sample the entire population to describe the characteristics, behavior, opinions, and attitude of the population (Klassen et al., 2016).

Moreover, the researcher was collect both quantitative and qualitative data by using interviews and questionnaires then statically analyzes the data. In addition, descriptive design is usually applied to achieve the research objectives, such as to estimate the proportion of the populations that have these characteristics, description of phenomena associated with a subject population, and discovery of associations among different variables. However, descriptive research does not make any direct cause-and-effect relationships among variables (Hewson & Laurent, 2012).

Moreover, this research also establishes the causal relationship between variables so that the researcher was adopted an explanatory research design to emphasize studying a problem to explain the relationship between the effects of knowledge, technology, and institution on the performance of solid waste management.

3.3. Research approach

This research was used both quantitative and qualitative research approaches because the qualitative approach allowed the research to solicit information that cannot be quantified while the quantitative approach allowed collecting data that is expressed in figures (Kamoni Margaret Wambui, 2013).

3.4. Study Population

3.4.1. Target population

A target population is a certain group of the population that processes certain attributes that can be classified properly to differentiate them from the whole population. Therefore, the target population of this research was considered all the solid waste group leaders, employees, solid waste small & micro-enterprise, and office manager of Addis Ababa some selected sub-city solid waste management office. This office was selected because it is responsible for solid waste collection, transportation, treatment, and disposal in the city.

3.4.2. Sampling techniques and procedure

From ten sub-cities in Addis Ababa, the researcher has divided the city into two groups based on their size and location. From each group, the researcher was select two sub-cities (Yeka and Kirkos) based on purposive sampling methods. That means Kirkos represents the small and inner-city and Yeka represents the large and developing sub-city. The researcher used also a purposive sampling for respondents especially those who have better knowledge and awareness about the research subject that includes political leaders and group leaders.

Moreover, to choose the representative sample from the employees and solid waste small & micro enterprises the researcher applies stratified random sampling based on their department, from each stratum respondents were selected using a non-probability convenience and purposive sampling strategy. Questionnaire was used as the main data collection instrument. This allowed every member in the sampled population have an equal chance of being selected(Taherdoost, 2016).

3.5. Data collection methods

In this section, the researcher has presented the methods used to obtain the data. It contains face-to-face interviews and questionnaires.

3.5.1. Questionnaire Survey

Questionnaire Survey method is more appropriate for gathering information from the representative sample of the population especially if the respondent number was too large to interview. It is also preferable to save time (Sekaran, 2003). This research questionnaire was adopted from international valid scholars which validity was tested, like (Zemena, 2016), WHO solid waste guideline 1996, Eric. W2016). During this process, the standardized questionnaires were particularly conducted to the respondents upon their willingness. The questionnaire Survey method involves collecting information about the influencing factors of solid waste management /SWM/ practice from a given sample member in a systematic manner.

3.5.2. Face-to-face interview

In this section, the data were collected from individuals by face-to-face interview. This data was specifically collected on the influencing factors of the performance of solid waste management from selected sub-city political leaders. The interview method enables the researcher to obtain in-depth information and elaborate ambiguous answers (Structured et al., 1998). During this study, structured or semi-structured and open-ended questions were used to collect the information from the respondents.

3.6. Sample size and selection

In this study, there were five types of populations which include political leaders, technical staff, solid waste workers, group leaders, and solid waste small & micro-enterprises. The researcher believed that political and group leaders have relatively deep information about solid waste management in their organization because they are top managers. To get full information, the researcher used purposive sampling. But for technical staff, solid waste workers, and solid waste small & micro enterprises the researcher used the Sampling technique.

Table.3.1. sample size

Respondent category	Target Population	Sample size	Sample technique
Political leader	2	2	Purposive sampling
Group leaders	6	6	Purposive sampling
Technical staffs	53	13	Sample technique
Solid waste workers	88	22	Sample technique
Solid waste small& micro Enterprises	1046	257	Sample technique
Total	1195	300	

The sample size of the research was determined based on Slovin formula.

That is ***Slovin Formula:***

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

Where n = sample size

N = the size of the population

e = the margin of error

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

$$n = \frac{1195}{1+1195(0.05)^2}$$

$$n = \underline{300}$$

Therefore, from the total population of 1195, The research sample size was 300 and it divided for all types of the population depends on their proportion as shown in the above table 1.

3.7. Data analysis methods

The data collected from the respondents were analyzed, interpreted, presented to make a meaningful full to the audience of the research work (Magout, 2020).

3.7.1. Quantitative Data Analysis

The statistics were analyzed in the form of descriptive or inferential statistics, percentage and frequencies, mean and standard deviation were collected and analyzed in the form of descriptive statistics whereas inferential statistics where Carl person product-moment correlation coefficients and multiple linear regression were determined. Pearson correlation was applied to observe the relationship between independent variables and dependent variables while multiple linear regressions were also applied to show the effects of the independent variable on the dependent variable. The researcher used the SPSS (Ver.26) computer statistical package for data analysis. The data were summarized into tables, charts, frequencies, and percentages. In addition, the Microsoft Excel program was used for drawing some charts with multiple responses to simplify interpretation of the data so collected.

3.7.2. Qualitative Data Analysis

Qualitative analysis was done to provide the necessary explanations to the quantified data and to share observations made through the interviews. The interview data were subject to content analysis. All responses were read and the main idea was extracted to obtain the core meaning (Gall & Cornblat, 2002). Then the data were described and others present in percentages and frequencies.

3.8. Reliability of the study

Research reliability is a measure of the degree to which research methods produce stable and consistent results. (Klassen et al., 2016)According to (Magout, 2020), a measuring instrument is reliable if it provides consistent results. A reliability test also performs to check the internal consistency and accuracy of the measurement scale**.** Cronbach's alpha is the coefficient of reliability. For testing the reliability of the data instrument, Cronbach's alpha will be used calculated. It is commonly used as a measure of the internal consistency or reliability test score

for a sample of examines. They measure between 0.8 and 0.95 are considered to have very well, scales with coefficient alpha between 0.7 and 0.8 are considered to have good reliability and coefficient alpha between 0.6 and 0.7 indicates fair reliability (Magout, 2020).

3.9. Validity of the research

The validity of the research can be explained as the extent to which the requirement of scientific research methods has been followed during the process of generating research findings. And it refers to the usefulness, meaningfulness, and appropriateness of the conclusion of the research. Validity is the testing of an instrument that ensuring the accuracy of the research results (Klassen et al., 2016).

To make sure the research's validity, the research was used reliable sources such as published books and recent articles written by highly praised authors in the solid waste management field. Based on the respondent's response additional, omission and modification of question will be undertaken. To further refine the accuracy of the instrument, the questionnaire was administered to selected colleagues and the organization management members and they review it and were provide their opinion on the questionnaire. In addition, the research advisor also was provided valuable comments on the questionnaire.

CHAPTER FOUR

4. PRESENTATION, ANALYSIS, AND INTERPRETATION OF RESULTS

4.1. Introduction

The findings are presented, analyzed, and interpreted in this chapter. There are five main parts of it. The first section presents results about the response rate. The second section presents the results of the respondent's background information. The third section presents results on institutions and SWM. The fourth section presents results on technological factors and SWM. The fifth section presents results on Knowledge and SWM.

Table 4.1: Response Rate

Respondent category	Targeted sampled size	Actual sampled size	Percentage %
Political leader	2	2	100 %
Group leaders	6	6	100 %
Technical staffs	13	13	100 %
Solid waste workers	22	22	100 %
Solid waste small& micro Enterprises	257	255	99.2 %
Total	300	298	99.3 %

Source: Data from politicians, technical staff, Solid waste workers, and SWSMI.

As a result, the overall response rate was 99.3 percent. According to Amin (2011), a response rate of 67 percent is sufficient. As a result of the study's 99.3% response rate, the findings were deemed indicative of what would have been collected from the general population.

4.2. Demographic Characteristics

Demographically sex, age, and educational characteristics of respondents were considered.

4.2.1. Age of the respondents

One of the most critical characteristics in understanding the views of politicians, technical staff, solid waste workers, and solid waste small& micro-enterprise is their age; in general, age suggests a person's level of maturity (Gibb, 2008). In that sense, age becomes more important to examine the response to a particular problem.

Table 4.2: Distribution of respondents by age

No.	Age	Frequency	Percent	Valid Percent	Cumulative Percent
1	below20	9	3.0	3.0	3.0
2	20-29	106	35.6	35.6	38.6
3	30-39	107	35.9	35.9	74.5
4	40-49	61	20.5	20.5	95.0
5	50-59	15	5.0	5.0	5.0
6	Total	298	100.0	100.0	100.0

Source: Data from politicians, technical staff, Solid waste workers and SWSMI

Findings show that the majority of the politicians, technical staff, solid waste workers, and solid waste small& micro enterprises (97 percent) of the respondents were youths over the age of 20 years. As a result of these results, it can be concluded that information on institutional, technology and knowledge aspects on SWM was collected from mature politicians, technical staff, solid waste workers, and solid waste small& micro-enterprises. Given their age, the likelihood of them learning about these issues was higher. The presumption was that the data gathered was reliable.

4.2.2. Gender of the respondents

Gender is a significant variable in any given social situation that is influenced by a variety of social and economic phenomena (Shattuck et al., 2011), and the respondents' responses to institutional, technological, and knowledge aspects of SWM are no exception. As a result

politicians, technical staff, solid waste workers, and solid waste small& micro enterprises were polled on their gender. Findings are presented in Table 4.3.

Table 4.3: Distribution of respondents by gender

No.	Gender	Frequency	Percent	Valid Percent	Cumulative Percent
1	Male	151	50.7	50.7	50.7
2	Female	147	49.3	49.3	49.3
3	Total	298	100.0	100.0	100.0

Source: Data from politicians, technical staff, Solid waste workers and SWSMI

According to the findings, male and female respondents were nearly equally represented in the sample (50.7 percent and 49.3 percent) respectively.

The results implied that information on institutional, technological, and knowledge aspects of SWM was gathered from a sample that represented the gender distribution of people in the study area.

4.2.3. Educational backgrounds of the respondents

Knowledge is one of the most critical characteristics that can influence a person's behaviors, perceptions, and comprehension of any social phenomenon (Zaremba & Smoleński, 2000).

In certain ways, an individual's answer is likely to be affected by their educational status. As a result, it is important to understand the educational backgrounds of respondents. Hence, respondents were questioned about their educational backgrounds. The results are discussed in the next table.

Table 4.4: Distribution of respondent by educational level and fields of study

Education level	Frequency Percent	Frequency Percent	Field of study/Subject/	Frequency Percent	Frequency Percent
Below 10or 12	118	39.6	None	118	39.6
Certificate	3	1	Management area	50	16.8
Diploma	89	29.9	Environment area	49	16.4
Bachelors Degree and above	88	29.5	Accounting and finance	68	22.8
			If others(Specify)	13	4.4
Total	298	100	Total	298	100

Table 4.4 shows the distribution of respondents by their level of education. It indicates that the majority of respondents (60.4%) had certified and above secondary education and had graduated in a variety of fields of specialization, while 39.6% had only primary and secondary education. As a result, shows that the majority of the respondents have a secondary or higher education experience. Therefore, the politicians, technical staff, Solid waste workers, and SWSMI educational backgrounds aided better responses to the questions about institutional, technological, and knowledge aspects of SWM because it was assumed that they knew what they were talking about. Thus, the information obtained was reliable.

4.2.4. Work experience of the respondents

The work experience of the respondents was measured as one of the variables that might Influence an individual to provide reliable information about solid waste management.

Table 4.5: Work Experience of the respondents

NO.	Years	Frequency	Percent	Valid Percent	Cumulative Percent
1	1-5	74	24.8	24.8	24.8
2	6-10	101	33.9	33.9	58.7
3	11-15	89	29.9	29.9	88.6
4	16-20	28	9.4	9.4	98.0
5	above 20	6	2.0	2.0	2.0
6	Total	298	100.0	100.0	100.0

Source: Data from politicians, technical staff, Solid waste workers and SWSMI

As shown from the above table the majority of the respondents (75.2%) had more experience in that organization more than 5 years, while 24.8 % of the respondents had low work experience. As a result of the respondents' work experience; we can reasonably conclude that they have been carrying out the activity in the capacities of management and technical work needed in the city's SWM adequately.

4.3. Reliability test

The study has used the questionnaire to investigate factors that affect the performance of SWM. Then, the researcher assesses the mod fit reliability and validity of the questionnaire to get confidence in comparing the sample with help of SPSS V-26 the most frequently used Cronbach's alpha. The reliability of the items is presented in the table below.

Table 4.6: Reliability analysis score

No	Types of questionnaires	Cronbach'sAlpha	No of Items
1	Institutional aspects	.855	6
2	Technological aspects	.748	6
3	Knowledge aspects	.746	6
4	Performance of SWM	.780	14

Source own survey: 2021

Research reliability is a measure of the degree to which research methods produce stable and consistent results (Klassen et al., 2016). The researcher was used Cronbach's alpha to establish the internal consistency of the quantitative items in the questionnaire.

According to (Hinton et al., 2004) Cronbach's Alpha value ranges from 0 (unreliable test) to 1 (reliable test). An Alpha score above 0.75 is generally taken to indicate a scale of high reliability, 0.5 to 0.75 is generally accepted as indicating a moderately reliable scale, and below 0.5 generally indicates a scale of low reliability. The above table shows that Cronbach's alpha from 0. 746 to 0.855 categories indicating that the survey instrument was generally accepted in terms of internal consistency.

4.4. Existing solid waste management practice

The effectiveness of a solid waste service delivery is one of the parameters used to evaluate its efficiency and effectiveness. Indicators such as waste collection, transportation, and disposal reliability may be used to evaluate the performance of a company's solid waste service delivery practice. The present study employs these indicators to assess the effectiveness of solid waste service delivery in Addis Ababa.

4.4.1. Solid Waste collection practices

When waste collection targets are met, a waste management practice is considered to be successful. When companies can have enough collection points near all beneficiaries, increase the frequency of waste pickup, prevent waste spillover, and waste staff is thoroughly and regularly educated, successful waste collection can be registered.

Table 4.7: Solid waste Collection Practices

No	Indicators	S.D	D	NDA	A	SA	Mean	Std.D
1	Frequency of waste pick – up are strictly followed by our company.	9 (3%)	146 (49%)	68 (22.8%)	69 (23.2%)	6 (2%)	2.72	0.921
2	There is full and continuous training on solid waste collection in our company.	29 (9.7%)	140 (47.1%)	87 (29.2%)	41 (13.8%)	1 (0.3%)	2.48	0.861
3	Our company has facilitated enough number of collection points near to all beneficiaries.	24 (8.1%)	146 (49%)	71 (23.8%)	54 (18.1%)	3 (1.0%)	2.55	0.913
4	Our Company maintains waste spillover to the ground at collection is cleaned.	23 (7.7%)	134 (45%)	75 (25.2%)	61 (20.5%)	5 (1.7%)	2.63	0.948

Source: Data from politicians, technical staff, Solid waste workers and SWSMI
Key: SD =Strongly disagree, D = Disagree, NDA = No definite answer, A = Agree, SA = Strongly agree

The results of the study, as shown in table 4.6, show the respondents' opinions on existing solid waste collections. Respondents expressed their views in terms of percentile on the indicator (Frequency of waste pick-up is strictly followed by our company). A large number of respondents (52 percent) from the total expressed their opinion with disagreement, 25.2 percent

agreed & strongly agreed, and the remaining proposed neutral. This finding suggests that, in the opinion of the respondents, the controlling system of waste collection is in poor condition.

When we look at the second indicator, which is centered on continuous training on solid waste collection, we find that 56.8% of those who replied generally disagreed with it. As a result, providing frequent training on solid waste collection is very low.

The third indicator looked at the accessibility of collection points near all beneficiaries; 57.1 percent of respondents said they disagreed or strongly disagreed, 23.8 percent said they were 'neutral,' and only 19.1 percent said they agreed or strongly agreed. This result suggests that there are insufficient collection points close to the residents.

On the other side, 52.7 percent of the respondent opinion on the indicator (The waste spillover our Company retains to the ground is cleaned at collection) was disagreed or strongly disagreed, 25.2 percent was 'neutral,' and just 22.2 percent agreed or strongly agreed. This result suggests that waste management companies' attention to clearing the waste spillover on the field is lacking. The interview results also indicated that the frequency of waste collection was very low due to inefficient vehicles, unsuitable points of waste collection sites, and improper waste handling systems.

To sum up, the entire mean figure on the indicators of current solid waste collection practice (2.595) which is the moderately low status of current solid waste management practice (Ibrahim et al., 2015).

4.4.2. Solid waste transportation practices

Safe and dependable transportation was considered one of the primary measurements for effective SWM within the context of effective solid waste management (Zemena, 2016). As a result, companies with adequate manpower and modern vehicles, as well as the existence of available highways, traffic conditions, and travel schedules can provide successful solid transportation (Schübeler, 1996).

Table 4.8: Solid waste transportation practice

No	Indicators	S.D	D	NDA	A	SA	Mean	Std.D
1	Company has sufficient manpower and vehicle to transport solid waste.	8 (2.7%)	157 (52.7%)	54 (18.1%)	75 (25.2%)	4 (1.3%)	2.70	0.923
2	Nature of traffic condition along collection route has jamming	13 (4.4%)	89 (29.9%)	61 (20.5%)	130 (43.6%)	5 (1.7%)	3.08	0.986
3	Supervisor records the daily number of trips, tonnage of waste and route plan to drivers.	6 (2%)	94 (31.5%)	100 (33.6%)	92 (30.9%)	6 (2%)	2.99	0.888
4	Our company use covered vehicles and there is no spillover of solid waste up on transport	3 (1%)	144 (48.3%)	58 (19.5%)	92 (30.9%)	1 (0.3%)	2.81	0.902
5	There is adequate internal roads (alternative roads) and traffic condition along collection route has overcrowding	20 (6.7%)	101 (33.9%)	94 (31.5%)	77 (25.8%)	6 (2%)	2.83	0.959

Source: Data from politicians, technical staff, Solid waste workers and SWSMI

Key: SD =Strongly disagree, D = Disagree, NDA = No definite answer, A = Agree, SA = Strongly agree

In table 4.7 respondents were asked whether an effective solid waste transportation system is practiced or not using five indicators with the Likert scale. Respondents were asked if the organization has enough manpower and vehicles to transport solid waste, and their responses were on the (mean = 2.70) which implied the response of respondents below the liker scale mean of 3, with 55.4 percent strongly disagreed and disagreed, 26.5 percent strongly agreed and agreed, and the remaining 18.1 percent undecided. This finding suggests that manpower and vehicles are impeding the current solid waste transportation system.

On the second indicator, 45.3% of the respondents approved of the nature of traffic conditions along the collection road were jam, outnumbering the 34.3% who disapproved and the 20.5% who were undecided, with a mean figure of 3.08.

In question three, respondents agree and strongly agree (32.9%) that Supervisor records the daily number of trips, the tonnage of waste, and route plan to drivers with a mean of 2.99 and standard deviation of 0.888 respectively, on another way 33.5 % responds where not approve it.

Only (33.3%) of the total remained neutral about the statement. It indicated that the controlling system of the organization is poor.

Concerning "Our company uses covered vehicles and there is no solid waste spillover on transportation," With a mean of 2.81 and a standard deviation of 0.902, 49.3 percent of respondents strongly disagree and disagree. However, 31.2 percent of people agree with the assertion, with the remaining 19.5 percent undecided or neutral. This discovery suggests that the majority of company vehicles are not shielded, resulting in solid waste spillover during transportation.

In the fifth question, (27.8%) of the respondents agree and strongly agree that the adequacy of internal roads (alternative roads) and traffic condition along the collection route have overcrowding with a mean of 2.83 and standard deviation of 0.959 respectively. However, (40.6%) of the people responded disagree and strongly disagree with the statement while 31.5 percent responded neutrally. Additionally, the interview result also revealed that the distance of the disposal site, the vehicle type, shortage of resources (car oil and maintenance) are the hindering factors of waste transportation.

In general, the average mean of effective solid waste transportation indicators turns to disagree with the mean of 2.88. Therefore, the status of the solid waste transportation indicator was moderately low (Ibrahim et al., 2015). This finding was supported by (Zemena, 2016), he revealed that the current reality in Addis Ababa, where solid waste hauling roads are not accessible to the level required, and even some of the available trucks do not all work to their full potential daily due to their age, frequent accidents, and maintenance issues.

4.4.3. Solid waste disposal practices

Waste management often necessitates a safe and dependable disposal system. This system can be implemented efficiently if the disposal site is located near collection points, is accessible, is closed and protected from animals, and does not emit a foul odor into the neighborhood.

Table 4.9. Solid waste disposal practice

No	Indicators	S.D	D	NDA	A	SA	Mean	Std.D
1	The existing disposal site is far-away from our collection point	0 (0%)	13 (4.4%)	59 (19.8%)	205 (68.9%)	21 (7%)	3.79	0.631
2	Municipality did not provides designated and accessible land fill site	0 (0%)	13 (4.4%)	82 (27.5%)	186 (62.4%)	17 (5.7%)	3.69	0.644
3	The existing disposal site is open and it has bad smell to the community	0 (0%)	7 (2.3%)	53 (17.8%)	200 (67.1%)	38 (12.8%)	3.90	0.625
4	Our company disposes waste at designated land fill by law and it is Environmentally safe.	0(0%)	12 (4%)	106 (35.6%)	166 (55.7%)	14 (4.7%)	3.61	0.643
5	Presence of animal on the disposal site is common.	1(0.3%)	12 (4%)	61 (20.5%)	203 (68.1%)	21 (7%)	3.78	0.646

Source: Data from politicians, technical staff, Solid waste workers and SWSMI

Key: SD =strongly disagree, D = Disagree, NDA = No definite answer, A = Agree, SA = strongly agree

Table 4.8: focused on the effective solid waste disposal indicators which consist of five questions. In the first indicator, the majorities (75.9%) of the respondents strongly agrees and agree that the existing disposal site is far away from their collection point and 4.4% disagreed with a mean of 3.79 and standard deviation of 0.631 respectively. The remaining 7 % of the respondents were undecided. It is shown that the disposal site is far from the sources especially in the Yeka sub-city.

In the next indicator, (69.1%) of the respondents strongly agree and agree that the municipality did not provide designated and accessible landfill sites with a mean of 3.69 and a standard deviation of 0.644. However, few (4.4%) of those polled disagree with the assertion, while 27.5% are undecided or registered as neutral. This result shows that the landfill was poorly designated and inaccessible to the beneficiary.

Question three asked whether the current disposal site is open and emits a bad smell into the community; (79.9%) of those polled agreed and strongly agree (mean 3.90, Sd 0.625). However,

2.3% of those polled disagreed or strongly disagreed with the assertion, while 12.8% said they were neutral.

In the fourth question, respondents were asked whether the organization disposes of solid waste at a designated landfill that is environmentally safe; the majority of the respondents (60.4 %) strongly agreed or agreed with the assertion, with a mean of 3.61 and a standard deviation of 0.643. Just 4% said they disagreed and 35.6% said they were undecided.

The last question asked whether the existence of an animal on the disposal site was common; 75.1 percent of respondents agreed or strongly agreed, with a mean of 3.78 and standard deviation of 0.646. However, (4.3 percent) of those polled disagreed or strongly disagreed with the assertion, while 20.5 percent said they were neutral. The disposal site was surrounded by housing areas and institutions, was quickly filling up. Residents in these area face hazardous and health risk. In general, from the above description, the performance of solid waste disposal in the city was poor.

4.5. Factors influencing the effectiveness of SWM practice

4.5.1. Effect of an institution on SWM

According to (UNEP, 2005) description, institutional strength measures included a proper organizational structure for accountability, integrated participation between private and public entities, and a sufficient and transparent arrangement between the service provider, beneficiaries, and the authority, as well as a waste management company responsible for service reliability.

Before assessing the impact of the institution on SWM, descriptive statistics on the institution and SWM were provided to show the respondents' views on this variable. As a result, for each hypothesis, this method was used, and the descriptive statistics used were frequencies and percentages.

The analysis and interpretation of the results regarding institutional aspects are done in the same order as they are presented in the next Table.

Table 4.10: Institutional condition of SWM

No	Indicators	S.D	D	NDA	A	SA	Mean	Std.D
1	There is a proper institutional set-up for solid waste management service.	9 (3.0%)	150 (50.3%)	68 (22.8%)	71 (23.8%)	0 (0%)	2.67	0.871
2	Several institutions or agencies are involved in SWM.	29 (9.7%)	143 (48%)	86 (28.9%)	40 (13.4%)	0 (0%)	2.46	0846
3	We have sufficient and consistent waste management contract period with the municipality	24 (8.1%)	152 (51%)	71 (23.8%)	51 (17.1%)	0 (0%)	2.50	0.869
4	There is integrated solid waste management practice between private and public agencies	22 (7.4%)	141 (47.3%)	73 (24.5%)	59 (19.8%)	3 (1%)	2.60	0.921
5	Our company has not faced frequent customer complaint about solid waste management on its assigned jurisdictions	8 (2.7%)	165 (55.4%)	47 (15.8%)	75 (25.2%)	3 (1%)	2.66	0.918
6	Decentralization approach is common in your company.	13 (4.4%)	148(49.7 %)	9 (3%)	123 (41.3%)	5 (1.7%)	2.86	1.1

Source: Data from politicians, technical staff, Solid waste workers and SWSMI

Key: SD =Strongly disagree, D = Disagree, NDA = No definite answer, A = Agree, SA = Strongly agree

The first independent variable, as shown in table 4.9, was institutional condition indicators, which consisted of six questions.

Regarding the issue that reflects about ‘‘ a proper institutional set-up for solid waste management service.’’ depend on the raised concepts majority of respondents (53.3%) were disagree and strongly disagree and also (23.8%) respondents were agreed with the stated issues this clearly shows that great number of respondents approved there is no proper institutional set-up for solid waste management service.

Concerning the involvements of several institutions in SWM, 57.7% of the respondents were strongly disagreed and disagree with the mean value of 2.46 which is significant and only 13.4% of respondents agree. This implies that there is insufficient involvement of different institutions in SWM.

Thirdly, respondents' reaction on the indicator (We have sufficient and consistent waste management contract period with the municipality), was scored as (59.1%) strongly disagreed and disagreed, (17.1%) as strongly agreed and agreed, and the remaining (23.8%) as neural. This result shows that there was no sufficient and consistent waste management contract period with the municipality.

On the other hand, the indicator (there is integrated solid waste management practice between private and public agencies) received a score of (54.7%) strongly disagreed and disagreed, (20.8%) strongly agreed and agreed, and the remaining (24.5%) neural. This finding suggests that private and public authorities do not have an integrated solid waste management strategy.

In response to the question, ‘‘Our Company has not faced frequent customer complaints about solid waste management on its assigned jurisdictions," 58.1 percent of participants are inclined to disagree, 26.2 percent agree and strongly agree, and the remaining 15.8 percent are neutral. The findings reveal that there is a high level of consumer dissatisfaction.

Finally, the majority of participants (54.1%) were inclined to disagree with the statement "decentralization approach is popular in your business." with a mean value of 2.86. In addition, 43% of participants say they agree or strongly agree, with only 3% saying they are neutral. It revealed that the organization used a centralization approach.

To sum up, the overall average mean of the institutional aspect variable was 2.63 which means moderately low. Therefore, there is a poor institutional arrangement in the city administration. According to an article looking at SWM in the developing world, inefficient institutional structure, inefficient organizational procedure, and deficient management capacity of the institution cause inefficient SWM service (Jama Farah, 2019).

4.5.2. Effect of technology on SWM

This section focused on the application of appropriate technology for supporting the performance of solid waste management.

Table 4.11: Technological condition of SWM

No	Indicators	S.D	D	NDA	A	SA	Mean	Std.D
1	Transportation of solid waste is done using appropriate technological based equipment.	23 (7.7%)	174 (58.4%)	64 (21.5%)	34 (11.4%)	3 (1%)	2.40	0.827
2	Solid waste information from the field is usually gathered using technological based instrument.	8 (2.7%)	201 (67.4%)	45 (15.1%)	42 (14.1%)	2 (0.7%)	2.43	0.789
3	Appropriate technologies are frequently used for monitoring waste garbage in the field.	13 (4.4%)	199 (66.8%)	16 (5.4%)	67 (22.5%)	3 (1%)	2.49	0.922
4	Appropriate technologies are applied for monitoring trucks during transportation of solid waste.	6 (2%)	184 (61.7%)	50 (16.8%)	53 (17.8%)	5 (1.7%)	2.55	0.864
5	Our company has adequate and modern waste management equipment.	3 (1%)	185 (62.1%)	40 (13.4%)	70 (23.5%)	0 (0%)	2.59	0.856
6	Generated Solid wastes are appropriately recycled before disposed in our city	20 (6.7%)	182 (61.1%)	49 (16.4%)	42 (14.1%)	5 (1.7%)	2.43	0.874

Source: Data from politicians, technical staff, Solid waste workers and SWSMI

Key: SD =Strongly disagree, D = Disagree, NDA = No definite answer, A = Agree, SA = Strongly agree

The second independent variable, as shown in table 4.10, was the technological condition of SWM indicators, which consisted of six questions.

Initially, respondents' responses to the indicator (solid waste transportation using appropriate technologically based equipment) were graded as (66.1 %) strongly disagreed and disagreed, (12.4 %) strongly agreed and agreed, and the remaining (21.5 %) as neural. This indicates that the transportation of solid waste was not facilitated by sufficient technologies.

The next question focused on how well technology was used to collect data from the field. The majority of the respondents (70.1%) scored strongly disagreed and disagreed, 14.8% strongly agreed and agreed, and the remaining (15.1%) as neural. This indicates that no suitable technology was used to collect solid waste information.

The third indicator was the frequency at which suitable equipment was used to detect solid waste garbage in the field. The majority of the respondents (71.2%) were strongly disagreed or disagreed, indicating that no appropriate equipment was used to track solid waste garbage in the field.

When we look at the fourth indicator, which is centered on the application of appropriate technology for monitoring trucks during transportation of solid waste, we find that the massive (62.7%) of those who replied generally disagreed with it. As a result, the application of technology for monitoring purposes is very low.

In the fifth question people strongly disagreed and disagreed (63.1 percent) that their organization has adequate and modern waste management equipment, however (23.5 percent) agreed with the argument, and the remaining (13.4 percent) replied neutrally. This suggests that the majority of companies lack suitable and modern waste management equipment.

Lastly, the majority of participants (67.8%) were inclined to disagree with the statement "generated Solid wastes are appropriately recycled before disposed of in our city." with a mean value of 2.43. In addition, 15.8% of participants say they agree or strongly agree and 16.4% saying they are neutral. It revealed that the recycling of solid waste is very poor.

In general, from the above descriptions, the researcher can conclude that the application of appropriate technology for supporting the overall solid waste management system was very low. According to the (Nicholas P, 2003) study, applying technology is important for solid minimization, resource recovery, reuse and recycle of waste and improve the environmental performance of both the industries and the public.

4.5.3. Effect of Knowledge on SWM

In this section, respondents were requested to respond to six items about knowledge aspects by demonstrating their agreement using a five-point Likert scale. Table 4:11 summarizes the findings. Following the presentation of the results, the findings are analyzed and interpreted concerning the knowledge aspects.

Table 4.12: Knowledge condition of SWM

No	Indicators	S.D	D	NDA	A	SA	Mean	Std.D
1	I know the whole process of integrated SWM system	19 (6.4%)	220 (73.8%)	18 (6%)	39 (13.1%)	2 (0.7%)	2.28	0.295
2	I know public health problems are associated with poor SWM system.	2 (0.7%)	166 (55.7%)	73 (24.5%)	56 (18.8%)	1 (0.3%)	2.62	0.804
3	I know well the rule and regulation of solid waste management in municipality	12 (4.0%)	205 (68.8%)	28 (9.4%)	50 (16.8%)	3 (1.0%)	2.42	0.859
4	I develop my knowledge on SWM system by frequently sharing experience from others.	37 (12.4%)	209 (70.1%)	12 (4%)	37 (12.4%)	3 (1%)	2.19	0.846
5	I obtain sufficient on job short term training about integrated SWM system.	28 (9.4%)	215 (72.1%)	16 (5.4%)	37 (12.4%)	2 (0.7%)	2.23	0.809
6	Solid waste small and micro enterprises are well educated and informed on SWM in their respective area.	25 (8.4%)	212 (71.1%)	22 (7.4%)	35 (11.7%)	4 (1.3%)	2.27	0.825

Source: Data from politicians, technical staff, Solid waste workers and SWSMI

Key: SD =Strongly disagree, D = Disagree, NDA = No definite answer, A = Agree, SA = Strongly agree

Table 4.11: shows that, the indicator (I know the whole process of integrated SWM system), was recorded (80.2%) strongly disagreed and disagreed whereas (13.8%) strongly agreed and agreed and the remaining (6%) remain neutral with a mean of 2.28 and standard deviation 0.295. The findings revealed that knowledge of the integrated SWM process is limited. Concerning "I know public health problems are associated with poor SWM system", 56.7 % did not know poor SWM system exposed to health problems.

The third criterion was to see if the respondents were aware of the SWM rules and regulations. The majority of the respondents (69.2%) had no understanding of the SWM rules and

regulations. While the remaining 17.8%, 9.4% respondents agree and neutral respectively, with a mean (2.42) and standard deviation of 0.859.

Item four centered on(I develop my knowledge on SWM system by frequently sharing experience from others), 82.5% of the respondents replied strongly disagree and disagree, only 4%nuteral and 13.4 % agreed and strongly agreed with mean 2.19 and standard deviation 0.846. This result indicates that the likelihood of gaining information by sharing experiences is limited.

In response to the question, ‘‘I obtain sufficient on job short-term training about integrated SWM systems," 81.5 percent of participants are inclined to strongly disagree and disagree, 13.1 percent agree and strongly agree, and the remaining 5.4 percent are neutral. The results show that on-the-job preparation is inadequate.

Finally, respondents on indicator (Solid waste small and micro-enterprise are well educated and informed on SWM in their respective area) said (by about 79.5%) they strongly disagreed or disagreed with the statement. Whereas 13% of respondents said they strongly agreed and agreed with only (7.4%) remaining neutral. With the least mean value of 2.27 and standard deviation of 0.825. This result suggests that solid waste small and micro enterprises in their respective areas are under-educated and under-informed about SWM.

In general, as shown in this study to adequate knowledge from on job training, sharing experience from others, and the employees' attitude to learning about SWM was very poor and inefficient know-how about their job description. Lack of knowledge about the practice and importance of a proper solid management system is a crucial factor for the failure of a solid waste management service (Agunwamba, 1998).

4.6. Relationships between the influencing factors and performance of SWM

4.6.1. Correlation analysis

Correlation is a statistical technique for determining when and how strongly two variables are associated, the sign of correlation coefficient determines the direction whether it's positive or negative or no correlation. The correlation coefficient's magnitude decides the association's degree of intensity(Akoglu, 2018). In this study, the data were normally distributed in this analysis, and Pearson's product-moment correlation was used to examine the relationships

between the dependent variable (the performance of SWM) and independent variables (institutional, technological, knowledge aspects, and the demographic factors). Pearson's correlation coefficient is a measure of the intensity of a linear relationship between two variables, as well as the normality of the variables under consideration, which is only valid for quantitative variables (Marlove, 2013). In general, there is no widely accepted standard for the range of correlation coefficients. The researcher uses (Akoglu, 2018) definition of correlation coefficient standards as follows: Between 0-0. 3 weak correlations, 0.3-0.7 moderate correlation, and greater than 0.7 strongly correlated.

Table 4.13: Correlations between the performance of SWM and the influencing factors.**(N= 298)**

NO.	**Variables**	1	2	3	4	5	6	7	8	9
1	Work experience	1								
2	Age	.199**	1							
3	Gender	.161**	-.167**	1						
4	Education	-.005	.158**	.029	1					
5	field of study	.031	.111	-.025	.760**	1				
6	Institution	-.283**	-.016	-.128*	.119*	.037	1			
7	Technology	-.187**	-.071	-.108	-.111	-.114*	.449**	1		
8	Knowledge	-.255**	-.003	-.070	.242**	.170**	.420**	.245**	1	
9	Performance of SWM	-.272**	-.062	-.125*	.143*	.056	.773**	.503**	.517**	1

**. Correlation is significant at the 0.01 level (2-tailed).

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

The above result shows that there was a positive correlation between the performance of SWM and other independent variables (institutional, technological, and knowledge). That means each of the given variables increases the performance of SWM also increase.

More specifically, the institutional aspects indicator variable (with 0 .773** correlation coefficient and P=0.00) has a significant positive, strong correlation, whereas technological and knowledge factors (with correlation coefficient 0.503** and 0.517** respectively, and P=0.00) have a significant positive moderate correlation. This indicated that effective SWM has relationships with strong institutional set-up, utilization of appropriate technology, and skillful /knowledgeable/ stakeholders on SWM.

Regarding the demographic factors work experience, age, and gender factors (with correlation coefficient -.272**, -.062, -.125* respectively) have a negative correlation. Whereas educational qualification (.143*) and field of study (.056) have significant, positive, and low correlation with the performance of solid waste management.

4.6.2. Diagnosis tests / Assumptions

According to (Garson's, 2012) description, if the number of independent variables in the study is only one while in the case of more than one independent variable in the study, the researcher has to make use of multiple regression models. Therefore, to analyze the impacts of institutional, technological, and knowledge factors on the performance of SWM and to evaluate the proposed hypothesis, multiple linear regression analysis is utilized, with a focus on standard beta values and P-values.

Assumption 1: Test of Normality

Normality test refers to the linear regression analysis that requires all variables to be multivariate normal. This assumption can best be checked with a histogram or a Q-Q-Plot (Rani Das, 2016).

It demonstrates that the data is regularly distributed. Using SPSS version 26, the kurtosis and skewness values were evaluated to see if the data was normal. The degree to which cases are grouped towards one end of an asymmetric distribution is measured by skewness. In general, the further the skewness value deviates from zero, the less likely the data are to be regularly distributed. The level of peak in a histogram is measured by kurtosis. Positive kurtosis is found in the high peak, while negative kurtosis is shown in the flatter distribution (Rani Das, 2016). A histogram is simply a graph that plots a frequency distribution of data for a variable. The variable's values are represented on the X-axis, while the frequency is represented on the Y-axis. Histograms are a useful tool for determining whether your data is regularly distributed. If the data is clustered around the mean in a normal distribution then the variables are normally distributed.

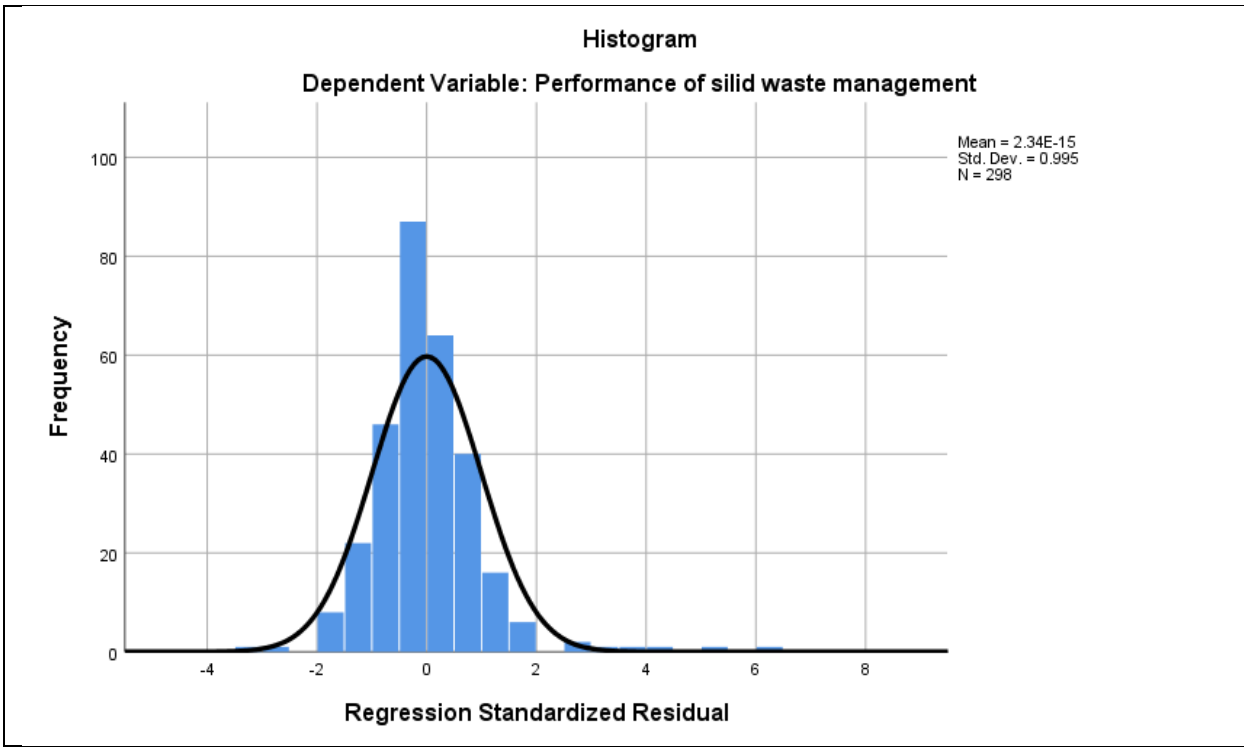

Figure 4.1: Normality Tests of Residuals

According to(Garson, 2012), the normal distribution of histogram graphs like bell-shaped. The kurtosis and skewness value of the variables should be between negative three and three. Therefore, in this research, as shown on the above graph the normal distribution of the variables score in the range between -2 and 2, and the graph has peaked and has bell-shaped. So the variables are normally distributed.

Assumption 2: Test of Linearity

In statistics, a P–P plot (probability–probability plot or percent–percent plot) is a probability plot that plots the two cumulative distribution functions against each other to see how close two data sets agree (Tabs, 2010). The relationship between the variables is assumed to be linear in regression analysis, which means that the points in the diagonal line plot must create a pattern that can be approximated by a straight line. Therefore, the result shows variables are linear.

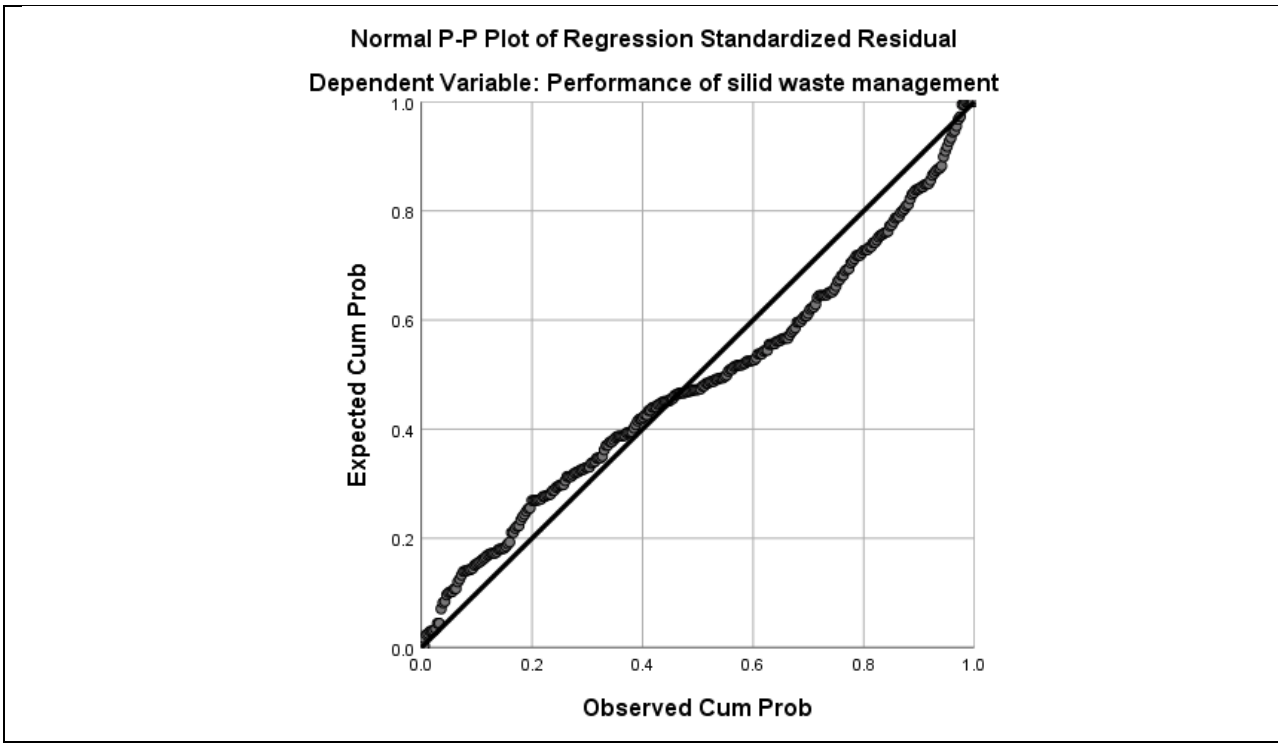

Figure 4.2 Test of linearity

Assumption 3. Homoscedasticity

The degree to which the data values for the dependent and independent variables have equal variances is known as homoscedasticity (Garson, 2012). The variance of the residual terms should be constant at each level of the predictor variables. This simply indicates that the residuals at each level of the predictors should have the same variance, hence verifying this assumption is beneficial to the fitness of t. In this case, the researcher plots the standardized residuals, or errors (ZRESID) on the Y-axis and the standardized predicted values of the dependent variable based on the model (ZPRED) on the X-axis to plot the homoscedasticity analysis, as suggested by(*Multiple Regration.Pdf*, n.d.), and the result is presented on the next graph.

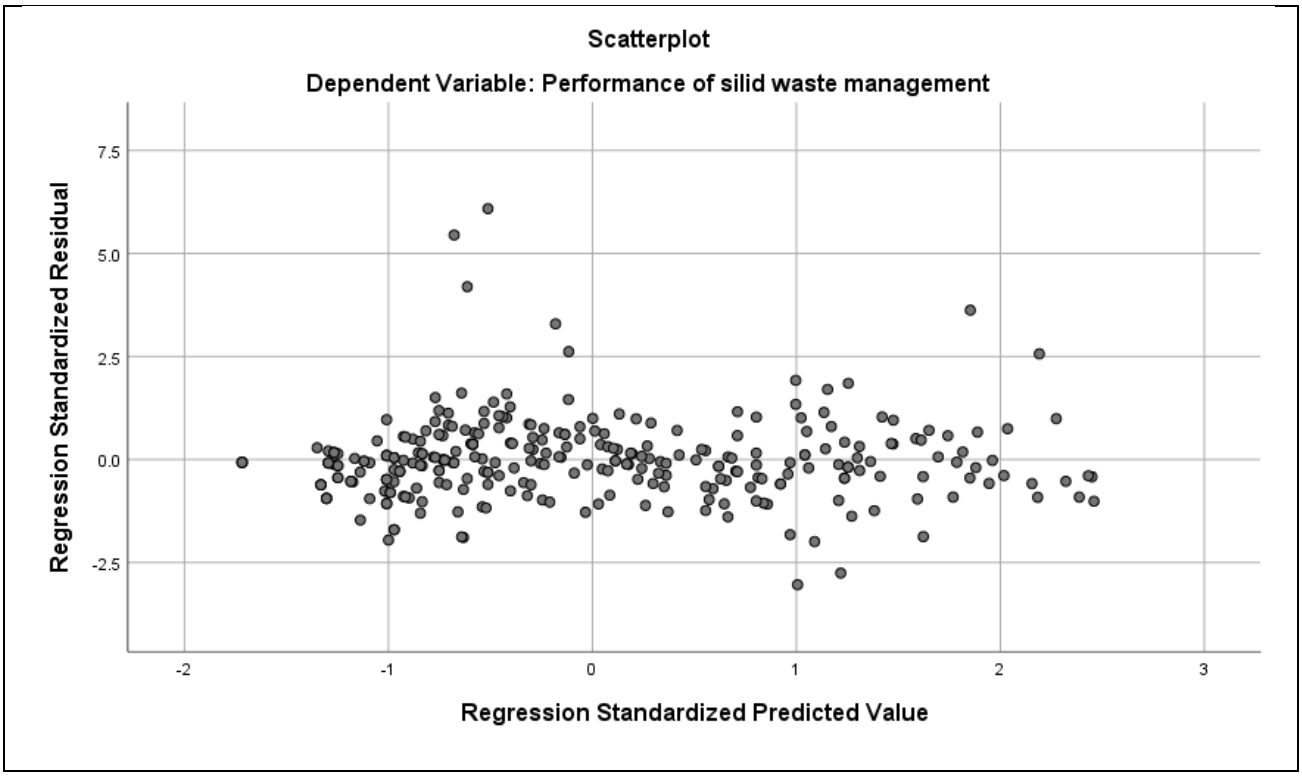

Figure 4.3: Scatter plot for testing homoscedasticity

Assumption 4: Multicollinearity Test

Table 4.14: Multicollinearity test

Coefficients

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	Institutional aspects	0.696	1.436
	Applying technology	0.795	1.259
	Knowledge aspects	0.820	1.220

a. Dependent Variable: Performance of solid waste management

The information in the above table also allows us to check for Multicollinearity. A common rule of thumb: for any predictor VIF between 1-10 should be examined for possible Multicollinearity problems (Dhakal, 2018b). According to (Joseph F. Hair Jr, William C. Black, Barry J.Babin, 2010)cited by Ramesh Tharu, (2019) the tolerance should be between 0.1 and 1.0.

In our multiple linear regression model the VIF of all independent variables (institution=1.436, technology= 1.259 and knowledge=1.220) which is < 10 and the tolerance was 0.696, 0.795 and 0.820 respectively, which is >0.1. This shows that there is no Multicollinearity problem.

Assumption 5: Autocorrelations Test

A common method of testing for autocorrelation is the Durbin-Watson test. Statistical software SPSS may include the option of running the Durbin-Watson test when conducting a regression analysis.

Table 4.15: Autocorrelations

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.820[a]	0.673	0.664	0.24545	1.478

a. Predictors: (Constant), Knowledge aspects, Applying technology, Institutional aspects

b. Dependent Variable: Performance of solid waste management

According to (Babatunde et al, 2014) description, the Durbin Watson statistic ranges in value from 0 – 4. A value near 2 indicates non-autocorrelation, a value towards 0 indicates positive autocorrelation and a value towards 4 indicates negative autocorrelation. In this study, as shown in the above table performance of the Durbin-Watson test is 1.478 and this is within the acceptable range.

4.6.3. Regression analysis

Table 4.16: Model Summary

Model	Unstandardized B	Std. The error of the Estimate	Standardize Beta(β)	P-value	R and R^2 in each model	R and R^2 of all variables
Model1(Constant)	3.438	.120		.000	R= 0.331 R^2= 0.110	R= 0.820 R^2=0.673
Work experience	-.100	.024	-.239	.000		
Age	-.026	.027	-.057	.330		
Gender	-.088	.048	-.106	.067		
Educational qualification	.081	.029	.244	.005		
Field of study	-.038	.027	-.119	.166		
Model 2(Constant)					R= 0.817 R^2=0.668	
Institutional	.596	.24545	0.559	.000		
Technology	.250	.26940	0.179	.000		
Knowledge	.265	.36692	0.222	.000		

a. Predictors: (Constant) , Age, Gender , Field of study, Work experience, Educational qualification , Institutional, Knowledge and Applying technology
b. Dependent Variable: Performance of solid waste management

To test the hypothesis, first, we explored the relationship between demographic factors, dependent and independent variables.

As shown in the table above the researcher was used demographic factors as control variables. These results revealed that the demographic variables statistically affected the performance of SWM. That means the coefficient of variance (R^2= 0.110, P= 0.000) indicated that the demographic factors accounted for an 11% change in the performance of SWM.

Moreover, from the demographic factors work experience and educational qualification were significantly affecting the performance of SWM. Whereas work experience (β= -0.239), age

(β= -0.057) and field of study (β =- 0.119) had negatively affected the performance of the organization. From these results the researcher suggested that employees increase in their experience and age they feel less committed to improving the organizational performance. This finding was supported by (Seid, 2019) in his study.

On the other hand, findings show that there was a strong positive correlation (R=0 .820) between the independent variables (the demographic factors, institutional, technological, and knowledge)

and the dependent variable (performance of SWM). The coefficient of determination (R^2= 0.673) shows that the independent variables accounted for a 67.3% change in the performance of SWM.

4.6.4. Hypothesis testing

The hypothesis test was employed by multiple regressions which were test independent variables (Knowledge aspects, Applying technology, Institutional aspects) can predict the dependent variable (Performance of SWM) and help to determine to what extent predict the variable.

The first hypothesis stated, "The institutional structure significantly affects the performance of SWM practice in Addis Ababa city." This hypothesis was investigated using the Pearson rank-order correlation coefficient (R) and the coefficient of determination. The results show that there was a strong positive correlation (R = .773) between institutional structure and the performance of SWM. The coefficient of determination (R^2= 0.597) shows that institutional structure accounted for 59.7% change in the performance of SWM. These findings were subjected to a test of significance (p) and it is shown that the significance of the correlation (p = .000) is less than the recommended critical significance at .05. Because of this, the first hypothesis was accepted

The second hypothesis stated, "There is a positive significant effect of applying modern technology on the performance of SWM practice in Addis Ababa city." Findings show that there was a moderate positive correlation (R = 0.503) between technological factors and the performance of SWM. The coefficient of determination (R^2= 0.253) shows that technological factors accounted for a 25.3% change in the performance of SWM. These findings were subjected to a test of significance (p) and it is shown that the significance of the correlation (p = .000) is less than the recommended critical significance at .05. Because of this, the second hypothesis was also accepted

The third hypothesis stated, "There is a positive significant effect of knowledge on the performance of SWM practice in Addis Ababa city.." Findings show that there was a moderate positive correlation (R = 0.517) between knowledge factor and performance of SWM. The coefficient of determination (R^2= 0.267) shows that technological factors accounted for a 26.7%

change in the performance of SWM. A test of significance (p) was performed on these results, and it was discovered that the correlation's significance (p =.000) is less than the recommended critical significance of.05. As a result, the third hypothesis was accepted.

On the other hand, the F-ratio in the above table determines if the overall regression model is a good fit for the data. F (3, 294) = 197.079, p (.000) <0.05, indicating that the independent variables statistically significantly predict the dependent variable (i.e., the regression model is a good fit of the data)

4.6.5. Statistical significance of the independent variables

Statistical significance of each of the independent variables tests whether the unstandardized (or standardized) coefficients are equal to zero in the population. If p < .05, the coefficients are statistically significantly different to 0 (zero). The usefulness of these tests of significance is to investigate if each explanatory variable needs to be in the model, given that the others are already there (Dhakal, 2018).

Table 4.17: Coefficient for the Predictor Variables

Coefficients [a]								
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.425	.080		17.752	.000		
	Institutional aspects	.363	.024	.599	14.875	.000	.696	1.436
	Applying technology	.134	.028	.179	4.759	.000	.795	1.259
	Knowledge aspects	.172	.029	.222	5.972	.000	.820	1.220

a. Dependent Variable: Performance of solid waste management

Table 4.17 shows that the t-value and corresponding p-value tells us that all the independent variables (institution, technology, and knowledge) p=.000 which is <0.05. This means that all the explanatory are significant and useful in the model. Unstandardized coefficients indicate how much the dependent variable varies with an independent variable when all other independent

variables are held constant. If the regression coefficient provides the expected change in the dependent variable (performance of solid waste management) for a one-unit increase in the independent variable. Referring to the coefficients in the above table the unstandardized coefficient for the institution is 0.363. This means for every unit increase in institutional aspect, there is a 0.363 unit increase in performance of SWM.

As a result, standardized coefficients are referred to as beta weights in the "beta" column. When the predictor variable is increased by one standard deviation, the outcome variable increases by one standard deviation, providing all other variables in the model remain constant. These are useful measures to rank the predictor variables based on their contribution (irrespective of sign) in explaining the outcome variable.

Hence, in this case, the institutional aspect is the highest contributing (0.555), the knowledge aspect (0.222) has the next rank and the technological aspect (1.179) has the third rank. However, only when the model is specified perfectly and there is no Multicollinearity among the predictors, (Dhakal, 2018) explains.

4.7. Discussion of Findings

The first variable was designed to find out the current status of institutional aspects for the performance of SWM. Institutional aspects concern the distribution of functions and responsibilities and correspond to organizational structures, procedures, methods, institutional capacities, and private sector involvement (Schübeler, 1996).

As shown in table 4.9 the entire mean of current institutional aspects (2.64) below the mean figure3. This indicates that the current status of institutional aspects has moderately poor (Ibrahim et al., 2015).

Moreover, the institutional arrangement, institutional integration, the relationships/ linkages/ between the SWMT and other municipal service sectors are weak. According to an article looking at SWM in the developing world, inefficient institutional structure, inefficient organizational procedure, and deficient management capacity of the institution cause inefficient SWM service (Naveed et al., 2013).

Regarding the organizational structure, the result of the study indicated that the centralization approach was common. The interview result also shown that the necessary resource is controlled and monitored at city and sub-city level and most decisions were not made at low-level management. According to (UNEP, 2005) studies, decentralization is an excellent institutional approach to dealing with SWM. And it also states that, to have efficient and effective SWM, equitable distribution of authority and responsibility from national to local managerial level. Especially, Local governments have more responsible for routine activities such as sweeping, collecting, transporting, and disposal service (MacRae & Rodic, 2015). At this level, community-based organizations such as small enterprises have a responsibility to manage the primary collection, which is a door-to-door collection and transport to the transfer station and often initiated by the resident disparately need for collection and also willing to pay monthly collection charge (McAllister, 2015). For example, most African countries like Uganda give more responsibility to local government and small& micro enterprises for solid waste collection and transportation (Naveed et al., 2013).

Additionally, the finding suggests that private and public authorities do not have an integrated solid waste management strategy. Privatization is an alternative to the government to manage the

operation of SWM (Shabani, 2015). To handle SWM operation public-private partnership plays a vital role (Nzeadibe & Ajaero, 2011). Most countries participate in private sectors, such as in Malaysia private companies are responsible for providing solid waste collection and transportation materials. Similarly in the Philippines hazardous wastes are incinerated with high temperatures by private sectors (Schübeler, 1996). In general, developing public-private partnerships and improving the participation of private sectors have a significant role in supporting local government throughout all SWM systems (Schübeler, 1996).

Finally, the first hypothesis was stated that the institutional structure significantly affects the performance of SWM practice in Addis Ababa city. This study has found that institution has a positive significant effect on the performance of solid waste management. This result is in line with those of previous studies that reveal ineffective solid waste management practices associated with weak institutional capacity (Zemena, 2016). These findings also concurred with (Jama Farah, 2019) and (Hailemriam, 2008) when they observed that the centralization approach, institutional setup, and public-private partnership are other problems associated with weak institutional aspects.

The second variable was focused to determine the current status of technological aspects for the performance of SWM. These include technologies associated with the control of solid waste generation, handling, storage, collection, transportation, processing, and disposal of solid waste (Ibrahim et al., 2015).

Table 4.10 shows that, the entire mean of current technological aspects on SWM (2.48) which is moderately low(Ibrahim et al., 2015). This result revealed that the city administration failed in the application of appropriate technology for solid waste collection, transportation, and disposal. More specifically, the Addis Ababa city administration was not properly applied appropriate technology for gathering solid waste information from the field, for monitoring of waste garbage, and monitoring of trucks during transportation to increase the performance of SWM. Many studies state that applying technologies is 80% efficient for optimizing waste collection and segregation and transportation (Idowu et al., 2012). It is important for giving information about several residents, more related routs, several contacts their validation, and the transfer station(Rada, 2013).

On the other hand, to reduce solid waste from the source generated solid wastes were not appropriately reused and recycled for other purposes before disposed of. In this study, the result revealed that only 12.4% of the respondents were agreed on the recycled process of generated solid waste in the city. Additionally, as a result of the survey, 62.2 percent of the respondents stated that they do not have suitable and modern waste management equipment. But applying modern technology is important for solid minimization, resource recovery, reuse and recycle of waste and improve the environmental performance of both the industries and the public (Nocholas P, 2003).

However, this study found that the status of technological aspects at the SWM unit is poor and not properly implemented. Proper implementation of the latest technologies in the sector of MSW management can play an important role in providing a pollution-free and sustainable environment (Ayilara et al., 2020).

The second hypothesis was stated that there was a significant effect of technology on the performance of solid waste management practice in Addis Ababa city. This study has found that technology has a positive significant effect on the performance of solid waste management. This result has concurred with those of previous studies that the technological dimension has a significant influence on the effectiveness of MSW collection (Chu et al., 2016). And this finding is also related to (Ahsan et al., 2014). When they observed that technology utilization has a direct effect on people's participation in waste management.

The third variable was designed to determine knowledge factors on the performance of solid waste management in Addis Ababa city. As shown in table 4.11 knowledge aspects were measured with indicators like the understanding level of the respondents, acquire solid waste management knowledge, and skilled stakeholders.

This study found that the status of knowledge aspects for the performance of SWM in Addis Ababa city is moderately low with a mean value of 2.33(Ibrahim et al., 2015).

The result revealed that the awareness of the stockholders about SWM was quite low. Only 13.8% of the respondents know the whole processes of integrated waste management, 19.1% know the impacts of solid waste on health, and 16.9% know the rule and lows of SWM. The educational qualification of the respondents shown in table 4.4 revealed that only 16.4% of the respondents were specialized in the environmental science field whereas 83.6 % have not any

educational background in the SWM area. This result indicates that the human resource department did not see the solid waste-related fields when they recruit the employees. According to (Town et al., 2017) description, all steps in municipal solid waste management system starting from waste generation, segregation, reuse, recycle, treatment, transportation, and final disposal are facilitated based on knowledge and awareness. Lack of knowledge about the practice and importance of a proper solid management system is a crucial factor for the failure of a solid waste management service (Tesema, 2010).

On the other hand, to improve the SWM knowledge of the stakeholders, providing on-the-job training and learning from others by sharing experience is very low in the city. To fill the gaps of knowledge and skills of the community on the handling of solid waste, educating and adequate training of the society is important (Ukpai, 1998).

In addition, the interview results show that people have developed the habit of discarding solid waste in rivers, fields, drains, and ditches; this is known to be the only way to deal with waste.

The third hypothesis was also stated that the status of knowledge aspects has a positive significant effect on the performance of SWM in Addis Ababa City. This study has found that there is a positive significant effect of knowledge on the performance of SWM. Therefore, this result is in line with those of previous studies that reveal the positive correlation relationship between knowledge and SWM practices (Laor et al., 2018).

CHAPTER FIVE

5. CONCLUSIONS AND RECOMMENDATIONS

The final part of the paper deals with the conclusion and the recommendations. The first section presents the conclusions and the recommendations are presented in this second section following the study objectives.

5.1. Conclusions

The study aimed to look into Addis Ababa's current performance of solid waste management practices and the factors that influence its effectiveness. According to the findings, Addis Ababa's current solid waste service delivery activity is characterized by massive solid waste generation and unbalanced solid waste management service. The study discovered that key factors of successful SWM, such as waste collection, transportation, and disposal, are ineffective in the Addis Ababa city administration. The results indicate that most of the indicators of effective SWM practices in the study area are not met by the city. The following constraints were linked to this ineffective performance of SWM activity in the city:

Considering that this study established there was the improper institutional arrangement and centralization approach was common in the city. The institutional integration / the relationship between the SWMT and other municipal service sectors/was weak. Additionally, there was also insufficient and inconsistent waste management contract period with the municipality and weak public-private partnerships. In general due to the above factors the company has faced frequent customer complaints about solid waste collection, transportation, and disposal.

Moreover, the level of applied appropriate technology on solid waste collection, transportation, and disposal was still low at city, sub-city, and community levels. Specifically, the Addis Ababa city administration was not properly applied appropriate technology for gathering solid waste information from the field, monitoring waste garbage, and monitoring trucks during transportation to increase the performance of SWM. On the other hand, to reduce solid waste generated at the source, solid wastes were not properly reused or recycled for other purposes before being disposed of.

Finally, the result revealed that the awareness of the stockholders about SWM was quite low. While only 16.4% of the solid waste workers and solid waste small and micro-enterprises were specialized in the environmental science field. On the other hand, to improve the SWM knowledge of the stakeholders, providing on-the-job training and learning from others by sharing experience is very low in the city.

Furthermore, Pearson's correlations measurement indicated that set of indicators as influencing factors like institutional, technological, and knowledge aspects. These indicators were significantly and positively associated at different strengths with the performance of SWM practice which are effective solid waste collection, transportation, and disposal. This indicates that the current poor performance of SWM practice was associated with factors of institutional arrangement, technological problems, and knowledge aspects.

5.2. Recommendation

Institutionally**,** the city administration should facilitate the proper institutional setup and improve the involvements of several institutions in integrated solid waste management programs. It should extend the contract arrangement with private waste management firms for possible cost recovery; further, the contract agreement should be updated to allow private enterprises to function flexibly. Moreover, the significant commitment of some levels of government and non-government organizations to expanding private sector municipal services is positive, but both the public and private sectors' partnership need to be strengthened in terms of carrying out their functions. To this goal, all parties, including households, must strengthen their capacities.

Many of the problems associated with Addis Ababa city SWM practice were related to the lack of a decentralization approach. They should establish clear and accountable authorities up to lower-level management that will help the municipality and other partners enhance their capabilities. In addition, there should be a continuous assessment for the satisfaction level of the community and improve the service delivery.

Technologically**,** the city government should ensure to provide adequate and modern solid waste management so that it will be easy to collect, transport, and disposal of waste. More specifically, they should apply modern technology like web-based GIS (geographic information system) for gathering the necessary information from the field; bin monitoring technology using a global

system of mobile/GSM/ for monitoring waste garbage and global positioning system/ GPS/ for monitoring trucks during solid waste transportation. These help the government to reduce the supervisory and transportation cost. Lastly, they should facilitate the reuse and recycling of solid wastes especially for solid waste micro and small enterprise by providing appropriate recycling equipment and training. The training is needed on the use of proper equipment for better and sustainable SWM systems.

Regarding the knowledge aspect, the city administrations can develop programs and education/training materials to empower the stakeholders in solid waste collection, transportation, and disposal. The city government could investigate the varied uses of various media outlets. This would allow them to reach a larger audience and collect essential inputs such as ideas, criticism, solutions, and citizens' dynamic perceptions. In addition, the integrated solid waste management system should be included in the school curriculum and instruction would be provided at the local school by trained volunteers and instructors under the curriculum. Furthermore, the local government should arrange field visits and experience sharing programs for developing stakeholder's knowledge and skill about SWM with informal education.

5.3. Recommendations for further research

This current study has focused on only three independent variables (institutional, technological, and knowledge aspects) and one dependent variable (performance of SWM). However, the current study has only focused on Addis Ababa city and it's just localized in only two sub-cities. Therefore, time and other resource limitations restricted this research to a narrow scope which only focused on two sub-cities. The researcher, therefore, recommends the study be done on a larger scale to cover more areas of the city with more variables and dimensions other than our research variables. Such a study should adopt more experimental methodologies since this current research only looks beliefs and opinions of the respondents. The researcher also recommended using a longitudinal data collecting system, in addition, to cross-sectional.

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Appendix

Appendix 1: Questionnaires for Addis Ababa SWM employees and small and micro-enterprises.

Topic: Factors affecting the performance of solid waste management /SWM/ practice in the case of Addis Ababa some selected sub-cities.

Dear Respondent.

As part of my study program, I am investigating the above topic. I am humbly requesting your input in answering the questions here by filling in the gaps using numbers and other guidelines are given. Would like to assure you that all the information you will give will remain confidential and only useful for this research.

I thank you.

Yours, Abera Mulatu

Section A: Background information

1) Your designation /position/ ----------

2) Work experience in this office in a year(s) (put a tick mark (√) on your correct year against the range provided)

1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ above 20 ☐

3) Age of the respondents (put a tick mark (√) on your correct age against the range provided)

Below 20 ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60 and above ☐

4) Gender of the respondents (put a tick mark (√) on the appropriate identity)

Male ☐ Female ☐

5) Educational qualification of the respondents (put a tick mark (√) against your correct qualification and field of specialization)

Qualification	Tick your qualification	Field of study/Subject/	Tick your field of study
1. Below 10or 12		None	
2. Certificate		Management area	
3. Diploma		Environment area	
4. Bachelors Degree and above		Accounting and finance	
5. Others(Specify)		If others(Specify)	

Please tick **(√)** in the appropriate number to indicate your level of agreement with the questions asked.

1= strongly disagree

2= Disagree

3= No definite answer

4= Agree

5= strongly agree

Section B: Institutional aspects on SWM

No	Statements	1	2	3	4	5
1	There is proper institutional set-up for solid waste Management service.					
2	Several institutions or agencies are involved in solid waste management					
3	We have sufficient and consistent waste management Contract period with the municipality.					
4	There is integrated solid waste management practice Between private and public agencies.					
5	Our company has faced frequent customer complaints about solid waste management in its assigned jurisdictions.					
6	The decentralization approach is common in your company.					

Section C: Applying Technology on SWM

No.	Statements	1	2	3	4	5
7	Transportation of solid waste is done using appropriate technological based equipment.					
8	Solid waste information from the field is usually gathered using technologically based instruments.					
9	Appropriate technologies are frequently used for monitoring waste garbage in the field.					
10	Appropriate technologies are applied for monitoring trucks during the transportation of solid waste.					
11	Our company has adequate and modern waste management equipment.					
12	Generated Solid wastes are appropriately recycled before disposed of in our city					

Section D: knowledge on solid waste management (SWM)

No.	Statements	1	2	3	4	5
13	I know the whole process of integrated SWM system					
14	I know public health problems are associated with a poor SWM system.					
15	I know well the rule and regulation of solid waste management in the municipality					
16	I develop my knowledge of the SWM system by frequently sharing experiences with others.					
17	I obtain sufficient job short-term training about integrated SWM systems.					
18	A solid waste small and micro-enterprise is well educated and informed on SWM in their respective area.					

Section E: The performance of solid waste management

No.	Statements	1	2	3	4	5
	Effective Solid waste collection indicators					
19	Frequency of waste pick–up is strictly followed by our company.					
20	There is full and continuous training on solid waste collection in our company.					
21	Our company has facilitated enough collection points near to all beneficiaries.					
22	Our Company maintains waste spillover to the ground at collection is cleaned.					
	Effective Solid waste transportation indicators					
23	The company has sufficient manpower and vehicle to transport solid waste.					
24	Nature of traffic condition along collection route has a jamming					
25	The supervisor records the daily number of trips, the tonnage of waste, and the route plan to drivers.					
26	Our company use covered vehicles and there is no spillover of					

	solid waste upon transport					
27	There are adequate internal roads (alternative roads) and traffic condition along collection route has not overcrowding					
	Effective Solid waste disposal indicators					
28	The existing disposal site is far away from our collection point					
29	The municipality did not provide a designated and accessible landfill site					
30	The existing disposal site is open and it has a bad smell to the community					
31	Our company disposes waste at the designated landfill by law and it is Environmentally safe.					
32	The presence of the animal on the disposal site is common.					

Dear respondent, using the following space you can put your general idea about the current SWM service delivering practice and its basic challenges you regard as necessary.....

.....

በአዲስ አበባ ዩኒቨርሲቲ
የቢዝነስና ኢኮኖሚክስ ኮሌጅ
ማስተር ኦፍ ቢዝነስ አድሚኒስትሬሽን
የምርምር ጥናት መጠይቆች

በአዲስ አበባ ከተማ የደረቅ ቆሻሻ አስተዳደር ሰራተኞችና አነስተኛ ጥቃቅን የፅዳት ማህበራት የሚሞላ መጠይቅ
እኔ የአዲስ አበባ ዩኒቨርስቲ በቢዝነስ ማኔጅመንት ትምህርት ክፍል የድህረ ምረቃ ጥናት በማድረግ ላይ እገኛለሁ፡፡ የጥናቴም ርዕስ "factors affecting the performance of solid waste mgt in Addis Ababa, some selected sub city" (በደረቅ ቆሻሻ አያያዝና፣ አስተዳደር እና አሰራር ላይ በሚታዩ ተግዳሮቶች) የተሰኘ ሲሆን እርስዎም በዚህ ጥናት መጠይቅ በመሙላት እንዲሳተፉ ተጋብዘዋል፡፡ በመሆኑም ለጥናቱ ውጤታማነት ትክክለኛውን መረጃ በመሙላት እንዲተባበሩኝ በትትህትና እጠየቅሁ የሚሰጡ መረጃዎች ሁሉ ሚስጥራዊ ሆኖ የሚቆይና ለዚህ ጥናት ብቻ የሚወሰድ ይሆናል፡፡
ጊዜዎን ሰውተው ስለሠጡን መረጃ በቅድሚያ አመሰግናለሁ፡፡
አበራ ሙላቱ 0911075877
ማሳሰቢያ፡ በመጠይቁ ላይ ስም አይፃፍም
ክፍል ሀ፡ የተጠያቂው የግል መረጃ

1. በመስሪያ ቤቱ የእርስም የሥራ መደብ ስያሜ _____
2. በዚህ መስሪያ ቤት የእርስዎ አገልግሎ በዓመት (በሳጥኑ ውስጥ የእርምት (√) ያስቀምጡ፡፡
   1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ ከ20 በላይ ☐
3. ዕድሜ በትክክለኛዎ ዕድሜ በሳኑ ውስጥ የእርምት (√) ምልክት ያስቀምጡ
   ከ20 በታች ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60 በላይ ☐
4. ፆታ ወንድ ☐ ሴት ☐
5. የትምህርት ደረጃ እና የሰለጠኑበት የት/ት ዓይነት (በትክክለኛው የት/ት ደረጃ የት/ት ዓይነት ፊት ለፊት የእርማት (√) ምልክት ያስቀምጡ

የት/ት ደረጃ	የእርማት ምልክት ያስቀምጡ	የሰለጡት የት/ት ዓይነት	በሰለጠኑበት የት/ት ዓይነት ፊት ለፊት የ(√) ምልክት ያስቀምጡ
1 ከ10/12 በታች		ቀለም	
2. ሰርተፊኬት		በአስተዳደር	
3. ዲፕሎማ		በአካባቢ ጥበቃ	
4.ዲግሪና ከዚያ በላይ		በአካውንቲንግእና ፋይናንስ	
5.ሌላ ካለ		ሌላ ካለ ይግለፁ	

ከዚህ በታች ለደረቅ ቆሻሻ አስተዳደር የአፈፃፀም ችግር ሊሆኑ የሚችሉ ጉዳዮች ተዘርዝረዋል፡፡ ከተዘረዘሩት ውስጥ የሥራ ዘርፍ ላይ ይበልጥ ተፅኖ የሚያሳድሩበትን ደረጃ በመምረጥ በእያንዳንዱ ጥያቄ ፊት ለፊት በተሰጡት ማራጮች አንዱ ጊዜ ብቻ የ(√) ምልክት በማድረግ ምላሾን ይስጡ
የተሰጡ አማራች መግለጫ

1. በጣም አልስማማም
2. አልስማማም
3. ለመወሰን እቸገራለሁ
4. እስማማለሁ
5. በጣም እስማማለሁ

ክፍል ለ፡ ተቋማዊ አሰራር ተፅዕኖ /Institutional aspect/

ተ/ቁ	መጠይቅ	1	2	3	4	5
1	ለደረቅ ቆሻሻ አሰባሰብና አወጋገድ ዘርፍ የተደራጀ መዋቅራዊ አሰራር አለ፡፡					
2	ብዙ ተቋማትና ባለድርሻ አካላት በደረቅ ቆሻሻ አሰባሰብና አወጋገድ ስራ ላይ እየሰሩ ነው፡፡					
3	በድርጅታችሁ (ተቋማችሁ) እና በከተማ አስተዳደሩ መካከል የማይለዋወጥ በቂ የሥራ ስምምነት አለ					
4	በደረቅ ቆሻሻ ላይ የግልና የመንግስት ድርጅቶች በመቀናጀት እየሰሩ ነው፡፡					
5	ድርጅታችሁ (ተቋማችሁ) በሚሰጠው አገልግሎት ከደንበኞች ተደጋጋሚ ቅሬታ ይገጥመዋል					
6	በተቋማችሁ ያልተማከለ አስተዳደር መተግበር የተለመደ ነው					

ክፍል ሐ፡ የቴክኖሎጂ አጠቃቀም ተፅዕኖ (technological factors)

ተ/ቁ	መጠይቅ	1	2	3	4	5
7	ደረቅ ቆሻሻ የማጓጓዝ ሥራ የሚከናወነው በተገቢ ቴክኖሎጂ ላይ የተመሰረተ መሳሪ በመጠቀም ነው፡፡					
8	የመስክ መረጃዎች ብዙውን ጊዜ በቴክኖሎጂ ላይ በተመሰረቱ መሳሪያዎች በመጠቀም ይሰበሰባሉ ፡፡					
9	የደረቅ ቆሻሻ ጊዜያዊ ማጠራቀሚያ ቦታዎችን ለመቆጣጠር ተገቢውን ቴክኖሎጂ እንጠቀማለን፡፡					
10	ትክክለኛና ተገቢ የሆኑ የቴክኖሎጂ መሣሪያዎች በመጠቅ ደረቅ ቆሻሻ የሚያጓጉዙ መኪናዎችን መከታተልና መደገፍ ችለናል፡፡					
11	ድርጅታችሁ (ተቋማችሁ) በቂና ዘመናዊ የደረቅ ቆሻሻ አያያዝና አስተዳደር ስራ የሚከናወንባቸው መሳሪያዎች አሉት					
12	በተቋማችሁ የሚመነጩ ደረቅ ቆሻሻዎች ከመወገዳቸው በፊት በአግባቡ እንደገና ጥቅም ላይ የማዋሉ ሥራ የተለመደ ነው፡፡					

ክፍል መ፡ የእውቀት /ክህሎት ተፅኖ/ knowledge factors

ተ/ቁ	መጠይቅ	1	2	3	4	5
13	የተቀናጀ የደረቅ ቆሻሻ አያያዝ ስርዓት አጠቃላይ ሂደትን ጠንቅቄ አውቃለሁ፡፡					
14	የህዝብ የጤና ችግሮች በአግባቡ ደረቅ ቆሻሻን ካለማስተዳደር ሥርዓት ጋር የተቆራኙ መሆናውን አውቃለሁ፡፡					
15	በማዘጋጃ ቤት ውስጥ የደረቅ ቆሻሻ አያያዝ ዙሪያ የወጡ ደንብና መመሪያዎችን ጠንቅቄ አውቃለሁ					
16	ከሌሎች ተቋማት ጋር በተደጋጋሚ የልድ ልውውጥ በማድረጌ በደረቅ ቆሻሻ አያያዝ ስርዓት ላይ ያለኝን እውቀት አዳብሬአለሁ፡፡					
17	ስለ ተቀናጀ የደረቅ ቆሻሻ አስተዳደር ስርዓት በአጫጭር የስራ ላይ ስልጠና በበቂ ሁኔታ አግኝቻለሁ					
18	በደረቅ ቆሻሻ የተደራጁ የአነስተኛና ጥቃቅን ማህበራት በደረቅ ቆሻሻ አያያዝ ዙሪያ በደንብ የተማሩና በቂ መረጃ ያላቸው ናቸው፡፡					

ክፍል ሠ፡ የደረቅ ቆሻሻ አያያዝ አፈፃፀም (the performance of solid waste management)

ተ/ቁ	መጠይቅ	1	2	3	4	5
ውጤታማ የደረቅ ቆሻሻ አሰባሰብ አመልካቾች /effective solid waste collection indicators/						
19	ተቋማችን ለደንበኞቹ ደረቅ ቆሻሻ በየጊዜው እንዲነሳ ጥብቅ ቁጥጥር ያደርጋል					
20	በተቋማችን ውስጥ ለሰራተኛና ለማህበራት ስለ ደረቅ ቆሻሻ አሰባሰብ በቂና ተከታታይ ስልጠና ይሰጣል፡፡					
21	ተቋማችን ለተጠቃሚዎች አመቺና ቅርብ በሆነ ጊዜያዊ የቅብብሎሽ ጣቢያ አዘጋጅቷል፡፡					
22	በጊዜያዊ የቅብብሎሽ ጣቢያ (ገንዳ ዙሪያ) ያለ አካባቢ ሁሌም ንፁህ ነዉ					
	ዉጤታማ የደረቅ ቆሻሻ ማጓጓዝ አመልካቾች (effective soild wnste transportation indicators)					
23	በተቋማችን ቆሻሻን ለማጓጓዝ የሚያስችል በቂ ተሽከርካሪና የሰዉ ሃይል አለ፡፡					
24	የትራፊክ ሁኔታ ደረቅ ቆሻሻን ለማጓጓዝ ችግር ፈጥሯል፡፡					
25	ተቋማችን በየቀኑ ስላለ የመኪና ምልልስና የቆሻሻ መጠን ይቆጣጠራል፡፡					
26	ቆሻሻ የሚጓጓበት መኪና የተሸፈነ በመሆኑ አካባቢዉን ለብክለት የማያጋልጥ ነዉ					
27	በቂ አማራጭ መንገድ ባለመኖሩ ቆሻሻን ለማጓጓዝ ተቸግረናል፡፡					
	ዉጤታማ የደረቅ ቆሻሻ ማስወገድ አመልካቾች (effective solid waste disposal indicators)					
28	በአሁን ወቅት የቆሻሻ መጣያ (ማስወገጃ) ከምንሠበስብበት ቦታ የራቀ ነዉ፡፡					
29	የፅዳት አስተዳደሩ አመቺ የሆነ የደረቅ ቆሻሻ ማስወገጃ ቦታ አላዘጋጀም፡፡					
30	የደረቅ ቆሻሻ ማስወገጃዉ ቦታ ክፍት በመሆኑ ለአካባቢዉ ነዋሪ መጥፎ ሽታ ፈጥሯል፡፡					
31	ተቋማችን ሁሌም ቆሻሻ የሚያስወግደዉ በህግ በተፈቀደለት ቦታ ብቻ ነዉ፡ ፡					
32	አሁን ያለዉ የቆሻሻ ማስወገጃና መሠብሠቢያ ቦታ የተለያ እንስሳት ይገኙበታል፡፡					

የተከበራችሁ ተጠያቂዎች በአጠቃላይ በደረቅ ቆሻሻ አሠባሰብና አወጋገድ ሥራ ላይ ያሉ ዋና ዋና ችግሮች ወይም አስተያየቶች ካሎት ባለዉ ክፍት ቦታ ይግለፁ፡፡ _____

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