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Environmental and Health Impact of Solid Waste Disposal System in Addis Ababa City: A Case Study of Yeka Sub City

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Environmental and Health Impact of Solid Waste Disposal System in Addis Ababa City: A Case Study of Yeka Sub City

A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Master of Education in Biological Sciences

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GRADUATE PROGRAMMES

This is to certify that the thesis prepared by Mulumebet Woldetensae, entitled: **Environmental and Health Impact of Solid Waste Disposal System in Addis Ababa City: A Case Study of Yeka Sub City,** Addis Ababa, Ethiopia and submitted in partial fulfillment for the requirements for the Degree of Master of Science in Zoological Science complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Title: Environmental and Health Impact of Solid waste Disposal System in Addis Ababa City: A Case Study of Yeka Sub City

Abstract

Waste is defined as eliminated or discarded unwanted or unusable material, substances, or by products produced by individuals, households or organizations. As a result waste is a complex mixture of different substances, only some of which are intrinsically hazardous to health and human activities have always generated waste. Increasing population levels, booming economy, rapid urbanization and the rise in community living standards have greatly accelerated the municipal solid waste generation rate in developing countries.

Objective: The aim of this study is to assess the environmental and health impact of solid waste management in Yeka sub city of Addis Ababa.

Methods: Community based cross sectional study design was employed. Data were collected using structured questionnaire on socio demographic, environmental and health impacts of solid waste management system of Yeka sub city. A total of 634 residents between age of 18 and 65 years were interviewed. FGD was conducted on two groups from two Weredas. Data were analyzed and presented using tables, charts and figures.

Results: The response rate was 99.2%. Among the residents, 82.5% perceived that their environment is dirty; 38.8% received information about waste management through media, followed by school (26.2%). About 90% of them used hands for waste management risking their health. Diarrhea and cough are the most prevalent diseases related to waste contamination. Assigning workers (67.1%), timely cleaning campaign (14.9%) and awareness creation trainings (12.6%)were measures employed from the sub city administration to alleviate the problem.

Conclusion: The environmental and health impacts of solid waste disposal system in Yeka sub city, Addis Ababa is high. Residents of the sub city have been suffering from related diseases due to poor solid waste management system. There is lack of awareness on how to store and dispose the solid waste produced at their households. Diarrhea and cough were the most prevalent. Support from the municipality on how to handle, store and dispose solid waste is not satisfactory. Expectation of the residents from the government was also high.

Recommendation: Yeka sub city administration, respective weredas sanitation offices and wereda health bureaus should be responsible for the alleviation of solid waste related problems of the sub city.

Key words: Environment, Health Impact, Solid Waste, & Urbanization

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Acronyms and Abbreviations

BMI	Body Mass Index
CI	Confidence Interval
ETB	Ethiopian Birr
FGD	Focus Group Discussion
MDG	Millennium Development Goals
MSWM	Municipal solid waste management
NGOs	Non - Governmental Organizations
PSUs	Primary Sampling Units
WHO	World Health Organization

Chapter One

1. Introduction

1.1 Background

Waste is defined as eliminated or discarded unwanted or unusable material, substances, or by products (Strategies, 2012; Al-khatib et al., 2007). According to the Basel Convention of the United Nations environment program 'Wastes are substances or objects, which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law (Zemena, 2014). Glossary of Environment Statistics (Strategies, 2012) defines waste in another way as following: "Wastes are materials that are not prime products (that is products produced for the market) for which the initial user has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose". As a result waste is a complex mixture of different substances, only some of which are intrinsically hazardous to health (Rushton, 2018). Human activities have always generated waste (Giusti, 2009). Increasing population levels, booming economy, rapid urbanization and the rise in community living standards have greatly accelerated the municipal solid waste generation rate in developing countries (Abarca et al., 2013). It became a serious problem with urbanization and the growth of large population.

Poor management of waste led to contamination of water, soil and atmosphere and to a major impact on public health. In medieval times, epidemics associated with water contaminated with pathogens decimated the population of Europe and even more recently (19^{th} century), cholera was a common occurrence (Giusti, 2009). Some of the direct health impacts of the mismanagement of waste are well known and can be observed especially in developing countries.

The environmentally acceptable management of municipal solid waste has become a global challenge due to limited resources, ever increasing population, rapid urbanization and industrialization worldwide (Giusti, 2009; Pokhrel & Viraraghavan, 2005; Sharholy & Ahmad, 2008). Statistics has shown that the world population reached 6 billion in 2001 with 46% of this population residing in urban areas. The urban population in developed nations was 75% of the total population in those countries, whereas the urban population in developing nations accounted for 40% of the total (Pokhrel & Viraraghavan, 2005)

Municipalities, usually responsible for waste management in the cities have the challenge to provide effective and efficient systems to the inhabitants (Abarca et al., 2013). However, they often face problems beyond the ability of the municipal authority to tackle mainly due to lack of organization, financial resources, complexity and system multi dimensionality (Abarca et al., 2013).

Poor collection and inadequate transportation are responsible for the accumulation of Municipal Solid Waste (MSW) at every nook. The management of MSW is going through a critical phase, due to the unavailability of suitable facilities to treat and dispose of the larger amount of MSW generated daily in metropolitan cities. Unscientific disposal causes an adverse impact on all components of the environment and human health (Sharholy & Ahmad, 2008).

1.2 Objectives of the study

1.2.1 General Objective

The aim of this study is to assess the environmental and health impact of solid waste management in Yeka sub city of Addis Ababa.

1.2.2 Specific Objectives

The specific objectives are:

- ✓ To explore awareness and habits of waste management practices of Yeka sub city inhabitants
- ✓ To identify solid waste management practices and its challenges in Yeka Sub-city
- ✓ To assess the health and environmental impact of solid waste disposal in Yeka Sub City based on data obtained from health posts and interviews with the residents

1.3 Statement of the problem

Urban waste management has been a challenge for municipalities and urban governments in the developing world, largely due to poor infrastructure, bureaucratic competence and limited institutional capacity of the municipalities (Giusti, 2009). Municipalities throughout Ethiopia are not free of these problems and are facing a major challenge with solid waste management.

Addis Ababa, the capital city of Ethiopia, like many other towns and cities of the developing countries has a serious problem in the provision of adequate solid waste management services.

Improper solid waste management causes all types of pollution: air, soil, and water. Health and safety issues also arise from improper solid waste management. The rapid population growth of Addis Ababa has been putting tremendous pressures on the city, not least in terms of environmental degradation. For instance, 35 percent of the solid waste generated by the city is not collected. The aesthetic quality of the city has deteriorated and the health situation of the community has come under serious threat (World Bank, 1999). Although some researchers came up with similar studies in the city, no such research finding has been accessed in the present study area, i.e, Yeka sub city of Addis Ababa. Due to shortage of logistics, financial and time limitations and the burden that the solid wastes impose on the aesthetic image of the city, the research focuses only on solid waste disposal system in the sub city administration.

Therefore, this study addresses the following research questions:

1. How does the sub-city manage its solid waste? What are the methods used for collection, sorting and disposal methods used and what are the challenges?
2. What are the impacts of the solid waste management systems on the environment? How do the residents perceive the impacts of solid waste on their environment?
3. What are the health impacts of the solid waste management among the residents of the sub-city?

1.4 Significance of the study

Different research findings revealed that poor solid waste management in cities leads to environmental pollution and poor health condition of its residents. In order to cope with the problem related to waste management system it is mandatory to know the waste management system of the study area. Furthermore, the health and environmental impact of solid waste in the sub city should be assessed.

Therefore, this study provides important information concerning the waste management strategy, and the health and environmental impact of solid waste in Yeka Sub City to the health professionals, Woreda health centers, residents of the area and significant others. So that will help them take contemporary solutions to solve the problem from its grass root if there will be any. Furthermore, it will provide baseline information to any interested researcher to conduct further research up on it.

Chapter Two

2. Literature Review

2.1 Definition of Waste

Waste is anything discarded by an individual, household or organization. As a result waste is a complex mixture of different substances, only some of which are intrinsically hazardous to health (Rushton, 2018). Municipal solid waste (MSW) is defined to include refuse households, non-hazardous solid waste from industrial, commercial and institutional establishments including hospitals, market waste, yard waste, and street swiping (Ch, 2009).

Domestic solid wastes are wide variety produced from household activities such as food preparation and consumption, sweeping, burning, and garden wastes, and used items like clothing, furnishings, and abandoned equipment. Domestic waste includes both solid and liquid and sometimes hazardous wastes generated from residential areas and sometimes referred to as household wastes (Mohammed, et.al, 2017).

2.2 Solid Waste Management Systems in Developing Countries

According to (Chandana, K. et.al., 2005) the common causes for poor waste management services are the lack of appropriate government policy and legislation lack of political will and public commitment, inadequate technical expertise, insufficient financial resources or inappropriate allocation of available resources, and unavailability of suitable lands for waste disposal sites.

Addis Ababa city started its solid waste management some four decades back but currently the service cannot meet the changing demands. The social waste collection service is unsatisfactory, and scenes of scattered waste are common in most part of the city (Mohammed et al., 2017). Solid wastes are collected by the government employees, private companies' based on contractual agreements and Micro and Small Enterprise (Li, et al., n.d.). A detailed survey conducted in 1986 concluded that only 21.6 percent of waste had been collected (Repository, 1999). A recent study made by the Addis Ababa City Administration shows that, the coverage has been constantly increasing from 38 percent in 1993 to 40 (1994), 53 (1995) and 53.9 in 1996 (Repository, 1999).

Several factors may make the problems of solid waste collection more difficult to solve. These factors can be professional, cultural, or economic factors. The professional category is related to questions about the quantity and quality of the municipal professional staff, the cultural factors may include the persistence of a semi caste system that the 'socio-economically poor' people have to do low-pay, low-prestige jobs, such as waste collection, transportation and informal gathering and sales of recyclables. Waste disposal, at the household level, is often left to servants. Furthermore, there is a tendency that the children from well-off families are not properly educated on cleanliness and tidiness of their housing environment. Some of them may even believe that 'their littering practice is the right thing, in that it offers employment for someone else and this leads to lack of respect for informal rules of socially responsible behavior (Mongkolnchaiarunya, 2005).

Most residents do not separate wastes at home since there is no awareness, knowledge, facilities, and there is no incentive system to do so (Azam & Ali, 2004; Mongkolnchaiarunya, 2005). In addition, the way of life, especially with regard to food, tends to produce large amounts of waste, such as numerous plastic bags for carrying cooked and fresh food from markets. Separation of kitchen wastes is not easy. The public's knowledge on hazardous waste is minimal (Ejaz, et.al,2010; Regassa, et.al, 2011).

The estimated quantity of Municipal Solid Waste (MSW) generated worldwide is 1.7–1.9 billion metric tons per year making cities a threat to the environment (Mohammed, et.al, 2017). It is also expected to increase approximately to 2.2 billion metric tons per year by 2025. While in sub-Saharan Africa it is approximately 62 million tons per year.

Solid waste management systems cover all actions that seek to reduce the negative impacts on health, environment and economy (Ejaz, et.al, 2010). Environmental and sanitary conditions are becoming very complex due to unplanned communities and developments in major cities. Due to a lack of awareness and low income sources, dwellers are forced to live with unhealthy and unhygienic conditions. An improper solid waste management system may contribute to a worsening environmental degradation of the community. Illegal dumping of communal solid waste is responsible for a number of diseases in developing countries.

Solid waste generation in developing countries is increasing annually due to an urbanization trend. Prototype and density of metropolitan areas, the physical composition of waste, density of waste,

temperature and precipitation, scavenger's activity for recyclable separation, treatment capacity, insufficiency and limited resources are making tasks very tough for the administration authority in developing countries (Giusti, 2009). Due to diverse life styles in communities, development authorities are not able to offer analogous type of solid waste management system for different communities, abnormal solid waste management systems are working. Collection efficiency of the existing solid waste systems in developing countries is very low due to a lack of storage bins and improper management system (Abarca et al., 2013).

2.3 Municipal solid waste management

Environmentally sound waste management is recognized by most countries as an issue of major concern. For both developing and developed countries, waste management is an important factor in ensuring both human health and environmental protection. Article 21.4 of Agenda 21 states that 'Environmentally sound waste management must go beyond the mere safe disposal or recovery of wastes that are generated and seek to address the root cause of the problem by attempting to change unsustainable patterns of production and consumption.

Municipal waste is collected and treated by, or for municipalities (Selin, 2013a). It covers waste from households, including bulky waste, similar waste from commerce and trade, office buildings, institutions and small businesses, yard and garden, street sweepings, contents of litter containers, and market cleansing (Selin, 2013a).

The generation of waste and the collection, processing, transport and disposal of waste, the process of 'waste management', is important for both the health of the public and aesthetic and environmental reasons (Ch, 2009; Rushton, 2018).

Municipal solid waste management (MSWM) encompasses the functions of collection, transfer, resource recovery, recycling, and treatment (Ch, 2009; Henry, et. al,2006). The primary target of MSWM is to protect the health of the population, promote environmental quality, develop sustainability, and provide support to economic productivity (Ch, 2009). To meet these goals, sustainable solid waste management systems must be embraced fully by local authorities in collaboration with both the public and private sectors (Henry et al., 2006). Although in developing countries the quantity of solid waste generated in urban areas is low compared to industrialized countries, the MSWM still remains inadequate (Henry et al., 2006).

Solid waste management has emerged as one of the greatest challenges facing state and local government environmental protection agencies (Ch, 2009).

The UK Environment Agency classifies waste as either controlled waste or non-controlled waste (Rushton, 2018). Controlled waste includes waste generated from households (municipal solid waste), commercial and industrial organizations and from construction and demolition. Non-controlled waste includes waste generated from agriculture, mines and quarries and from dredging operations. The mean production of daily household and commercial waste in EU Member States in 1993–96 was approximately 370 kg/capita/annum, ranging from 350 to 430 kg. Municipal solid waste (MSW) consists of many different things including food and garden waste, paper and cardboard, glass, metals, plastics and textiles. These are also generated by commercial and industrial organizations although large volumes of chemical and mineral wastes are produced in addition, depending on the sector. Agricultural waste comprises mainly slurry and farmyard manure with significant quantities of straw, silage effluent, and vegetable and cereal residues. Most of this is spread on land. Certain types of waste are defined as hazardous because of the inherent characteristics (e.g. toxic, explosive). The three largest waste streams in this category are oils and oily wastes, construction and demolition waste and asbestos, and wastes from organic chemical processes (Omar & Kadir, 2011; Olukanni, et al; 2016).

2.4 Impact of poor solid waste disposal system on the Environment

Improper management of solid waste is one of the main reasons for environmental pollution and degradation in towns and cities, of the third world especially (Selin, 2013a). Open dumping, open burning and un-engineered sanitary landfills are common practice throughout the country. Due to improper solid waste disposal and collection systems dwellers are facing serious negative environmental impacts in developing countries. For example, in Pakistan, according to the Ministry of the Environment, about 54,850 tons of solid waste is being generated on daily basis in urban areas, less than 60 percent of this generated solid waste is being collected properly. According to the same department there is no city in Pakistan having proper waste collection and disposal system for municipal and hazardous wastes

Household residents in Freetown, Sierra Leone, especially those who are closer to dumpsite residents, are not happy about the location of the dumpsite in their community. They complained that the dumpsite is too close to their houses causing them a lot of sicknesses. Furthermore, they

argued that their surroundings are smelly and filthy and some the wastes from the dumpsite overlap their houses causing pollution in the environment (Luang, 2001).

Poor solid waste management systems in cities of developing countries results in many negative environmental impacts (Ejaz et al., 1996; Luang, 2001) . Poor solid waste disposal system is creating a number of negative environmental impacts. Blockages of the drains and sewers ultimately are creating flooding and unhygienic conditions in the city which again suitable for mosquito breeding and causes for Malaria. Flies breeding are directly linked with open solid waste dumps which are very effectual vectors that spread disease in the community. Uncollected solid wastes from few locations in the city are degrading the urban environment and discouraging efforts to keep streets and open spaces clean. During transportation of the wastes, open body trucks are being used for the collection of solid wastes in most of cities of developing countries without covers which is totally unhygienic (Abarca et al., 2013; Pokhrel & Viraraghavan, 2005).

Due to poor domestic waste collection and disposal systems, high amounts of waste ends up in open dumps or drainage system, threatening both surface and ground water quality and provide a breeding ground for pests (Mohammed et al., 2017). Open burnings cause air pollution and unpleasant odor to the environment more exacerbated in areas where there is lack of garbage collection containers. It also leads to loss of productive land due to the presence of non-biodegradable items and contamination of soil, ground and surface waters by leaching. Buried hazardous domestic wastes can filter down through the soil and contaminate groundwater. Pouring hazardous liquids on the ground can poison soil, plants and water (Mohammed et al., 2017; Strategies, 2012).

Dealing with the environmental costs in rapidly growing economic development, urbanization and improving living standards in cities have led to an increase in the quantity and complexity of generated waste, representing a phenomenal challenge (Sharholy & Ahmad, 2008; Regassa, et. al., 2011). This is particularly true in the area of solid waste management. While cities are generating an ever-increasing volume of waste, the effectiveness of their solid waste collection and disposal systems are declining. In urban centers throughout African regions, less than half of the solid waste produced is collected, and 95 percent of that amount is either indiscriminately thrown away at various dumping sites on the periphery of urban centers, or at a number of so-called temporary sites, typically empty lots scattered throughout the city (Selin, 2013b).

2.5 Impact of poor solid waste disposal system on the health of the community

The potential health effects of both waste itself and the consequences of managing it have been the subject of a vast body of research (Henry et al., 2006; Rushton, 2018). The safety and acceptability of many widely used solid waste management practices are of serious concern from the public health point of view (Hamer, 2003). The generation of waste and the collection, processing, transport and disposal of waste, the process of 'waste management', is important for both the health of the public and aesthetic and environmental reasons (Rushton, 2018). Sites are found on the outskirts of urban areas.

Many countries in developing countries face serious environmental degradation and health risks. These areas become children's sources of contamination due to the incubation and proliferation of flies, mosquitoes, and rodents. They, in turn, are disease transmitters that affect population's health, which has its organic defenses in a formative and creative state. The said situation produces gastrointestinal, dermatological, respiratory, genetic, and several other kind of infectious diseases

Poorly managed solid wastes are potentially hazardous to the health of the community. Wastes from different sources (industrial, agricultural, hospitals add/or households) can inter human bodies through different routes. These toxicants can be found in air, water and soil and could find their way into the human body through inhalation, ingestion absorption (Selin, 2013a; Li et al., 2011). Skin Disorders, Respiratory Abnormalities, Abdominal and Intestinal Problems, Dental Disorders, Ear Infections, Skeletal Muscular Systems problems, Central Nervous System impairment, Eye Infections, Blood Disorders, malaria, chicken pox, septic wounds and congenital abnormalities, cardiovascular diseases and lung cancer are among health related problems due to improper solid waste management system in urban areas (Selin, 2013a; Mazhindu, et al., 2012).

The United States public health service has published the result of the study tracing the relationship of 22 diseases to improper solid waste management. Waste water is the cause of enteric communicable diseases. Human excreta contain disease causing organisms, thus it is the source of many infections (UNICEF and WHO, 2010; Hutton G., Bartram J. 2008).

In Sub- Saharan Africa, 69 percent of the population does not have access to improved sanitation facilities. At the current rate of progress, the sanitation Millennium Development Goals (MDG) will not be met for a long time (WHO, 2003). Waste management is a growing public concern in

Ethiopia. In many cities of the country, waste management is poor and solid wastes are dumped along roadsides and into open areas, endangering health and attracting vermin. Access to sanitation is also among the lowest in the world. Sixty percent of the population still practices open field defecation. Only12 percent (8%in the rural and 29% in the urban) of the population use improved sanitation facilities (Tefera W., 2008).

Chapter Three

3. Materials and Methods

3.1 Description of the study area

The study was conducted in Addis Ababa, Yeka Sub City, one of the ten administrative divisions of Addis Ababa, from May 1st to June 1st 2018. Addis Ababa lies at an elevation of 2,200 meters above sea level; at 9°1′48″N 38°44′24″ E coordinates. The city lies at the foot of Mount Entoto and forms part of the watershed for the Awash. Addis Ababa rises to over 3,000 metres in the Entoto Mountains to the north. Yeka sub-city is located in the North east Part of the city. The total area of the sub-city is 85.98 km square and 4,284.9 people live in one kilometer square. Moreover, the entire population of the area is 368,418 people. Administratively, Yeka sub city is structured in to 14 Weredas. Altogether, according to information obtained from the sub city, there are 159,067 households and 368,418 residents living in the area.

Figure 1: Location of Addis Ababa in Ethiopia and Map of Addis Ababa (Source: Yeka Sub City Administration)

Figure 2: Geographical location of Yeka Sub City in relation to other sub city administrations of Addis Ababa (Source: Yeka Sub City Administration)

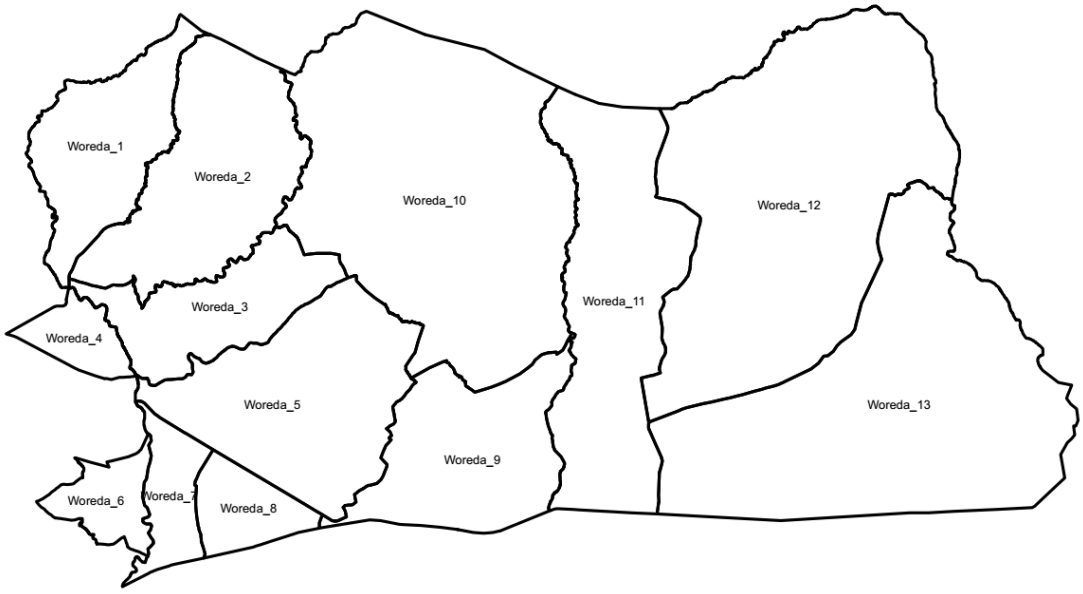

Figure 3: Map of Yeka sub city, showing geographical locations of Wereda administration. (Source: Yeka Sub City Administration)

3.2 Study design

This research was conducted in Yeka sub city, one of the administrative divisions of Addis Ababa, the capital of the county. Six Weredas were randomly selected from the total of 14 for the study. Households were proportionally allocated according to the total number of the households in the respective weredas. Questionnaires that focus on the impact of solid waste on the environment and health of the community were prepared after reviewing different literatures. The questionnaires were prepared in English and translated in to Amharic for easy communication with the subjects. Guideline was prepared for the focus group discussion (FGD). After the data collection, charts and graphs were used for analysis on Microsoft excel software. Responses from the FGD were described qualitatively.

3.3 Population

All people whose ages are greater than 18 years of age that live in Yeka Sub City for at least six months were the source population for the study.

3.4 Inclusion criteria

Those individuals that live in Yeka sub city for at least 6 months, in the age range of 18 – 65, who were voluntary to participate were included in the study.

3.5 Sample size and sampling procedure

3.5.1 Sample size determination

The study employed the single population proportion sample size determination formula. The proportion (**p**) of health and environmental impact of solid waste disposal in Yeka sub city was 50 %, with 95% CI, and 5% marginal error (where **n** is desired sample size, **Z** is value of standard normal variable at 95% confidence interval (CI) and, **d** is marginal error which is 5%). Since similar study on this issue in Ethiopia was not accessed, the 50% proportion of health and environmental impact was used to obtain the optimum sample size.

$$n = \frac{Z^2 \alpha/2\ P\ (1-P)}{d^2} = \frac{(1.96)^2 * 0.5 * 0.5}{(0.05)^2} = 384$$

Then, multiplying by 1.5 for design effect and adding 10 % contingency for non respondent, the final total sample size was 634.

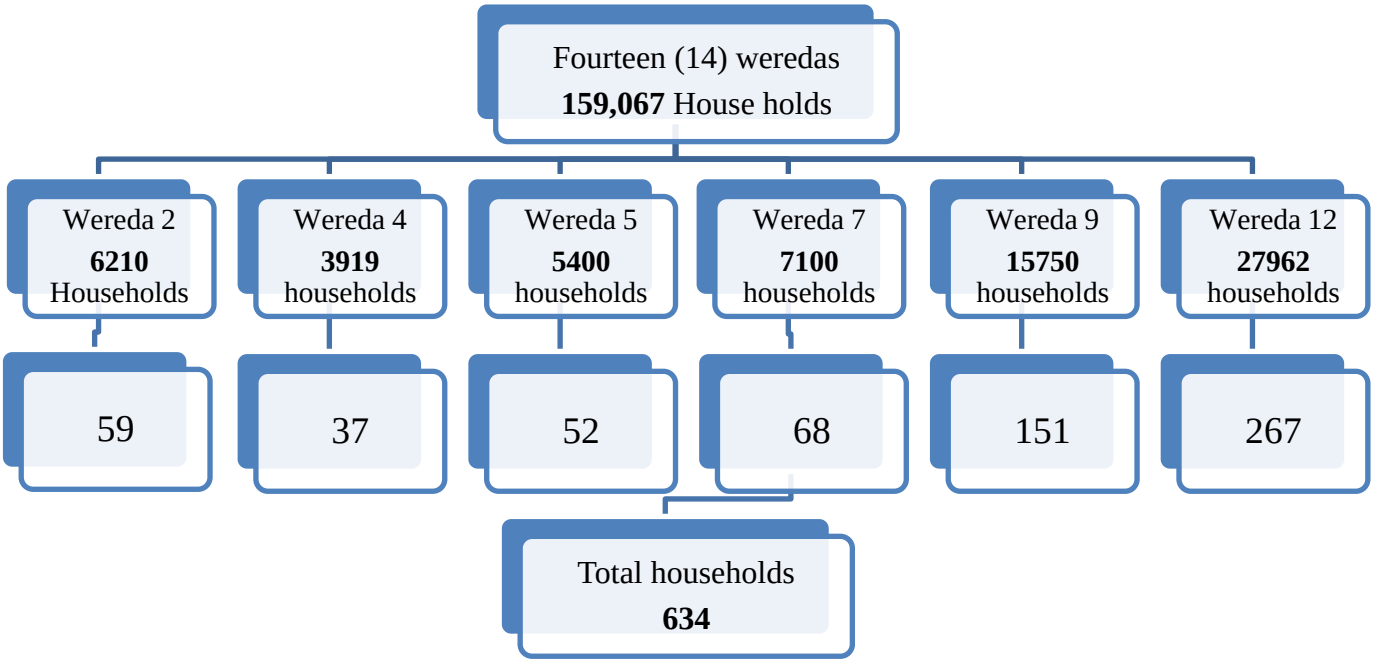

Figure 4: Sampling Procedure of Households in Yeka Sub City

3.5.2 Sampling procedure

The sampling design adopted for the study was a multi stage simple random sampling using sub city as primary sampling units (PSUs). As per the sample design prepared for this survey, 6 weredas were randomly selected out of 14 weredas in Yeka Sub City. Then listing of households was carried out in each selected wereda by going from house to house. By assuming the presence of at least one person in each house hold, after counting the number of total house hold, proportional allocation of sampling for each wereda was fixed. Then respondents were approached by interviewers at their places of residence. On each household, randomly selected respondents were interviewed using individual questionnaire. In a case if there is no eligible person in selected house hold, the next household was substituted. If the selected respondent refused to respond to the question, he/she was considered as a non respondent. If the selected respondent was not found during the initial visit, an attempt was made to get him/her and after all was considered as non respondent.

3.6 Data collection instrument and procedure

A pre tested, structured and interviewer administered questionnaire was used that was adapted through reviewing relevant literature to the problem under the study to include all the possible variables that address the objective of the study.

The questionnaire was divided into three sections. The first section covered socio demographic factors such as sex, educational level, and occupational level.

The second part of the questionnaire contains questions related to solid waste disposal system of the sub city and the third portion requests the respondents about the health and environment related problems of solid waste management system of the study area.

In addition, Guideline for focus Group Discussion (FGD) was prepared and used for collecting more detailed data from the study participants. Moreover, the Yeka sub city administration health office was requested for information on the health situation in the sub city administration. Accordingly, information on the status of diarrhea and typhoid recorded on weekly bases for the last 10 months was secured. Comparison was made between the data collected through questionnaires & FGD and information taken from the health office.

3.7 Data quality control

The quality of the data was assured by doing pretest, providing training for data collectors and supervisors and intensive supervision during data collection.

The questionnaires were translated to Amharic and back to English by language professionals. Daily close supervision was made by the supervisor and the principal investigator. At the end of each day, the questionnaire was reviewed and checked for completeness, accuracy and consistency by the supervisor and the principal investigator and immediate corrective measures were taken on the spot.

Since the instruments were developed after reviewing different literatures, it was pre-tested on the relatively similar population. Therefore, the questionnaire was tested on 5% (30 subjects) of the total sample size in one of the weredas in Yeka Sub City that was not considered in actual data collection process. Cronbatch's Alpha was calculated by using SPSS window version 20.0 to test internal consistency (reliability) of the data collection instruments and Cronbatch's Alpha

greater than 0.7 was considered as reliable. On top of this, content validity was cross checked by another expert in the area.

Data collection facilitator or supervisors were trained for two days on the study instrument and data collection procedure. For this purpose, guideline was developed by principal investigator for data collectors and clarifying how to undertake the data collection process. The principal investigator and the supervisors have checked the collected data for completeness and on spot corrective measures were taken accordingly.

3.8 Data processing, analysis and presentation

The data was checked for completeness and consistencies, and then it was cleaned, coded and entered into computer. Percentages, charts and graphs were computed on Excel Microsoft program to determine the impact level of solid waste on health and environment in the study area.

3.9 Ethical consideration

When conducting a study involving human beings, it is very important to make sure that the subjects are well informed about the research, what it is about and that their participation is by free willingness. What this actually means is that the subjects have the opportunity to leave the study if they do not want to continue. Based on this, the information on those who participate was confidential; therefore all information collected that can identify a participant was well protected. Names did not appear in the written report. Names of the participants were replaced by codes and not become public in any way to keep their confidentiality. They were all volunteering to participate and they were informed on the research and its benefits.

Chapter Four

4. Results and Discussion

4.1Results

4.1.1 Quantitative Data Analysis

Socio-demographic characteristics of the respondents

Six hundred thirty four (634) study participants between the age of 18 and 65 years took part in the study. Six hundred twenty nine complete questionnaires were used for analysis yielding a 99.2% response rate. The rest 5 (0.8%) were excluded from analysis due to incomplete points in the required data. Among the study participants, majority, i.e., 341 (54.2%) were females and the complement percentage 288 (45.8%) were males. More than one-third 250 (39.7%) completed their primary education followed by 198 (31.6%) who were in their secondary education level. Those who completed their tertiary education constitute 94 (14.9%) and those who didn't get the chance to education were 87 (13.8%). With regards to occupational status, nearly one third 224 (35.6%) were self-employed and about one out of five 122 (19.4%) were daily laborers. One third 201 (32%) of the participants were government employed. Regarding the marital status of the subjects, more than half 364 (57.9%) of the subjects were married and nearly one third 218 (34.7%) of them were single. Nearly half 336 (53.4%) earned more than 2000 ETB per month and about a third 202 (32.1%) earned their monthly income between 1000 and 2000 ETB. In relation to family size of the participants, one fourth 153 (24.3%) of them had less than five family members and 476 (75%) had a family size of five or above (see table -2).

Table 1: Socio-demographic status of Study participants, Yeka Sub City, Addis Ababa, Ethiopia

Variables		NO.(n=629)	Percent
Sex			
	Male	288	45.8
	Female	341	54.2
Educational Status			
	Tertiary Education	94	14.9
	Secondary Education	198	31.6
	Primary Education	250	39.7
	Not educated	87	13.8
Occupation			
	Daily Laborer	122	19.4
	Self employed	224	35.6
	Government employed	201	32
	Unemployed	82	13
Income			
	≤1000	91	14.5
	1000-2000	202	32.1
	≥ 2000	336	53.4
Marital Status			
	Single	218	34.7
	Married	364	57.9
	Divorced	31	4.9
	Widowed	16	2.5
Family size			
	< 5	153	24.3
	≥ 5	476	75.7

Residents' view about their surroundings

Among the total participants responded to the questionnaires, majority, 519 (82.5%) and 450 (71.5%) responded that they perceive their surrounding as dirty and smelly respectively. Three hundred eighty nine (61.8%) of them perceived that the surrounding environment in which they live is dirty but not smelly. Only a quarter of them responded that their environment is clean.

Table 2: Residents view about their environment

Participants view	Frequency (n-629)	Percent
Dirty	519	82.5
Smelly	450	71.5
Dirty, but not smelly	389	61.8
Clean	151	24

Source of Information of participants about solid waste management system

Figure 5 shows that residents of Yeka sub city get information about solid waste management system from different sources. Accordingly, more than a third 244 (38.8%) of the study participants informed about solid waste management system of the city from wereda administration they live in followed by media 165 (26.2%) and school 119 (18.9%). Less number of the participants obtain information about solid waste management system through training 79 (12.6%) and from other sources 22 (3.5%) such as through informal discussions with friends.

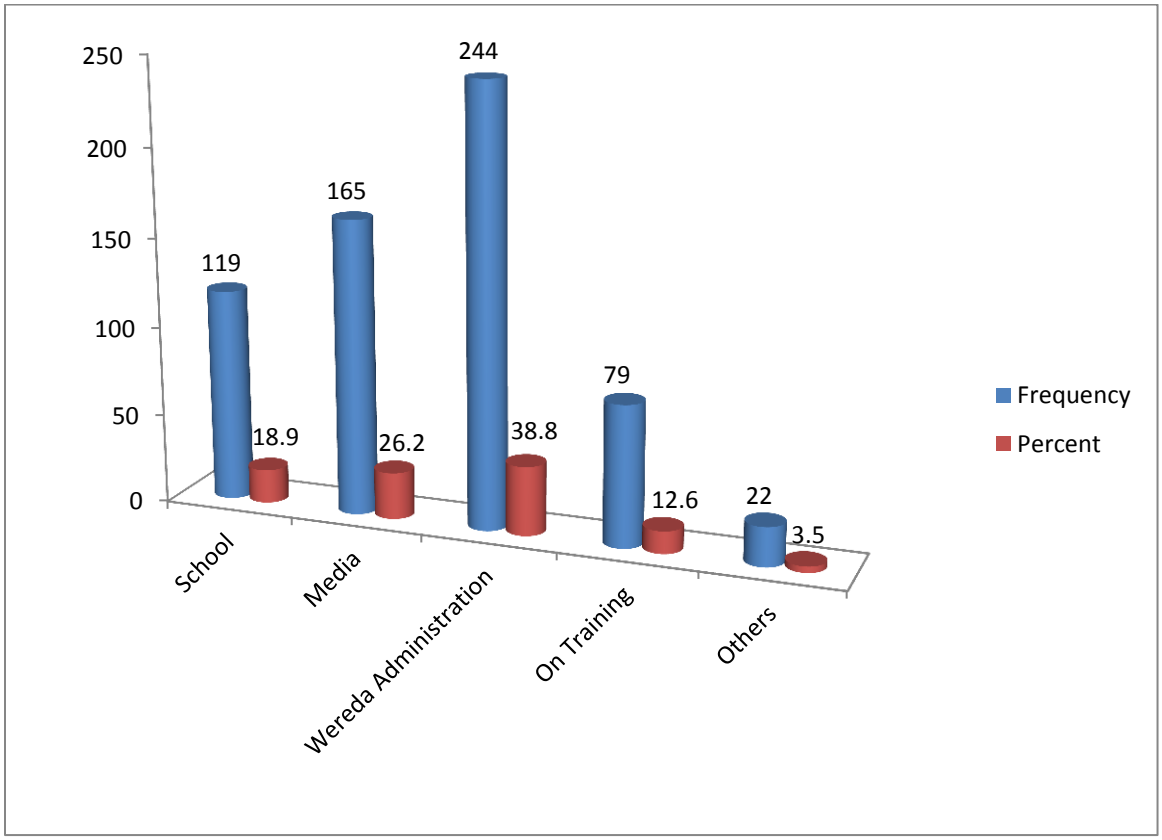

Figure 5: Participants source of information about solid waste management system in the sub city

Solid waste disposal methods used by residents

As indicated in table 3 below, residents of Yeka sub city administration have used different methods of solid waste management systems. The majority, nearly three fourth of the respondents 432 (68.7%) indicated that they dispose their solid waste products in a temporary storage until waste collectors came and took it. About one in six 92 (14.6%) of the study participants took the waste to the nearby dumpsite while almost nearly similar number 105 (16.7%) disposes the solid waste in to the backyard area.

Majority of the respondents 479 (76.2%) have temporary storage for solid waste at home like plastic bags and overused containers (see table 4 below) while about a quarter 150 (23.8%) of them do not have any container for temporary storage of the solid waste.

Table 3: Solid waste disposal methods used by study participants

Waste disposal method	Frequency (n=629)	Percent
In a temporary storage	432	68.7
Taking to dumpsite	92	14.6
Pit in the backyard	105	16.7

Table 4: Availability of solid waste temporary storage at home

Temporary storage at home	Frequency (n=629)	Percent
Yes	479	76.2
No	150	23.8

Means of waste transportation

Among the study participants, majority 561 (89.2%) indicated that they transport the solid waste produced at their household by their hands to the nearby dumpsite which expose them to health hazards. Since there is no horse drawn cart available at the sampled weredas of Yeka sub city, no participant indicated that he/she can use horse drawn carts for waste transportation. Minority number 12 (1.9%) among the participants use hand pushed carts and another small number 56 (8.9%) of participants use other means of transportation of household solid waste to the nearby dumpsite where the waste collectors assigned from the sub city takeover the responsibility for further administration. (See table 5 below)

Table 5: Means of transportation of household solid waste to nearby dumpsite

Means of transportation	Frequency (n=629)	Percent
By hands	561	89.2
By hand drawn carts	12	1.9
By horse drawn carts	0	0
Other means	56	8.9

Implication of poor waste management system on health

As it has been observed in other places in Addis Ababa, Yeka sub city is with no special and it is in a poor hygienic condition. All study participants were aware of the implications of poor solid waste management system in their surroundings.

Table 6: Awareness on implications of poor waste management on health of the community

Health implications of poor waste management system	Frequency (n=629)	Percent
Yes	629	100
No	0	0

Figure 6 below shows that majority 269 (42.8%) of the study participants indicated that poor solid waste management system contributes for breeding of disease agents and nearly half 298 (47.3%) of the respondents said poor sanitation and poor waste disposal system of the city causes diseases. Among the respondents, 62 (9.9%) indicated that poor waste management makes the area dirty.

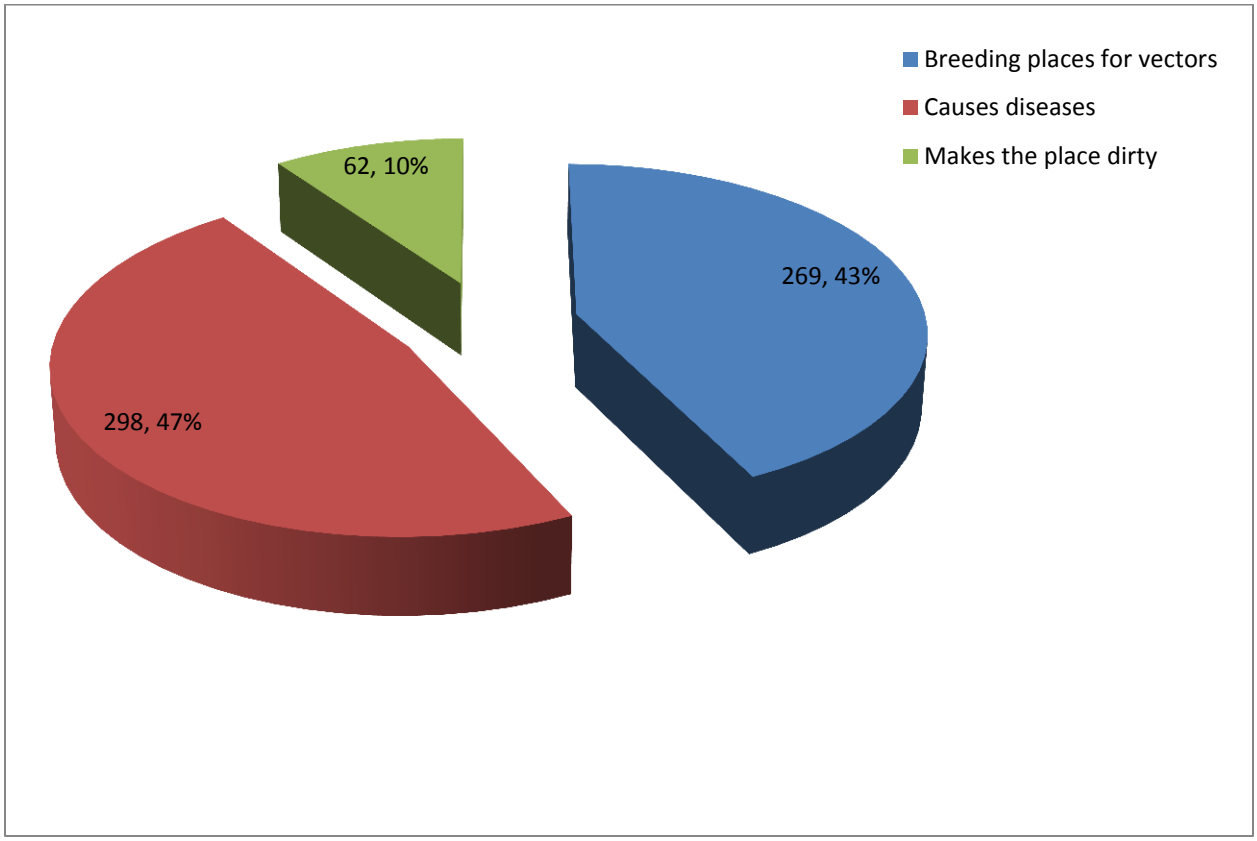

Figure 6: Implications of poor solid waste management system on health of residents

Effect of poor solid waste management on the health of the community

This question was open for the participants to choose more than one answer based on the reality at their residence (wereda) and on what they feel about the effect of poor solid waste management system and its impact on the health of the surrounding community. Accordingly almost all the respondents agreed that cough and diarrhea are common in the sub city as a whole due to poor waste management of the area. The study subjects further indicated that health problems of the community related to nose, eye and skin are frequently appearing. More than half of the participants responded that cholera now a day is the major health risk of the sub city.

Table 7: Effect of poor solid waste management system on the health of the community

Effect of poor solid waste management	Frequency (n=629)	Percent
Cause cough	624	99.2
Cause for Diarrhea	629	100
Cause for Cholera	342	54.4
Irritation of the skin (itching)	247	39.3
Irritation of the nose	366	58.2
Irritation of the eye	411	65.3

Family health condition related to solid waste management system (last six months)

The table below, (table 8) shows that all the respondents agreed that at least one of their family members became sick due to poor solid waste management system in their residence area. In addition to this information, the respondents indicated that diseases such as flu (cough), diarrhea and skin rush are the most frequent and appear at least once a month to at least one of their family members.

Table 8: Family health condition during last six months

Is your family become sick due to poor waste management	Frequency (n=629)	Percent
Yes	629	100
No	0	0

The figure below (figure 7) indicated poor solid waste disposal related diseases and their prevalence in Yeka sub city based on the perception of the study subjects. Accordingly, cough or chest pain is the most prevalent disease due to poor solid waste management followed by diarrhea and cholera. Based on the view of the study subjects, running nose is the fourth prevalent disease followed by malaria, skin rush and eye irritation in order.

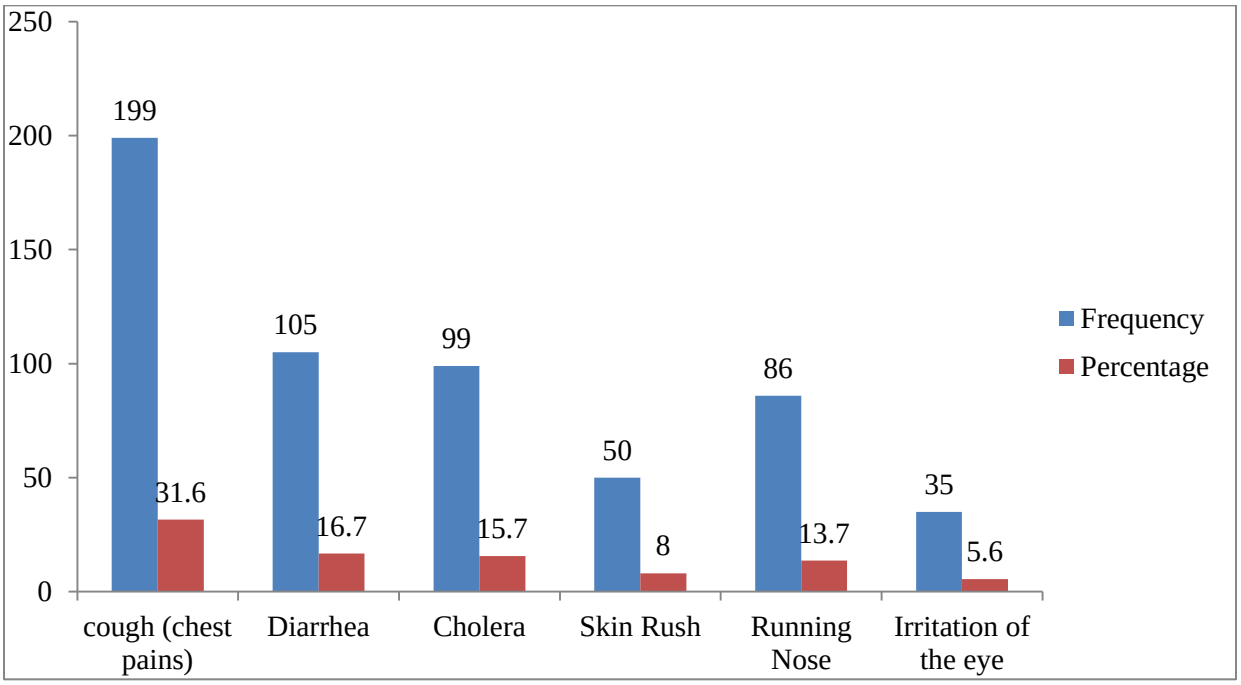

Figure 7: Prevalence of poor solid waste related diseases in Yeka sub city

Measures taken by the government to solve solid waste related problems

As indicated in figure 8 below, among the major activities done by the government to alleviate solid waste related problems is assigning workers (waste pickers) to weredas and resident areas which was indicated by the majority of respondents 422 (67.1%). On the other hand, doing timely cleaning campaigns 94 (14.9%) and providing awareness creating trainings 79 (12.6%) were rarely done in the sub city administration. Some subjects 34 (5.4%) responded that nothing was done in some parts of the sub city administration and therefore, wastes are continuously accumulated and became source of environmental pollution and of disease to the community.

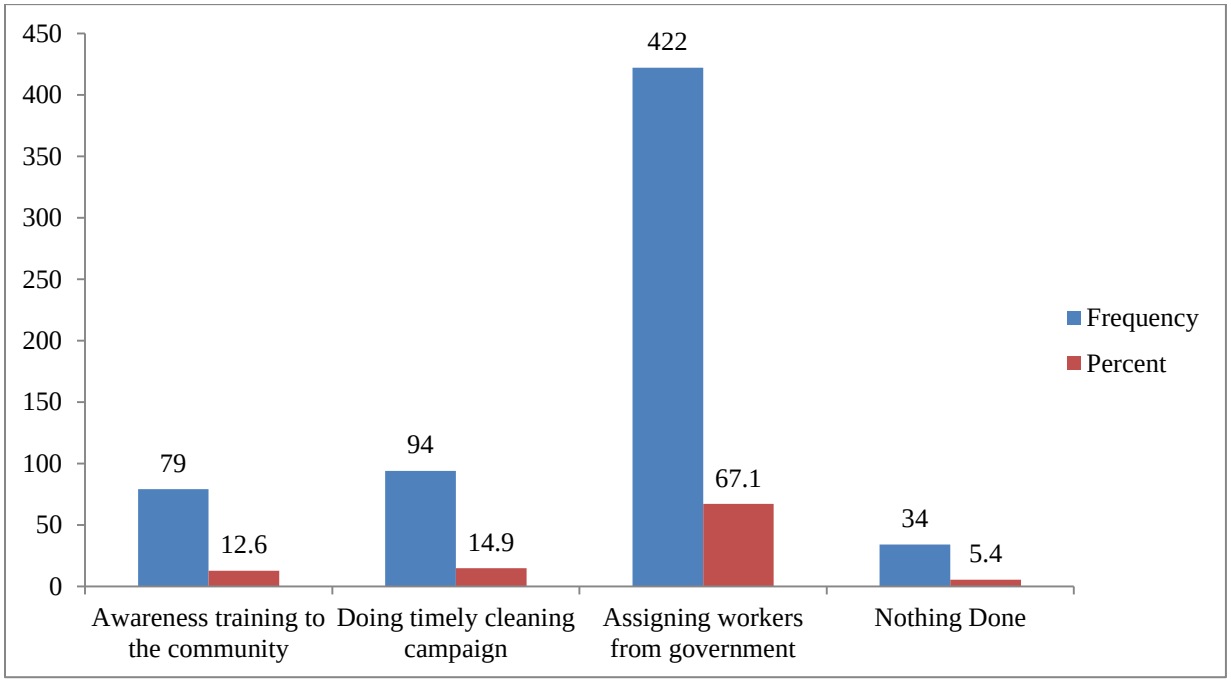

Figure 8: Measures employed to alleviate solid waste management related health problems in Yeka sub city administration of Addis Ababa.

Municipality waste management share, financial coverage and monitoring system for solid waste disposal.

In the following table, the management ability of the municipality, residents' expectation of financial coverage for waste disposal and assignment of a supervisor to residents' area to monitor the solid waste disposal system was assessed. According to the response from the study subjects, only about one third of them were in agreement that the support system from the municipality was satisfactory, however, two thirds of the respondents indicated that management support from the

city municipality is not enough and it is unsatisfactory. They claimed that the garbage bins are not timely picked up and the solid wastes from different sources are scattered across a street and made unpleasant smell in most of the city areas.

Regarding to the expectations of the respondents to cover the expenses for the waste management systems, more than half 355 (56.4%) of them indicate that the financial coverage should be made by the government followed by NGOs 107 (17%) and the public 95 (15.1%). Some participants 72 (11.4%) suggested that the financial sources could be investors and voluntary individuals in the sub city administration.

In relation with the monitory system whether the solid waste is properly managed or not, majority 582 (92.5%) agreed that the monitoring system was better with a justification that youths were organized by the government to work on the solid waste management to earn money and support their own life, but few 47 (7.5%) of them disagree with this idea.

Table 9: Municipality management, financial coverage and monitoring of the waste disposal system in Yeka sub city administration

Questions	Frequency (n=629)	Percent
Waste management by the municipality is satisfactory		
Yes	205	32.6
No	424	67.4
Whom do you think should cover the expense		
Public	95	15.1
Government	355	56.4
NGOs	107	17
Other **	72	11.4
Anyone who monitors proper collection of wastes		
Yes	582	92.5
No	47	7.5

** Investors, voluntary individuals

Participants view of the impact of poor solid waste management on the environment

Figure 9 clarifies participants' view of poor solid waste management on the environment. Accordingly, most 264 (42%) of the subjects responded that poor solid waste management can make the environment dirty. More than a third 235 (37.4%) of them indicated the waste can cause sickness and the rest 130 (20.6%) identified that it can add more load to the environment and so that it can create more pollution if it is poorly managed.

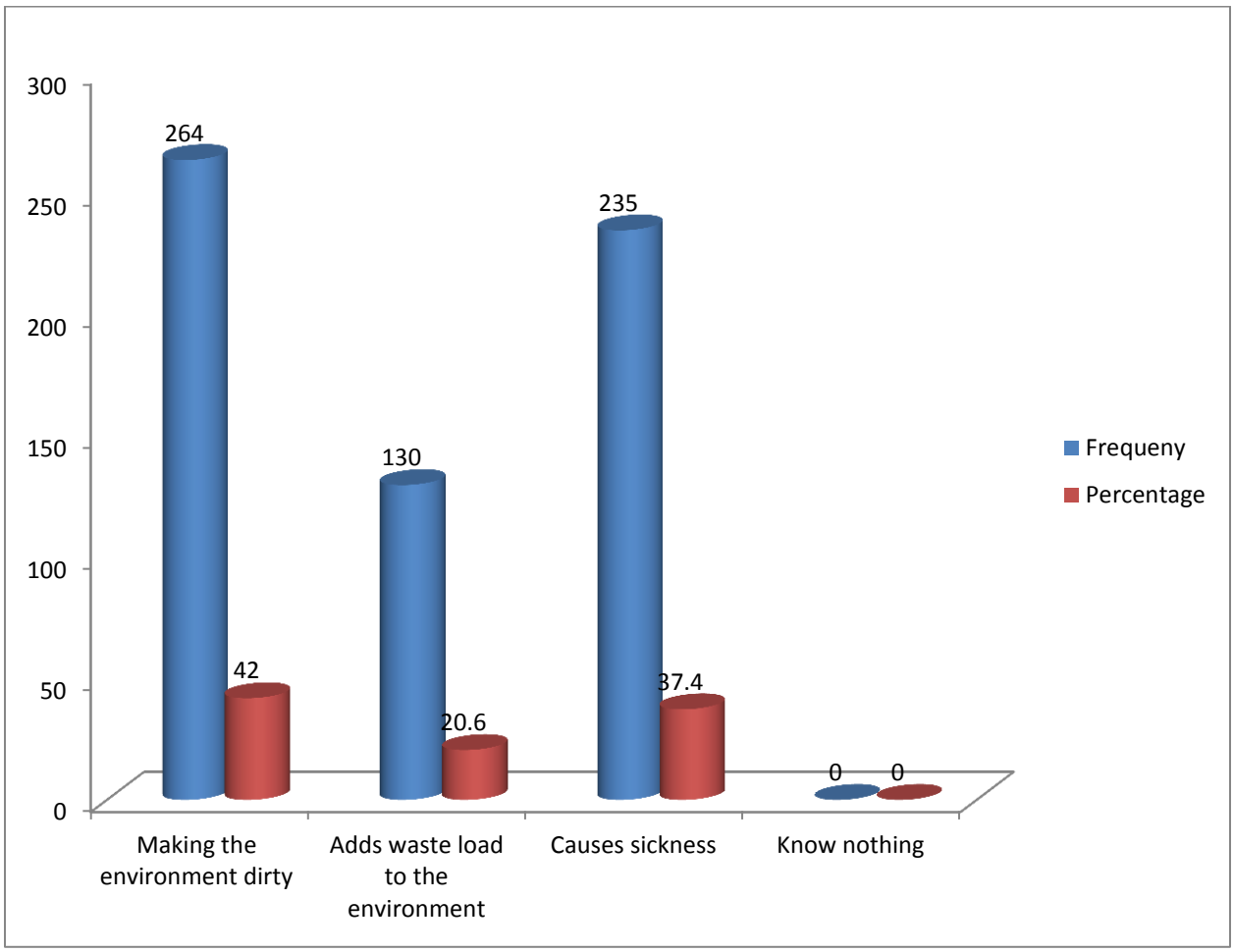

Figure 9: Participants' view of the impact of poor solid waste management on the environment

Participants' perception on things to be done to get rid of the problems related to poor solid waste management

Figure 10 shows the participants perception about what to be done to solve problems related to poor waste management system in the sub city. Based on the response from the subjects participated on the study, nearly half 289 (45.9%) of them indicated that the solid wastes should be collected and burned. The other majority, about one third, 211 (33.5%) suggested that the solution will be sorting the solid wastes according to their nature of decomposability before disposing to the dumpsite. Some participants recommended relocating 78 (12.4%) and managing the dumpsite 51 (8.2%) will be a solution.

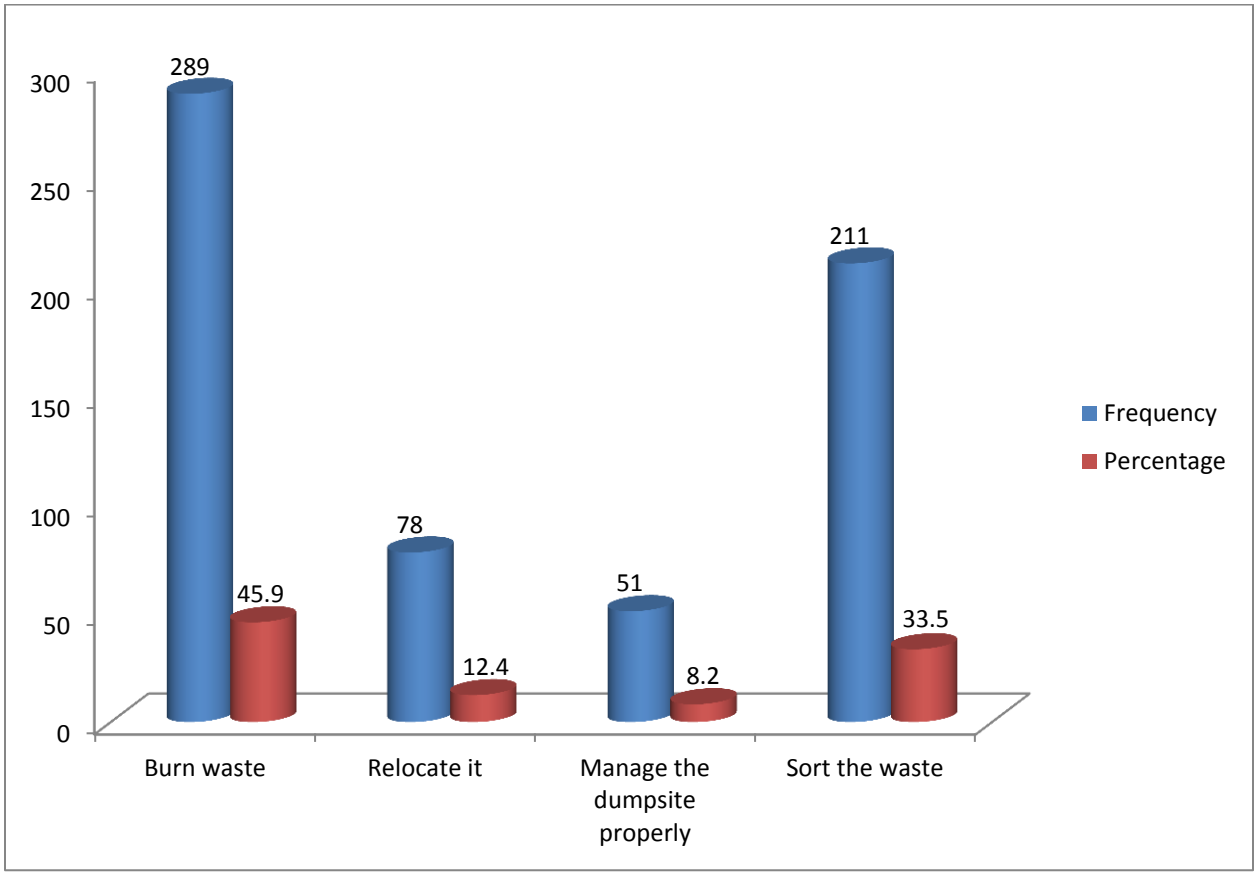

Figure 10: Participants perception on things to be done to get rid of the problems related to poor solid waste management

4.1.2 Qualitative Analysis

Focus Group Discussion (FGD)

In addition to the questionnaires, Focus Group Discussions (FGD) was conducted to get more relevant data from the study participants. The discussion was done on two groups on two consecutive Sundays. Total time invested for the discussion was one hour for each group. Willingness of the participants was asked and those who agreed were participated. The participants were at their regular gatherings for their own social affairs "idir" on Sunday morning. The purpose for their participation in to the discussion was explained to them after they completed their own meeting. Two weredas which were not previously included in this study during questionnaire administration were selected to give chance for the residents of other weredas. Six participants volunteered in the first and seven in the second group discussions.

The points to be asked were categorized into different themes like questions related to sources of wastes, questions related to the impact of solid wastes have on the environment and on the health of the community, questions related to removal of wastes and garbage at household level and outside the house, whether they sort the wastes before they dispose it.

The responses from the discussion were recorded using pen and paper and well noted. In relation to the sources of the solid wastes, the discussants responded that the solid wastes that we are observing starting from our own house here and there are from food leftovers from households, cafeterias, hotels; plastic bags, plastic bottles and papers from market places, khat leftovers pit here and there from individuals passing around. In addition to this, solid waste produced during food preparation such as peels from vegetables and fruits are the most contributing factor for environmental pollution and hence made human health problems. Besides this, dead bodies of animals are the major cause of environmental pollution these days.

Regarding the environmental and health burden, discussants in both groups raised similar points. According to both groups, the solid wastes scattered on the road are making the city dirty looking, producing bad smell which will be potential for spreading of different diseases, closing water ways which is a cause for over flow during the rainy season and creating traffic problems, were among the points indicated by the discussants as the environmental burden of solid wastes. Summarizing responses from the discussants of both groups, diarrhea, cholera, cough, itching (skin rash), are the most frequently observed diseases in the community indicating that poor solid waste management impose severe health burden and making the life of the community very hard.

With population increase, production of solid waste is increasing from time to time in urban areas of the world. The same is true for our city Addis Ababa in general and Yeka sub city in particular. The discussants replied to questions presented to them regarding the way they collect the solid wastes at their household level, whether they have special bins or buckets for garbage collection. They said that they don't have any special bins or buckets for waste collection, instead, they are using any plastic material or sac 'madaberia' for the collection of the wastes which are not suitable for handling and exposing them for contamination. Regarding the support system they have from the government, although it is not enough, they indicated that they have got awareness creating training on how to collect, transport and dispose solid wastes and this is also limited to only some part of the sub city and all the residents are not benefiting from it. Waste pickers are now assigned and they come and pick wastes once a week. Most of them indicated that there are

many problems related to waste handling. Some of them responded that they are satisfied with their waste management system, because they used to manage it based on knowledge; some are not convenient with it because they do not know how to manage it. Community based continuous trainings on how to collect, store, transport and dispose solid wastes should be given to alleviate the problem, according to the discussants.

Another point asked for the discussants to respond to is whether they separate the solid wastes to different components or not. "We used to separate wastes according to their nature; those, with plastic nature are put together, those which will be easily decomposed, and those which are potentially harming like broken glasses are separated and put in to different containers" they responded. But, some argued that there are inconsistencies observed as one moves from one house to the other.

The next question is related to how the collection and removal of solid waste is done outside the house. It is about where the waste is thrown away to, when and who removes it, to what extent they are satisfied with the manner it is done, and many other issues. Almost all the members of the discussants in both groups responded similar in that they are not caring about the final destination of the wastes once it is removed from the house. Some respondents has said that they spread it in the backyard so that it can be used as compost for plants in the yard, others said they separate it and put in different materials and make it ready to picked by workers assigned from the government, and still others responded that they don't care about it. Regarding the responsible member of the family who is in charge of bringing out the waste from home, almost all members of the discussants agreed on that there is no one who is regularly assigned for this duty, but any one member of the family including children can do it. "The cars are sometimes arrived on time, but most of the time they come too late so that the waste is scattered out of the garbage bin. This makes the environment dirty, unpleasant odor comes out from the area which is a cause for many communicable diseases" they responded.

The discussants were asked whether they are satisfied with quality of garbage and solid wastes removal or not. They responded that "the cars are not picking the waste bins regularly and frequently, the surrounding areas where the garbage bins are put are smelly and looking ugly, the garbage bins are put near the residence area so that people nearby are suffering from poor life quality due to poor health conditions happening to them regularly" all of which are indicating they are not satisfied by the service.

In alleviating solid waste related problems observed in Yeka sub city, the discussants suggested that;

- Awareness training on how to collect, handle, store, transport and dispose solid waste should be given to all residents.
- During collection of solid waste, the waste should be separated based on the nature of the waste so that it will be easy for the municipality waste handlers and hence will be disposed properly.
- The respective sub city offices (environmental beauty and sanitation) offices should follow the timely picking of the garbage bins and as a result the existing poor condition of the surrounding environment will be improved.
- Solid waste management is not only the issue of Yeka sub city, it is also a city wide as well as a country wide issue, therefore, the sub city administration in collaboration with the Addis Ababa city administration and the national respective bodies, should give continuous and timely information to all residents of the city through different media outlets so as to minimize solid waste related problems across.

Data from Yeka sub city Administration Health Office

In addition to questionnaires and FGD, Yeka sub city health office has been approached to access information on the general health status of the residents. Accordingly, more effort has been made to get information on the case in point. Based on this, data on two highly prevalent diseases frequently appeared, namely, dysentery and typhoid fever has been accessed. As it is indicated in the information from the health office, typhoid is the most prevalent disease observed in the record obtained from the health office followed by dysentery. The accessed data was a record from wereda health centers for the last ten months, January 2018 to October 2018. A total of 3,164 dysentery and 22,882 typhoid cases registered in the last 10 months in the sub city administration. Both conditions might be connected to the poor hygienic condition seen in the sub city as a result of poor solid waste management of the sub city administration.

4.2 Discussion

The study explored the impact of solid waste management system on health and environment of Yeka sub city, Addis Ababa. The result of this Study has shown that solid waste management in Yeka sub city is poor. Majority of the respondents (82.5) perceived that the environment in which they live is dirty, while 71.5% of them agreed that the solid waste surrounding the environment made bad odor to the environment. Some degree of variation exhibited with a research done on environmental and health impact of solid waste disposal at mangwaneni dumpsite in manzini, Swaziland which explored that 32% of the respondents indicated that the waste made the environment dirty, followed by 52% indicated the environment was smelly (Salam Abul, 2010; Leone, *et al*., 2013). The variation in the values could be due to difference in sample size and difference in geographical locations respondents.

Regarding the storage system of the solid waste, it was also explored that most of the respondents (68.7%) use temporary storage until the waste is taken by the waste pickers assigned by the wereda administration or until they themselves take it to the nearby dumpsite. Some (16.7%) pit the waste in their backyard area while the rest (14.6%) took it to the dumpsite nearby them. This study is in agreement with a study in Sierra Leone (Leone et al., 2013) reporting 60.3% used temporary storage for solid waste, showed variation with a study in (Salam Abul 2010).

In this study, it was indicated that nearly 90% of the study participants used hands for transportation of the wastes and hence, exposed to different related diseases (reported by 47.3%) since the waste is the major source for breeding of disease causing agents (reported by 42.8%) of the respondents. The result is in agreement with a study done in 2011, (Omar & Kadir, 2011), reporting similar figure 82% residents used unsafe handling, but different from other findings (Sharholy & Ahmad, 2008; Salam Abul 2010; Leone *et al*., 2013). The difference in the magnitude could be due to geographical difference where the studies were done and it could also be due to sample size variation between the studies.

Diarrhea and cough are the most prevalent waste related diseases reported in this study. This results are in agreement with other studies that reported high percentage values of these diseases Salam Abul (2010). However, the result of this study deviates largely from other studies in other places (Nabegu, 2010; Leone et al., 2013; Sharholy & Ahmad, 2008; Post, 2017). The differences

may arise from differences in sampling, differences in design or may be due to differences in awareness level of the study participants in the studies.

It is well known that poor solid waste management results in the spread of communicable diseases. Accordingly, diarrhea and cough are the most prevalent waste related diseases reported in this study. Researches done in other countries have shown similar findings in which their findings are in agreement with our case Salam Abul (2010). However, the result of this study deviates largely from other studies in other places (Nabegu, 2010; Leone et al., 2013; Sharholy & Ahmad, 2008; Post, 2017). The differences may arise from differences in sampling, differences in design or may be due to differences in awareness level of the study participants in the studies.

This study explores that residents of Yeka sub city are aware of the implications of poor solid waste management on the quality of their life. Accordingly, majority 269 (42.8%) of the study participants indicated poor solid waste management system contributes for breeding of disease agents and nearly half 298 (47.3%) of the respondents said poor sanitation and poor waste disposal system of the city causes the spread of different diseases. Although there are some variations in the figures, this finding is supported by a study by Ali Mohammed and his colleague, (Mohammed, et.al, 2017) that explores domestic solid waste is a threat to Addis Ababa city's environment, as only 65% of the waste produced per day is collected and disposed, 5% is recycled, 5% is composted and the remaining 25% is uncollected and dumped in unauthorized areas which is potentially hazardous to the health and environment of the city. Since domestic waste dominate the municipality's waste category, its management and associated environmental impacts is worthy of attention (Mohammed et al., 2017) and this is also supported by the result of this research through information gathered from FGD.

According to findings of this research, poor solid waste management system has a devastating effect on the health of residents of Yeka sub city. People in the sub city are suffering from many related diseases (Cough, Diarrhea, Cholera, Itching, Irritation of the nose and Irritation of the eye) according to the respondents with diarrhea and cough the most prevalent diseases most frequently appearing in the sub city administration.

Information was also sought from the sub city health office to consolidate the data gathered through questionnaires and FGD. Accordingly, a ten months record on the health status of residents of the sub city indicated dysentery and typhoid fever are the most frequently observed

diseases at the health centers of the sub city. In line with this result, African population center (Population, n.d.), reported that cholera/diarrhea, Chest problems, Allergies, Skin problems, Asthma and Heart problems were among the health burdens frequently observed due to improper solid waste management system in urban areas.

Another study, in support of this result, indicated that communicable diseases attributable to poor sanitation and practices, affecting mainly the underprivileged sections of the population, are considered as the major causes of morbidity, mortality as well as disability in Ethiopia. The high prevalence of communicable diseases in the country has been positively linked with the poorly developed socio-economic and environmental factors that have been inherent for centuries. The rapidly shifting demographic and morphology of the city of Addis Ababa - featuring the rapid population size, widespread unemployment, the unremitting housing shortages, the demand for social and physical infrastructure are worsened by incompatible and unregulated land use activities. Intestinal parasites, Common diarrhea, Respiratory infection, Amoeba, Typhoid fever, Typhus, Dysentery are the most prevalent diseases in Addis Ababa city (Mazhindu, et al., 2012).

Alleviating problems related to solid waste management system in the sub city should be the primary concern of the sub city administration. The government is planning and implementing some activities at the city level. Accordingly, the result of this study has shown that among the major activities done by the government to alleviate solid waste related problems is assigning workers (waste pickers) to weredas and resident areas which was also responded by the majority of the subjects 422 (67.1%). On the other hand, doing timely cleaning campaigns 94 (14.9%) and providing awareness creating trainings 79 (12.6%) were rarely done in the sub city administration. Some subjects 34 (5.4%) responded that nothing was done in some parts of the sub city administration and therefore, wastes are continuously accumulated and became source of environmental pollution and of disease to the community. Different studies have been done in different countries to explore and forward different strategies of solving solid waste management problems. In line with this, a study done in Bangladesh showed that both public and private sectors are active in management of solid waste in developing countries (Azam & Ali, 2004). There is an emerging trend in encouraging the private sector to enter into solid waste management (SWM) operations, and attempts are being made to formally link the public and private sector operators. Here such linkages may improve the efficiency of the entire sector and create new opportunities for employment.

Another study done in Yala, Thailand, focuses on problems in waste disposal and has sought ways of addressing these through alternative techniques, including recycling (Mongkolnchaiarunya, 2005). A package of new practices was introduced in this study. The (‘‘Garbage for Eggs’’) was in which residents were encouraged to bring recyclable material to exchange for eggs, at monthly exchanges in local communities, with emphasis on poorer communities. The aim was to empower the community rather than focusing at only garbage reduction through self-reliance.

Chapter Five

5. Conclusion and Recommendation

5.1 Conclusion

This study examined the environmental and health impacts of solid waste disposal system in Yeka sub city, Addis Ababa. Results from the analysis of data revealed that residents of the sub city have been suffering from related diseases due to poor solid waste management system. It was discovered that residents are affected due to lack of awareness on how to handle, store and dispose the solid waste produced at their households. Hence they were victims of, chest pains, diarrhea, and cholera, irritation of the skin, nose and eyes. This poor health condition of the residents can be attributed to contamination from solid waste during cleaning, storage and transportation. It can also be linked to food and drink contamination since the waste, which is poorly managed and serves as a breading place for flies which are carriers for pathogenic organisms. The study revealed that diarrhea and cough are the most prevalent diseases occurred to the residents of the sub city during the last six months among others. The residents complained that the solid waste management in the sub city is so poor, observed on the street scattered everywhere here and there causing environmental pollution. It was also indicated that support from the municipality on how to handle, store and dispose solid waste is not satisfactory. Expectation of the residents from the government was also high.

5.2 Recommendation

This community based cross sectional study assesses the health and environmental impacts of solid waste management system in Yeka sub city, Addis Ababa.

Based on the findings of the study, the following recommendations are forwarded to relevant stakeholders and responsible bodies in the area.

- Among the findings of this study, most of the residents were less aware about waste handling, storage and transportation. Therefore, respective wereda sanitation office should give frequent and timely awareness creating trainings to the residents.

- Most of the residents found to be expectants from the government instead of cleaning and managing sanitations of their surroundings. Most of them were victims of sanitation related diseases. Therefore, wereda health bureau and sanitation offices should be responsible to give trainings on how the residents become responsible for their own sanitation and hence for their health.
- The municipality is less cooperative in giving different support systems. Therefore, the sub city municipality, respective wereda health, and sanitation offices should give necessary support so that the solid waste can be picked timely.
- These bodies should also be responsible for regular monitoring of sanitary situations of residents in the respective weredas.

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Appendices

ANNEX A: INFORMATION SHEET

INFORMATION SHEETFOR PARTICIPANTS

YOU WILL BE GIVEN A COPY OF THIS INFORMATION SHEET

"Environmental and Health Impact of Solid Waste Disposal in Addis Ababa City: A Case Study of Yeka Sub City"

We would like to invite you to participate in this original post graduate research project. You should only participate if you want to; choosing not to participate will not disadvantage you in any way. Before you decide whether you want to take part, it is important for you to understand why the research is being done and why your participation will be required. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information.

This study is being conducted as a Masters Degree requirement in Biology given by the Department of Biology, Addis Ababa University.

Aims of the research; *this study is to assess the Environmental and Health Impact of Solid Waste Disposal in Addis Ababa City: A Case Study of Yeka Sub City*

Who are we recruiting? Residents of Yeka sub city administration who will be selected to be included in to the study will be recruited.

What will happen if you agree to take part?

You will be asked to respond to questions related to solid waste management systems and the impact of solid waste on the health and environment of the study area.

Risks of being in the study

We don't expect any sort of risks associated with this study. In case if you are not comfortable to participate in this study, you are not obliged to do so.

Possible benefits: we hope that the result obtained from this study will help to understand the solid waste management system of the sub city. After the completion of the study, the findings will be shared with the sub city administration through report. We will try to prepare awareness creation workshop to residents of the sub city concerning the status and risks of solid waste management in the sub city.

What we will do with your data

If you participate in our study, we will make sure that any information we get from you do not include your name or any identifying information. It will be coded and kept confidential. Nobody except the principal researcher will know that the information belongs to you. After the end of this study, the information you give us may be used by other researchers, but they will not be able to identify you in any way.

It is up to you to decide whether to take part in the study or not. If you decide not to participate you are free to withdraw at any time and without giving a reason.

ANNEX B: WRITTEN INFORMED CONSENT FORM (English Version)

I hereby confirm that I have been adequately informed by the researcher about the procedures, nature, benefits and risks of the study. I have received, read and understood the written information sheet. I am aware that the results of the study will be processed into a research report. I am also aware that the final result can be used by other researchers in their future studies. I understand that my participation is voluntary and that I may, at any stage, without any pre condition, withdraw my consent and participation in the study. I had opportunities to ask questions on unclear ideas about the procedures. Now I myself freely declare to participate in the study.

Research participant‘s name: _____

Research participant‘s signature: _____ Date: _____

Researcher‘s name: _____

Researcher‘s signature: _____Date:_____

APPENDIX C: VERBAL CONSENT (English Version)

I hereby declare that I have read and explained the contents of the information sheet to the research participant. The procedure, purpose, possible risks and benefits of the study were explained. The research participant has been aware of the right to withdraw from the study at any time, for any reason. I hereby certify that the research participant has verbally agreed to participate in this study.

Research participant‘s name_____

Researcher‘s name: _____

Researcher‘s signature: _____ Date: _____

Appendix D: Questionnaire - English Version

Dear respondents, I am collecting data for a research entitled "Environmental and Health Impact of Solid Waste Disposal in Addis Ababa City: A Case Study of Yeka SubCity". This research is done for the fulfillment of masters of Science degree in the department of Biology, Addis Ababa University. In addition, based on the result, I will try to forward possible recommendations to alleviate problems related to solid waste management in the area, if any.

Therefore, I kindly request your cooperation in responding to the questions related to solid waste disposal in your residential area. Your cooperation is crucial for the success of my work.

Thank you.

Make a circle to your choice that you agree on. Give additional comments where necessary.

1. Sex : A. Male B. Female
2. Age: _____
3. Marital Status:
    A. Single
    B. Married
    C. Divorced
    D. Widowed
4. Family Size: A. < 5 B. $\geq$ 5
5. Educational level of respondents
    A. Tertiary
    B. Secondary
    C. Primary
    D. Not educated
6. Employment status of the residents
    A. Daily Laborer
    B. Self employed
    C. Government employed
    D. Unemployed

7. Income level: A. ≤ 1000 B. 1000 – 2000 C. ≥ 2000
8. What is your view about your surroundings?
    A. Dirty
    B. Smelly
    C. Dirty, but not smelly
    D. Clean
9. From where do you get information regarding solid waste management?
    A. School
    B. Media
    C. Wereda administration
    D. On training
    E. Other, specify _____
10. How do you dispose dry wastes at your home?
    A. In a temporary storage
    B. The dumpsite nearby
    C. Pit in the backyard
11. Do you have temporary solid waste storage in your home?
    A. Yes ___
    B. No ____If yes what kind of storage? _____
12. What means do you use to transport wastes?
    A. By hands (ourselves)
    B. Hand pushed carts
    C. Horse drawn carts
    D. Others, specify
13. Do you think that poor solid waste management system has an implication on one's health?
    A. Yes _____ B. No_____
14. What do you think is the Implication of having a poor solid waste management system to the community?
    A. Breeding place for disease vectors
    B. Causes diseases
    C. Makes the place dirty

15. What will be the effect of the poor solid waste management on the health of the community?
    A. Can be a Cause cough
    B. Can be a Cause for Diarrhea
    C. Can be a Cause for Cholera
    D. Irritation of the skin
    E. Irritation of the nose
    F. Irritation of the eye
    G. Other, specify _____
16. In the last six months, is any one of your family members become sick due to inappropriate solid waste management system?
    A. Yes
    B. No
    C. If yes, how often? _____
17. Which poor solid waste management related diseases are more frequently occurred in your residential area?
    A. Chest pains (cough)
    B. Diarrhea
    C. Cholera
    D. Irritation of the skin
    E. Irritation of the nose
    F. Irritation of the eye
    G. Other, specify _____

18. What measures were employed to protect the community from the poor waste management effects?
    A. Awareness training to the community
    B. Doing timely cleaning campaign
    C. Assigning workers from the government
    D. Nothing done

19. Is the existing waste management system by the municipality satisfactory? Yes ___, No____.

    If no. what measures should be taken to improve?

    _____

    _____

20. Whom do you expect to cover the expenses of the improvement?
    A. Public
    B. government
    C. NGOs
    D. Others, specify _____ .
21. Is there anybody who monitors that the solid waste is properly collected and transported to the disposal site? Yes _____ No ____ If yes, who?

    _____

22. What is your view on the impact of poor solid waste management on the environment?
    A. Making the environment dirty
    B. Adds waste load to the environment
    C. Causes sickness
    D. know nothing
23. What do you think should be done to get rid of the problems related to solid waste management?
    A. Burn waste
    B. Relocate it
    C. Manage the dumpsite properly
    D. Sort the waste

Appendix E: **በአማርኛ የቀረበ መጠይቅ**

ውድ የዚህ ጥናት ተሳታፊዎች

በአዲስ አበባ ከተማ፣ የካ ክ/ከተማ የደረቅ ቆሻሻ አያያዝና አወጋገድ በጤናና በአካባቢ ላይ የሚያመጣውን ተፅዕኖ ጥናት በማድረግ ላይ እገኛለሁ፡፡ ይህ ጥናት በአዲስ አበባ ዩኒቨርሲቲ፣ በስነ ህይወት ትምህርት ክፍል ለ2ኛ ዲግሪዬ ማሟያ የሚሰራ ነው፡፡ በተጨማሪም ከዚህ ጥናት በሚገኘው ውጤት መሰረት የደረቅ ቆሻሻ አያያዝና አወጋገድን በተመለከተ ችግሮች ካሉ ለሚመለከታቸው ባለድርሻ አካላት የመፍትሄ ሃሳብ ይቀርባል፡፡ ስለሆነም የርስዎ ተሳትፎ ለጥናቱ መሳከት እጅግ አስፈላጊ ስለሆነ ለሚጠየቁት ጥያቄዎች ተገቢውን መልስ በመስጠት ትብብር እንዲያደርጉ በትህትና እጠይቅዎታለሁ፡፡

አመሰግናለሁ፡፡

ቀጥሎ ለቀረቡት ጥያቄዎች ትክክለኛውን መልስ ለጠያቂው/ዋ በመስጠት ትብብር ያድርጉ፡፡

1. *ፆታ* : ሀ. ወንድ ለ . ሴት
2. *ዕድሜ*: _____
3. የጋብቻ ሁኔታ: ሀ. ያላገባ
   ለ.ያገባ
   ሐ. በፍቺ የተለየ
   መ. በሞት የተለየ
4. የቤተሰብ መጠን ሀ. < 5 ለ. ≥ 5
5. የትምህርት ደረጃ
   ሀ. ከፍተኛ ትምህርት
   ለ. 2ኛ ደረጃ
   ሐ. 1ኛ ደረጃ
   መ. ትምህርት የሌለው
6. የስራ ሁኔታ
   ሀ. የቀን ሰራተኛ
   ለ. የግል ስራ
   ሐ. የመንግስት ሰራተኛ
   መ. ስራ የሌለው

7. የወር ገቢ ሁኔታ

ሀ. ≤ 1000

ለ. 1000 – 2000

ሐ. ≥ 2000

8. ስለ አካባቢዎ ያለዎት ግንዛቤ ምን ይመስላል?

ሀ. በጣም የቆሸሸ ይመስለኛል

ለ. መጥፎ ሽታ ያለው ይመስለኛል

ሐ. የቆሸሸ ቢሆንም መጥፎ ሽታ የለውም

መ. ንጹህ ነው

9. በአካባቢዎ ወይም በቤትዎ አካባቢ ስለሚኖረው ደረቅ ቆሻሻ አወጋገድ ስርዓት በተመለከተ መረጃዎችን ከየት ያገኛሉ?

ሀ. ከትምህርት ቤት

ለ. ከ መገናኛ ብዙሃን

ሐ. ከወርዳው አስተዳደር

መ. ከስልጠና

ከሌላ ምንጭ፣ ካለ ይጥቀሱ _____

10. በቤትዎ ደረቅ ቆሻሻ እንዴት ያስወግዳሉ?

ሀ. ጊዜያዊ ማጠራቀሚያ በመጠቀም

ለ. ቅርብ ወዳለው የቆሻሻ መጣያ በመውሰድ

ሐ. ወደ ጓሮ በመበተን

11. በቤትዎ ውስጥ ጊዜያዊ የቆሻሻ ማጠራቀሚያ አለዎት?

ሀ. አዎ አለኝ

ለ. የለኝም “ ካለዎት ምን ዓይነት? _____

12. ቆሻሻውን ለማጓጓዝ ምን ዓይነት ዘዴ ይጠቀማሉ?

ሀ. በእጅ

ለ. በእጅ በሚገፉ ጋሪ

ሐ. በፈረስ በሚሳብ ጋሪ

መ. ሌላ ዘዴ ካለ ይግለፁ _____

13. በእርስዎ አመለካከት፣ ትክክለኛ ያልሆነ የቆሻሻ አወጋገድ በሰዎች ጤና ላይ ተፅዕኖ ይኖረዋል ብለው ያስባሉ?

ሀ. አዎ

ለ. አይደለም

14. ደካማ የቆሻሻ አወጋገድ ስርዓት መኖር በማህበረሰቡ ላይ ምን ዓይነት የጤና ችግር ያስከትላል ብለው ያምናሉ?

ሀ. ለበሽታ አምጪ ተህዋሲያን መራቢያ ይሆናል

ለ. በሽታን ያስከትላል

ሐ. አካባቢን ያቆሽሻል

15. ደካማ የቆሻሻ አወጋገድ ስርዓት መኖር በማህበረሰቡ ጤና ላይ ያለው ተጽዕኖ ምንድነው?

ሀ. ለጉንፋን ምንስኤ ይሆናል

ለ. ለተቅማጥ በሽታ መንስኤ ይሆናል

ሐ. ለኮሌራ በሽታ መንስኤ ይሆናል

መ. ለቆዳ በሽታ መንስኤ ይሆናል

ሠ. ለአፍንጫ ማሳከክ ያጋልጣል

ረ. ለዓይን ማሳከክ ያጋልጣል

ሰ. ሌላ ካለ ይግለፁ_____

16. ባለፉት 6 ወራት ውስጥ ቆሻሻን በአግባቡ ካለማስወገድ ጋር በተያያዘ ከቤተሰብዎ አባላት ውስጥ የታመሙ ይኖራሉ?

ሀ. አዎ

ለ. አይደለም

ሐ መልስዎ አዎ ከሆነ በየስንት ጊዜው_____

17. ደረቅ ቆሻሻን በአግባቡ ካለማስወገድ ጋር ተያይዙ በአካባቢዎ በብዛት በተደጋጋሚ ተከስቶ የነበረው የትኛው በሽታ ነው?

ሀ. ጉንፋን

ለ. ተቅማጥ

ሐ. ኮሌራ

መ. ቆዳን ማሳከክ

ሠ. አፍንጫን ማሳከክ

ረ. ዓይንን ማሳከክ

ሰ. ሌላ ካለ ይግለጹ _____

18. ደካማ የቆሻሻ አወጋገድ ስርዓትን ለመቅረፍና ህብረተሰቡን ከተያያዥ ችግሮች ለመታደግ ምን ምን የተከናወኑ የምፍትሄ ስራዎች አሉ?

ሀ. የግንዛቤ ማስጨበጫ ስልጠና መስጠት

ለ. ወቅታዊ የፅዳት ዘመቻ ማካሄድ

ሐ. የአካባቢ ፅዳት ሰራተኞችን ከመንግስት መመደብ

መ. ምንም የተሰራ ስራ የለም

19. በማዘጋጃ ቤት ወይም በከተማ አስተዳደሩ የሚደረገው የደረቅ ቆሻሻ አወጋገድ ስራ በቂ ነው ብለው ያስባሉ?

ሀ. አዎ

ለ. አይደለም

መልስዎ አይደለም ከሆነ እርስዎ ምን የመፍትሄ ሃሳብ ያቀርባሉ?

_____

_____

20. የደረቅ ቆሻሻ አወጋገድ ስርዓትን ለማሻሻል የሚያስፈልገውን ወጪ ማን መሸፈን አለበት ብለው ያስባሉ?

ሀ. ህዝቡ

ለ. መንግስት

ሐ. መንግስታዊ ያልሆኑ ድርጅቶች

መ. ሌላ ካለ ይግለፁ_____ .

21. በእርስዎ አካባቢ፣ ደረቅ ቆሻሻ ከተሰበሰበ በኋላ በትክክል እንድወገድ ክትትል የሚያደርግ አካል አለ ብለው ያስባሉ?

ሀ. አዎ

ለ. አይደለም

መልስዎ አዎ ከሆነ፣ ማን ይከታተለዋል?_____

22. ደካማ የሆነ የደረቅ ቆሻሻ አወጋገድ ስርዓት መኖር በአካባቢ ላይ ያለውን ተፅዕኖ እንዴት ያዩታል?

ሀ. አካባቢን ያቆሽሻል

ለ. በአካባቢ ላይ ተጨማሪ የቆሻሻ ጫና ያመጣል

ሐ. ህመም ያስከትላል

መ. አላውቅም

23. ከደረቅ ቆሻሻ አወጋገድ ጋር ተያይዞ ያሉትን ችግሮች ለማስወገድ ምን መከናወን አለበት ብለው ያስባሉ?

ሀ. ቆሻሻውን ማቃጠል

ለ. የቆሻሻውን ቦታ መቀየር

ሐ. የቆሻሻ ማጠራቀሚያውን በአግባቡ መያዝ

መ. ቆሻሻውን በዓይነት በዓይነቱ መለየት

Appendix F: FASILITATOR'S GUIDE FOR FOCUS GROUP DISCUSSION (FGD)

Introduction

My name is Mulumebet Woldetensae. I am working as a data collector on the impact of poor solid waste disposal system on the environment and health of residents of Yeka sub city, Addis Ababa. This study is done as a requirement for the Master of Science degree in Biological science under the supervision of Addis Ababa University, Department of Zoological Sciences. First of all let me thank you for your time to come here today. Our job is to get the groups similar to yours and discuss so as to learn what people think about the impact of solid waste disposal system in your locality on the health and environment of residents.

I am acting here not as an expert or specialist for the matters in question intending to teach you something or answer your questions. On the contrary, you yourselves will be the experts today, and, therefore, I would like to hear what your personal ideas are. In addition to our group, we will initiate and go into discussions devoted to similar subject matter in other groups as well. The results of this study will be further used by other respective offices in weredas of the sub city to change the bad situations regarding solid waste disposal systems if any.

Discussion Procedure

Let me explain some of the basic rules for the conduct of our discussion.

- First, our discussion will take approximately one hour and will be noted. I want to assure you that no one, except me, would ever hear anything you could say here. Prior to preparation of a report, your opinions will be summarized, and your names will be never mentioned anywhere.
- Further, we would like to hear your opinions regarding every issue which we will discuss from the viewpoint of your own experience. During discussions no answers would be treated as to be correct or incorrect, therefore, please, feel absolutely free to say everything you think. It will be quite normal if you express both positive and negative opinions, to disagree with other participants or change your opinion. Shortly speaking, please, be absolutely relaxed.
- It is very important for me to hear each of you. You are absolutely not required to answer each question, but, please, try to express your thoughts any time you have something to

say. Besides, let other participants speak out as well. Also, you are kindly requested to avoid discussing any other matters unrelated to our issue so that all of you could hear well enough of what we are talking about.

Let us start with introducing each other. Please, tell us your names, how many children do you have, what is your position (if you are working). I'll start with myself, my name is Mulumebet Woldetensae, I am a teacher in a preparatory school found in Yeka sub city, Addis Ababa. I am doing my Masters degree at Addis Ababa University, Department of Biology. I am collecting data for my research on the topic '***environmental and health impact of solid waste disposal in Addis Ababa city: a case study of yeka sub city***.'

All of you probably know and feel that life in such a big city like Addis Ababa is connected with a lot of problems relating to solid waste management. With this in view, I would like to speak a little about these problems which you believe the most vital for today.

- Please, indicate an environmental and health problem which, to your opinion, is the most important for us as the residents of Yeka sub city.
- How serious is the problem of solid waste disposal system in the sub city and what support system is on board from respective government bodies?

Removal of Household Solid Wastes

Now I would like to discuss the situation with removal of garbage and household wastes at your houses. Please, try to speak out in more details about everything that might be related to this issue.

Collection of garbage and solid wastes at households

- Please, describe how you usually collect the solid waste at your home. Do you have any special bins or bucket to collect the garbage in? What are those made of?
- Do you face any problem with garbage collection at your home? What are these problems? How do you manage to settle such problems?
- Are you satisfied with the method of collecting the waste at your households? If not, then - why? Have you thought out how the collection of the solid waste could have been arranged in another way? If yes, then - how?

Now let us speak a little of whether you sort out the solid waste and household wastes at your home, and how you do this?

- Whether you separate solid wastes to some portions? What exactly are those portions? Why to such portions? Where do you collect in the separated portions of solid wastes?
- How, in your opinion, does the major part of people that you know act? Whether they separate the solid wastes to any portions and what portions exactly?
- Have you ever left anything for solid wastes with you so as to re - use those? What type? For what purpose?

Outdoor Collection of Solid Waste

Now I would like to discuss how the collection and removal of solid waste is done outside your house. We should discuss where your waste is thrown away to, when and who removes it, to what extent you are satisfied with the manner it is done, and many other issues. I also would like you to remember as many details as possible from your everyday life.

- So, let us start with the question where usually you throw away the solid wastes formed in your household. Please, describe in more details.
- Who is usually in charge to bring out the solid waste at your home? Whether there is a member of your family who is assigned with this duty? (to clear up in respect to small children)
- How often do you carry away the household wastes?
- How often is the household wastes which is thrown by you and your neighbors removed? What are the vehicles arriving to pick up the garbage - specialized or usual loaded with garbage by manpower?
- Who, in your opinion, is responsible for the garbage removal? Whether the persons responsible for garbage removal do their work perfectly?
- Are you satisfied with the current quality of garbage and solid wastes removal? If not, then what is the point? (To investigate the frequency, regularity and quality of cleaning, conditions of places where the garbage is thrown to, location of dustbins, etc.)

Environmental and health Impact related discussion

Now I would like to discuss some issues related to the impact on the surrounding environment due to improper solid waste disposal methods.

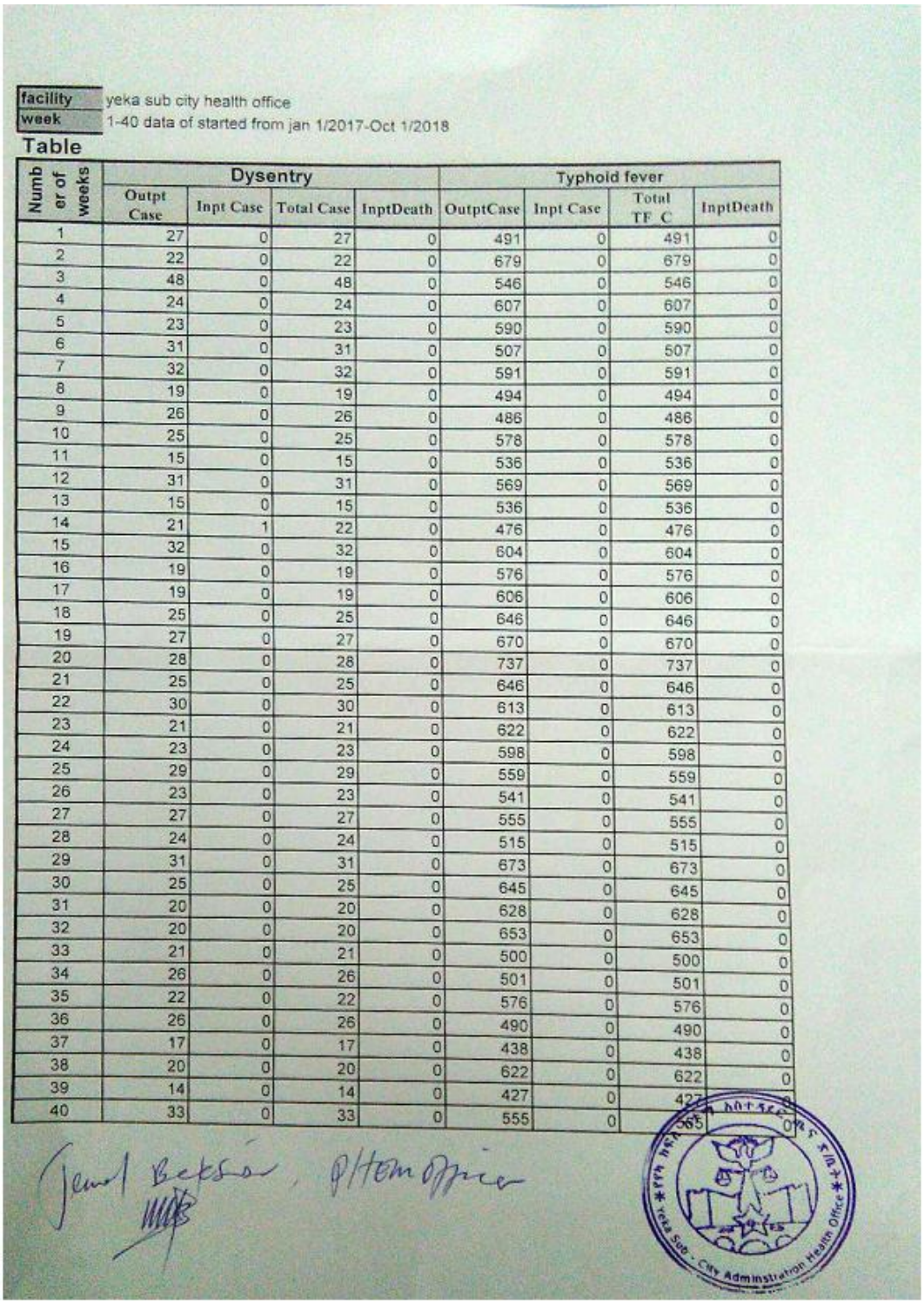
- In your observation, have you been observed any environmental pollution due to poor solid waste disposal system from households?
- How serious/ hard is the degree of the pollution?
- How do you think this environmental pollution due to poor solid waste management affect the residents of your area?
- In your opinion, do you think that the poor managed solid wastes in your sub city affect the health of the residents? How?
- Are anyone/more of your family members become sick due to the solid waste?
- What diseases are observed more often in your family? Do you think that these diseases are due to the poorly managed solid wastes?
- Finally, what do you suggest to alleviate these problems?

End of Discussion

That is all with our discussion. Thank you very much for your time and participation.

Appendix G: Photos taken during Data collection

Appendix H: Yeka Sub City Administration Health Office statistical Data on health Status of Residents



facility	yeka sub city health office
week	1-40 data of started from jan 1/2017-Oct 1/2018

Table

Number of weeks	Dysentry				Typhoid fever			
	Outpt Case	Inpt Case	Total Case	InptDeath	OutptCase	Inpt Case	Total TF C	InptDeath
1	27	0	27	0	491	0	491	0
2	22	0	22	0	679	0	679	0
3	48	0	48	0	546	0	546	0
4	24	0	24	0	607	0	607	0
5	23	0	23	0	590	0	590	0
6	31	0	31	0	507	0	507	0
7	32	0	32	0	591	0	591	0
8	19	0	19	0	494	0	494	0
9	26	0	26	0	486	0	486	0
10	25	0	25	0	578	0	578	0
11	15	0	15	0	536	0	536	0
12	31	0	31	0	569	0	569	0
13	15	0	15	0	536	0	536	0
14	21	1	22	0	476	0	476	0
15	32	0	32	0	604	0	604	0
16	19	0	19	0	576	0	576	0
17	19	0	19	0	606	0	606	0
18	25	0	25	0	646	0	646	0
19	27	0	27	0	670	0	670	0
20	28	0	28	0	737	0	737	0
21	25	0	25	0	646	0	646	0
22	30	0	30	0	613	0	613	0
23	21	0	21	0	622	0	622	0
24	23	0	23	0	598	0	598	0
25	29	0	29	0	559	0	559	0
26	23	0	23	0	541	0	541	0
27	27	0	27	0	555	0	555	0
28	24	0	24	0	515	0	515	0
29	31	0	31	0	673	0	673	0
30	25	0	25	0	645	0	645	0
31	20	0	20	0	628	0	628	0
32	20	0	20	0	653	0	653	0
33	21	0	21	0	500	0	500	0
34	26	0	26	0	501	0	501	0
35	22	0	22	0	576	0	576	0
36	26	0	26	0	490	0	490	0
37	17	0	17	0	438	0	438	0
38	20	0	20	0	622	0	622	0
39	14	0	14	0	427	0	427	0
40	33	0	33	0	555	0	565	0

Yeka Sub - City Administration Health Office