Addis Ababa University
School of Graduate Studies

ASSESSMENT OF SOCIO-ECONOMIC AND DEMOGRAPHIC FACTORS AFFECTING SOLID WASTE HANDLING IN ARADA SUB-CITY, ADDIS ABABA.

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A Thesis Submitted to the School of Graduate Studies Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Master of Science in Population Studies

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An Assessment of Socio-economic and Demographic Factors Affecting Solid Waste Handling in Arada Sub-City, Addis Ababa

By

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ACRONYMS

CBOs	Community Based Organizations
CGASBPDA	City Government of Addis Ababa Sanitation, Beautification and Parks Development Agency
CSA	Central Statistics Authority/Agency
ENDA	Environmental Developing Action in the Third World
EPA	Environmental Protection Authority
ECA	European Commission for Africa
HICE	Household Income Consumption and Expenditure
IWMB	Integrated Waste Management Board
MSW	Municipal Solid Waste
NOP	National Office of Population
PPPS	Percentage of Probability Proportionate to Size
SBPDA	Sanitation, Beauty, Parks & Development Agency
SKAT	Swiss center for Development technology and Management
SWM	Solid Waste Management
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
UNHCR	United Nations Higher commission for Refugee
UNICEF	United Nations International Children emergency fund
WMU	Welfare Monitoring Unit

Abstract

To plan and implement an integrated and sustainable waste handling system for the future assessing and distinguishing the most influential socio- economic, demographic and physical factors are very essential in the process of solid waste handling apart from legal, institutional and financial aspects.

The current solid waste management system of the city is poor and relied on getting ride of the trash with very little attention paid to waste prevention at the source and its recovery efforts, which will result a miss guiding policy and a failure to design policy intervention on solid waste management of a city.

Thus, in Arada, one of the sub-cities of Addis Ababa, 398 households were surveyed based on systematic random sampling and responded to designed questions which ask about their socio-economic, demographic, ways of waste handling and disposal as well as interview was administered to expertise of solid waste management at various levels.

Obtained data were analyzed using both descriptive and inferential statistical tests. The descriptive statistical tests like percentage and inferential statistical tests like bi-variate analysis to show association and logistic regression analysis to rank and indicate the strength of independent variables over dependent variable.

As far as the influence of the tested variables concerned household income, educational level and location of community waste bins have significant influence on waste handling. Higher income groups of households showed better waste handling practices than low income groups. Level of education of households showed positive relation with solid waste handling. Location and distance of community waste bins have also direct impact on solid waste handling. Solid waste handling habit of the community especially at the source is poor and feeble relationship to institutions. Finally household size showed neither positive nor negative relation with solid waste handling. Thus, to increase the consciousness of the community about solid waste handling upgrading educational level and linkage of institutions with community-based organization is needed.

CHAPTER ONE

1. Introduction

1.1. Background of the study

For the first time in history, rapid population growth and its concentration in cities around the world constitute a crucial element affecting the long-term outlook for humanity. Despite the fact that being centers of civilization and economic activity cities never attracted more than ten percent of the global population until the second half of the nineteenth century. Now, systems of cities have become the world's social, economic, cultural and political matrix (UN HABITAT, 2003).

Since the beginning of the twenty century half of the world's population is considered to be living in areas classified as urban and it is expected to increase by 1.5 billion people in 2025. The speed of urbanization and the enormous number of population involved create various development challenges (World Bank, 2000).

The rapid increase in urbanization and industrialization in cities has resulted in an increased volume of waste generation. Municipalities all over the world and especially those from the developing countries are faced with the problem of effective solid waste management. It is explained that solid waste problems are global; everywhere collection and handling of garbage is not adequately executed (Eshuan, 2002; Van Demculen, 1996).

It has been estimated that about 40-85 percent of waste generated by the developing countries is made up of solid waste while developed countries constitute between 20-30 percent (Eshuan, 2002; Cointreau, 1992). Beside, its small in amount, developed countries are able to manage the various types of wastes (solid, liquid and gaseous) to an acceptable level, in contrary developing courtiers are still struggling to deal with the great amount of waste they generate.

With the current rate of urbanization and industrialization, SW collection, transportation and disposal has been a major problem of most municipalities of the developing countries. Most previous studies looked at the characteristics of municipal solid waste at the final disposal sites (Ali, 2004; Blight, 1999) with management strategies shifted towards more recycling,

determining the quantity and composition of waste at the source of generation and extensive recovery of SW before disposal. Assessing the socioeconomic and demographic influence of solid waste handling which is more valuable (Yitayal, 2005; UNEP, 2000) was not touched by these studies.

Collection of solid waste in urban areas is difficult and complex because the generation of residential and commercial industrial waste is a diffuse process that takes place in every home, every apartment building and every commercial and industrial facility as well as in the streets, parks and even in the vacant areas of every community. The mushroom like development of suburbs all over the city has further complicated the collection task (Agrawal, 2002).

Addis Ababa is the capital city of the country, diplomatic capital for Africa and home of regional head quarters like UNDP, UNICEF, FAO, UNHCR, ILO, ITU and others. It is the most populous city of the country with the population of 3.305, 135 living in 10 sub cities and 101 small districts known as kebeles for administrative purpose (Mesfin, 2006). Besides, the attraction of the city as a capital, seat of government administration, and center of industrial and commercial activities resulted in the springing up of a number of people. But, the city's development could not meet the demands of the increasing population due to inadequate solid waste handling which is the major environmental problem in Addis Ababa.

The daily waste generation rate in Addis Ababa is estimated to be 0.252 kg/ca/day, which is 2,297,000 kg (Sturdy, 1995) and 0.45 Litter/cap/day (Abera, 1997) of this only 65percent, is collected daily. The remaining 35-40 percent of the waste is disposed off through informal means. But smaller percentage of it is going to incineration, the rest dumped on open sites, drainage channels, and rivers and on the streets.

The current waste collection capacity and disposal system are not matching with the growing SW generation rate. According to SBPDA (2003) about 40 percent of SW which is dumped on to the street and drainages contributed a lot in breeding insects, rodents vectors and spread of disease (Zurbrugg, 2004). Tadesse (2004) also stated that inadequate SW collection that is generated from houses and industries create a range of environmental problems in Addis Ababa.

The situation is exacerbated in slums where households can not make use of community waste bins. Besides, crunching poverty and crowdedness of the society, the major contributor to high morbidity and mortality among the urban poor is lack of basic SW disposal service. Thus in urban areas especially in the rapidly urbanizing cities like Addis Ababa the socio- economic and demographic factors and their impact in the process of solid waste handling are studied. The study is based on a sample of households collected from one of the oldest and densely populated sub-cities called Arada.

1.2 Statement of the problem

Urban population in the developing cities is estimated to account for over one third of a country's total population (Eshuan, 2002). Besides, high birth rates, urban centers have attracted migration from the rural areas due to "assumed" more work opportunities, better health and educational facilities, among others. Abbott (2000) has described that informal SW disposal accounts for a large and still growing percentage of the population of the cities of the developing world. He further stated that the contribution of informal settlement to improper SW disposal ranges from ten percent in Cape Town and Buenos Aires to 90 percent in Addis Ababa and Luanda in respect to developing countries.

Lee (1997) pointed out that SWM Continues to be a major challenge of urban areas through out the world particularly in the rapidly growing cities and towns of the developing world. The consequence results an ineffective waste management and an increased morbidity and mortality in urban areas (Eshuan, 2002). In poor countries, problem of SWM causes several illnesses that are infectious and parasitic diseases in pattern with morbidity and mortality. If SW is not properly collected from both inhabited areas and sanitary facilities the situation will be conducive to the spreading of diseases. The case is even worse in developing countries especially densely populated cities like Addis Ababa.

Any person while walking on the city from any corner all public spaces like road sides and open spaces attest eye catching piles of garbage, flying festal, rubbish, construction demolition and moved earth from new construction site, littering the urban space indefinitely. Obnoxious odors emanating from decomposing SWs, semi-liquid and liquid wastes are sickening all citizens.

According to Tadesse (2004) the city council recognizes six major sources of SWs: households, street, commercial institutions, industries, hotel and hospitals. Available data in 2004 showed that household takes the lion-share of SW generated in the city. From total generated 71 percent from household, 10 percent from street, 9percent from commercial institution, 6percent from industries, and 3percent from hotels and 1percent from hospitals. In spite of huge amount of SW is generated at the households, no appropriate measures put into practiced concerning SWM systems in Addis Ababa particularly in Arada Sub-city (Nor-Consult, 1982; Tadesse, 2004).

The current rate of SW generation is 0.252kg/ca/day in the city of Addis Ababa (Sturdy, 1995 and SBPDA, 2003). According to this rate the total amount of SW generated in a year reached about 321,930 tones. In contrast the administrative disposes a huge amount of SW in the land fill around 838,405 tones which is higher by 150 percent in volume with the generation rate of 0.252 kg/ca/day.

While Median (2004) stated that the generation rate of SW in most cities of the developing countries is not exactly studied but it is estimated to be between 0.4-0.6 kg/ca/day for developing countries. Abera Kume's volumetric method of study since 1994 has asserted that the Addis Ababa SW generation rate was estimated to be 0.45Litter/cap/day, Mesfin's case study in Addis-ketema sub-city revealed SW generation rate of 0.505Kg/ca/day and 0.11Kg/ca/day in Arada sub-city (Abera, 1997; Yitayal, 2005 and Mesfin, 2006).

Therefore, improper handling and careless disposal of SWs poses a serious problem, which contribute to high morbidity and mortality rate in the city. Reliable and recent data about solid waste handling in Addis Ababa is very limited, a few surveyors and studies have been carried out in early 1980s and mid 1990s but these studies mentioned the generation rate, composition and density of SW based on the socio-economic status of the city, not the handling aspects including its causes.

Thus, the key socio economic and Demographic variables such as the relationship between education, household size, income, institutional involvement, distance, infrastructure and solid waste handling were the focal point of this study.

1.3 Objectives of the study

1.3.1 General Objective

The general objective of the study is to assess the socio-economic and demographic factors which influence Solid Waste Handling at the household level in the sub-city of Arada.

1.3.2 Specific objectives

1. To describe the existing solid waste handling system in the sub-city;
2. To assess the links between income of the household and solid waste handling;
3. To examine the association of household size of the respondents on solid waste handling;
4. To asses the suitability location of community waste bin to household and its association with waste handling; and
5. To examine the impact of education level of the households on solid waste handling;

1.4 Research Hypotheses

In relation to the above specific objectives the study has the following hypotheses:

1. Household size of the respondents is inversely related to solid waste handling;
2. Distance of community waste bins has direct impact on solid waste handling;
3. The education level of the households is positively correlated with solid waste handling; and
4. Household income of the respondent is positively related with solid waste handling.

1.5 Significance of the study

In this research the impact of socio-economic and demographic factors on solid waste handling was conducted in Arada Sub-city, which is the central sub-city of Addis Ababa. It is selected for the study for the following reasons:

- It is relatively the appropriate place to determine household waste handling systems and variability with socio-economic level in the area. About 60percent or more of Addis Ababa population fall under low income groups (region 14 administrative, 1997) and it is believed

that most of these people who have a major share in household waste generation with problem of management live in the sub-city.

It is characterized by densely built up and city center areas, which needs different waste handling systems; and it is the area that is drained by different rivers that carry SWs and dispose down streams.

Now days, by passing the open spaces of the city, the rivers of Addis Ababa are commonly used as a waste disposal site. Particularly in areas of high population concentration, rather than developing proper handling of SWs, the tendency of using rivers as a disposal site is increasing. This exacerbates further environmental pollution and adverse health hazards to the city's population. Thus;

a) The study will contributes a better theoretical understanding of the overall features of SW and the influence of demographic, social, economic and physical factors on the process of solid waste handling on the whole population;

b) There is a gap in knowledge about how to handle and properly dispose. Because most research works on SWM emphasize on final destination of the waste. But in between generation and final disposal there is a bridge which connect the two that are handling at the source and collection via various stages and

c) Finally its ultimate significance is achieving the objective of the study.

1.6 Limitations of the study

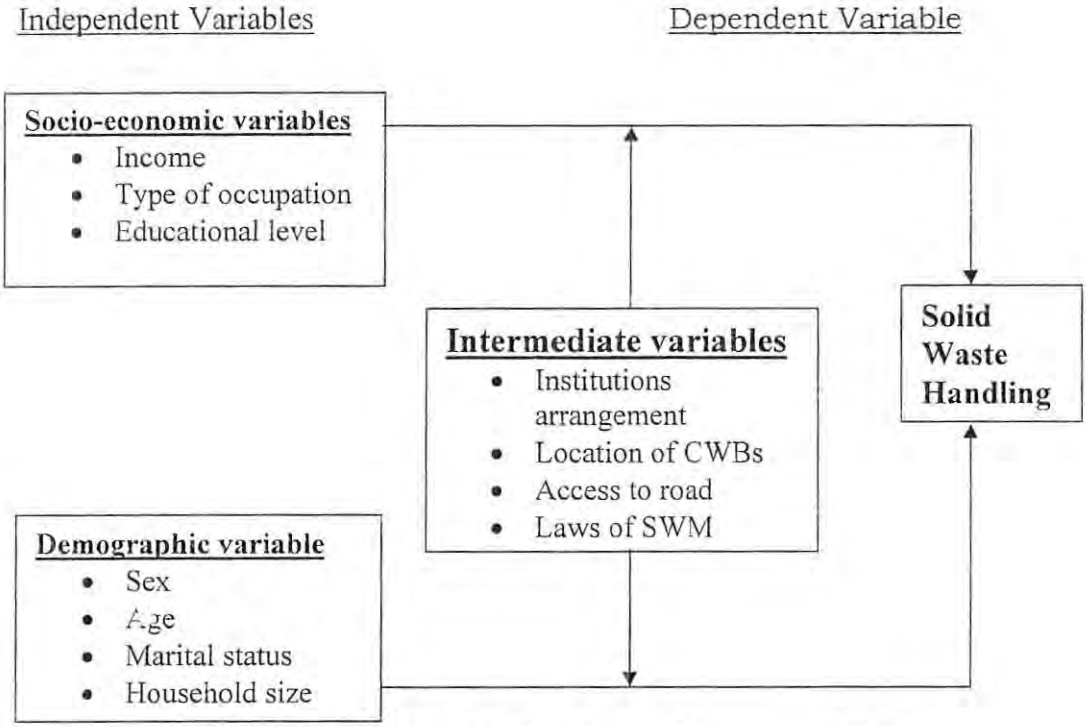
- One of the major problems during the study period was lack of information especially from households at the time of data collection. As stated in the background of the respondents the majority of residents in the sub-city are below poverty line. Besides, they were not easily voluntaries to sensitive questions like income amount hence at the early stage of data collection the way of getting information were changed to other system. Similarly, some respondents replied something regrettable irritating responses like "Do you have waste storage material?"And they replied "storage is needed if I have edible food." In fact it was logical to say what they responded since there is critical level of living condition. The other problem, which the researcher faced during data collection, was from various sector officials especially from the sub-city

Sanitation and Beautification Office. The head of the office and an expert to this sector gave me four appointments to interview but it was practical at the fifth stage. The city's SBPDA and EPA of the city government were better than the previous.

- The researcher focused on only solid waste handling at household level. Problem of solid waste management is not relied on at household level rather the problem expanded and touches all corners of community, institutions, business area and the environment as a whole. Therefore, other researchers may touch and dig out more information about the different but interrelated problems of solid waste management in the city of Addis Ababa in particular and Ethiopia in general.
- Besides, data collection problem, there was also lack of recent secondary source of data to elaborate some of the variables which were to be tested. Most reference books found in AAU library are old and outdated besides no references related to solid waste management and the like.

1.7 Conceptual framework and analysis

Figure1.1 Conceptual framework of variables



Source: - Modified by the Researcher from Kumar Heeramum (1995)

The Conceptual framework was adopted from Kumar Heeramum (1995) which is originally made for the analysis of the impact of informal settlement on SW collection. However the researcher modified and includes some intermediate variables as mediating factors between the dependent and independent variables. The relation-ship between dependent and independent variable and their intervening variable is stated as follows.

Though there are various factors that influence solid waste handling, based on the objective of this study the researcher focuses only on demographic and socio-economic factors which influence solid waste handling.

The first variable in this conceptual framework is educational level of households. It is a social variable; lack of information on how to handle waste properly, lack of knowledge, where and how to reduce at household level and community level at large will make them to throw. This may be a potential factor for pollution and health risk. Besides, the function of MSWH system is influenced by waste handling patterns and underlying attitudes of the urban population and these factors are themselves conditioned by the people's social and economic as well as cultural context.

The other variable was income. It is a socio-economic variable which influences the handling of solid waste. Residential households are mainly interested in receiving effective and dependable waste collection service at a reasonably low price. However, in low-income countries like, Ethiopia since most people is below standard of living (Yitayal, 2005) it is difficult to pay for those who collect wastes from households. These lead to simply throw away of wastes along streets and water bodies.

1.8 Operational definitions of key terms

Commercial waste: all municipal solid waste emanating from business establishment, markets, office buildings and restaurants. (World Bank 2004)

Disposal: final placement of solid waste that is not recycled by the household /World Bank

Domestic waste: A household wastes or waste generated from any residential buildings. (World Bank, 2004)

Garbage: A solid waste, which includes animal and vegetable wastes resulting from the handling, preparation, cooking and serving of foods.(World Bank , 2004)

Head of Household: A person who economically support or manage the household or for reason of age or respect, is considered as a head by the household or declare himself as such (CSA, 1998).

Household: constitutes a person or group of persons irrespective of whether related or not who normally live together in the same housing unit and who have common cooking announcement (CSA, 1998).

Household size: Total number of members of a household (CSA, 1998).

Municipal solid waste: includes non-hazardous waste generated from home, commercial and business establishment, institutions and industries (WB, 2004).

Pollution: the presence of matter or energy whose nature or location generates undesirable environmental effects (WB, 2004)

Primary collection: is the collection of solid waste at the source (from households, businesses, institutions, etc) or from street containers and its transportation to point of transfer (Addis Negari Gazeta, 2004).

Recycle/ reuse: recovering and reprocessing usable solid waste that might otherwise disposed (World Bank, 2004).

Secondary collection: is the collection of the waste from transfer points for transport to the final disposal site (Addis Negari Gazeta, 2004).

Solid waste handling: the management of storage, collection, transfers and final disposal of solid wastes. (E: WAC 173- 350-100 definition.htm. Accessed on 23/11/2006)

CHAPTER TWO

2. REVIEW OF THE RELATED LITERATURE

2.1 Introduction

Solid waste or refuse is generated through human activities (Fureay, 2002; Cotton and Fraecys, 1991). Through out history, cities and towns have struggled with how to collect and dispose of the refuse generated by their population (Doan, 1998). The increasing complexity and costs of waste management are making it difficult for local authorities in many developing countries, to handle the process efficiently. Often solid waste receives scant attention at the municipal planning period in developing countries, while in developed countries, for SWM the allocated budget may account for between 20 and 40percent of municipal revenues (Cointreau-Levine, 1994, Cottone and Franceys, 1991).

Attention for such solid waste management problems has increased in the international circle since the 1990s. Two main reasons account for this. The primary reason is the issue of public health. Improper waste collection can lead to filth, stench and the possible spread of disease from vectors perhaps even leading to epidemics. The second reason for increased attention for solid waste management stems from an environmental point of view, improper handling of solid waste could degrade the environment, create nuisance and make places unsafe for habitation (Obirich-opareh and post 2001 and Hasan, 1998). This chapter, therefore, reviews relevant literature, in the field of solid waste management in general and solid waste handling at household level in particular.

2.2 Nature and characteristics of solid waste in developed and developing countries

SWM scholars explained the various patterns of solid waste handling in terms of collection, transfer and disposal in developed and developing countries. Cointreau (1982, 1992) and Mesfin, (2006) defines solid waste as material that has been abandoned and discarded because it has no more use for the owner. This type of waste may be solid, semi-solid or liquid. It is made up of households refuse, institutional waste, commercial refuse, constructional and demolished debris, residential ashes, street cleaning, maintenance refuse, abandoned dead

animals and sanitation residuals, and bulky waste (Techobanoslous, 1993, Eshuan, 2002 and, Mesfin, 2006).

2.3 Types of Solid Wastes

According to Cointreau (1982) and Medina (2004) three general categories of solid wastes are municipal waste, industrial waste and hazardous wastes.

Industrial Wastes: are wastes arising from industrial activities which include rubbish ashes, demolition and construction wastes, special wastes and hazardous wastes.

Hazardous Wastes: a waste or combination of wastes which because of its quantity, concentration, or physical, chemical or pathogenic characteristics may: cause an increase in serious illness, morbidity and mortality.

Municipal Waste: Urban solid waste (Cointreau, 1982; Medina, 2004) also commonly referred to as municipal refuse is defined as: material for which the primary generator or user abandoning the material within the urban area requires no compensation upon abandonment. In addition, it qualifies as an urban solid waste if it is generally perceived by society as being within the responsibilities of the municipality to collect and dispose off. Categories of urban solid waste materials discarded in urban areas and generally viewed as a municipal responsibility includes:-

Household wastes: - Also referred to as residential refuse or domestic waste, this category comprises wastes that are the consequence of household activities. These include: food preparation, sweeping, cleaning, fuel burning and gardening wastes. They also include: old clothing, old furnishings, retired appliances, packaging and reading matter.

Commercial refuse: - This category consists of wastes from stores offices, fuel service stations, restaurants, warehouses and hotels. The wastes typically consist of packaging and container materials, used office supplies, and food wastes. In developing countries, markets may contribute the major portion of this waste category's refuse

Institutional refuse: - Schools, government offices, hospitals, police, barracks and religious buildings are included in this category. Where the institution involves residents, such as in camps, the wastes are similar to those from households.

Street sweepings: - This category of waste always includes dirt and litter. However, in developing countries it-may also contain appreciable amounts of household refuse, drain cleanings, human faecal matter and animal manure.

Industrial wastes: - Industrial wastes come from processing and non-processing industries, as well as utilities: Packaging materials, food wastes, spoiled metal, plastic and textiles, fuel burning residuals, and spent processing chemicals are among the wastes within this category.

Heeramum (1995) considered solid waste as any unwanted solid material generated from human and animal activities that have been put aside. In broad terms, solid wastes are categorized in to three main groups' namely municipal waste, industrial waste and hazardous waste. According to him municipal waste can be classified in to two broad categories. These are Bio degradable or recyclable and non-degradable (non-recyclable). In other words municipal solid waste may be partly composed of organic matter that would be easily degradable and those non-organic matters such as bottles, glasses and papers among others that go through before degradable. The variation in the nature of solid waste affects the level of solid waste handling.

Thus, this study consider municipal solid waste as, any solid waste that is generated with in the city's resident and abandoned by the users because of its non-value with in the administrative set up of the municipality.

The characteristics of municipal waste can be divided in to different categories depending on its physical properties and waste composition. The categories may fall in one of the following: its moisture content, waste density, waste composition and size of the waste particle (Cointreau, 1994).

The quantity of waste generated is the other characteristics that determine the handling of wastes in urban areas. The quantity of waste generated is increasing because of rapid population growth, economic development, and urbanization and improved living condition in

cities. However, in most developing countries like Ethiopia the increasing of solid waste generation is resulted from rapid urbanization and population booming. This has out paced financial and man power resource of municipalities to deal with provision and management of service of solid waste. In most cities of the developing world in- appropriate handling and disposal of municipal solid waste is the most visible cause of environmental degradation, i.e. air pollution, soil contamination, surface and ground water pollution, etc... resulted from improper disposal of MSW (WHO, 1996; AAHB, 2002).

From all these definitions and characterizations of solid waste management in the literature, it is clear that SWM includes the cleaning and sweeping of public area and streets, as well as the primary and secondary collections, transfer and final disposal of solid waste. Waste composition and characteristics depends up on mainly geographical area, the standard of living, and economic status of the country, which the prevailing climatic condition and type of energy used. Developed countries solid waste differs significantly from developing and middle income countries in both quantity and quality. The following table shows these differences in waste characteristics.

Table 2.1 MSW characteristics for low, middle and high income countries.

Composition (% by wet weight)	Low income countries	Middle income countries	High income Counties
Paper	1-10	15-40	15-40
Plastics	1-5	2-6	2-10
Metals	1-5	1-5	3-13
Class, Ceramics	1-10	1-10	4-12
Leather, Rubber	1-5	-	-
Wood, bones, straw	1-5	-	-
Textile	1-5	2-10	2-10
Vegetables/organic matter	40-85	20-65	20-50
Miscellaneous	1-40	1-30	1-20

Source: Cointreau, 1994

Developing countries according to Cointreau (1994) have 40-85percent waste made up of household's organic matter with a high density of 450-500kg/m^3 with a high proportion of moisture content (40-80percent) and small particle size ranging between 5-35percent. From

the table it can be concluded that density of waste as reflected in humid weight is high in developing countries and low in developed countries. Thus handling and disposal methods may differ as waste of the developed and developing countries differ greatly. This is mainly due to the mechanism to reuse, compost, to transport and control from pollution varied according to the nature and characteristics of the waste.

2.4 Solid Waste Handling in Developing Countries

In an overview of solid waste handling in the developing countries, it is worth while to note that the amount of solid waste generated in many cities in the developing countries, has been increasing rapidly over the years, mainly as a result of increases in population and urbanization amongst other factors. Rapid population growth in developing countries has direct implications for human living patterns, leading to a greater concentration of people mostly organized in the form of urban centers. In urban Asia alone 760,000 tones of waste are produced daily (Thomas & Hoornwer, 1999) while in Latin America, 240,000 tones of waste are generated daily (Moreno, 1999).

Urbanization in the third world implies the expansion of slum areas and the creation of new ones population growth intensifies the pressure on urban structure in many cities already over burdened with the provision of urban services most level world cities lack the resources to meet the demand for services such as water, sanitation and SWM. The sufficiency of services results in deterioration of the urban environment in the form of air, water and land pollution that passes risks to human health and the environment (Medina, 2004 and Cointreau, 1994)

Solid waste management in developing countries has received less attention from policy makers and academics than that paid to other environmental problems, such as air pollution and waste water treatment. Nevertheless, the improper handling and disposal of SW constitutes a serious problem; it contribute to high morbidity and morality rate in many developing country cities (Martin, 2004)

Currently, collecting, transporting and disposing of MSW represent a large expenditure for cities of developing countries: waste management usually accounts for 30-50 percent of municipal operational budget. Despite these high expenses cities collect only 50-80 percent of the refuse generated. In India for instance about 50 percent of SW,33 percent in Karachi, 40

percent in China and 50 percent in Cairo and 60 percent in Addis Ababa was the only amount of SW that was collected in 2000 (Medina, 2004; SBPDA,2003).

Usually low income community residents tend to gather and dump their garbage at the nearest vacant lot public space, near river or simply burn it in their surrounding. These uncollected wastes may accumulate on the street and blocked drains when it rains which may cause flooding (Medina, 2004; Eshuan, 2002; Demanya, 2006)

Thus if these wastes are not collected, treated and disposed properly health, psychological, aesthetic and environment conditions will further deteriorate in developing countries. Various measures have been implemented in order to extend refuse collection, upgrade disposal facilities and diminish the risk to human health and the environment associated with inadequate WM. The measures which are proposed to the problem in SWM in these countries have socio economic, demographic, and institutional features.

Mostly in developing countries, the approach to managing wastes has mainly focused on getting ride of the trash, with very little or no attention paid to waste minimization or recovery efforts (Cointreau, 1982, 1994). If a household can find a nearby site simply to dump the waste, it has solved its disposal problem contributing to ecological degradation, and health hazards in most developing countries in general and through out Africa in particular. Threats to both human and ecological health have also persisted due to economical, technical, legal, social and institutional in adequacies that have emerged from the use of current solid waste handling approaches.

Most of the literature on solid waste issues in Africa cities focuses on collection options and equipment for collecting wastes, and cost recovery through private sector involvement.

In Africa the sheer volume of waste alone does not actually constitute the problem; it is the inability of governments and waste disposal firms to keep up with it. The situation in Nairobi, for instance, aptly explains this; although between 1977 and 1983 the population of this city increasing at an estimated annual rate of 6percent, the amount of refuse collected fell from 202,229 tones in 1977 to 159, 974 tones in 1983, a decline of 21percent over 6 years (Kumuyi, 1999).

In many African cities, refuse collection is restricted to high income area (Leduka, 1991). Collection in other areas of the city is irregular, and the uncollected refuse soon attracts rodents, flies and other vermin. Hence, situation with respect to waste disposal in African cities is very serious because it has a tremendous direct effect on the quality of the environment (Izeogu, 1991). According to Izeogu this has led to the environment's aesthetic and ecological deterioration. Since the city of Addis Ababa experience these problems it is essential to treat and reduce the waste crisis in Addis Ababa.

Although production of solid waste is minimal, environmental problems are possible to occur due to improper handling and lack of service that result from different characteristics of solid wastes in developing countries. Besides, collecting, transporting and disposing, SW requires high expenditure which is still scarce in the developing world. Even though small amount of solid wastes are produced in the developing countries, responsible authorities do not properly handle and dispose their SW (Hogland, 1996). Thus an adverse effect of improper SW handling brings about health and environmental problems in most developing countries.

In general based on the literature reviewed a profound differences exist between developed and developing countries in terms of income, standard of living consumption patterns, institutional capacity and capital available for urban dwelling investment. Even conventional solutions usually do not take in to account these differences, resulting in less than optimum out comes. However, (Medina, 2004; Sunil 2005 and Demanya, 2006) identified the following major differences between developed and developing countries about SWH.

- The physical characteristics of cities in developing and developed countries differ markedly,
- Dissimilar amount and characteristics of wastes generated,
- In many developing countries there is an involvement in informal sector of waste collection and
- Developed countries enjoy a relative abundance of capital and have high labor costs while developing countries have a relative scarcity of capital and an abundance of unskilled and inexpensive labor.

2.5. Solid Waste Handling Systems

Tchobanoglous (1993) explained that solid waste handling includes not only the gathering up of SW from various sources but also the hauling of these wastes to the location where the content of the collection vehicle are emptied. Solid waste handling Practices includes the process of collection, transfer; reuse, composting and incineration.

Among the various form of handling system, collection and disposal of household garbage is a persistent problem in most cities. According to African Development Bank report of 2002, collection rate in Africa range from 20-80 percent. Common features of the municipalities are futile, under equipped and poorly maintained, inadequately funded and poorly staffed. Often collection services are limited to high visibility areas, the wealthy and business willing to pay for this service.

Most major cities in Africa have an established municipal waste collection system. In the case of Addis Ababa, there are three basic types of collection equipments: Human powered, Animal powered and engine powered (AAHB, 1997 and Nor-Consult 1982).

Human powered collection equipment: - this includes pushcarts, pedal tricycles, wheel barrows, and two wheel donkeys with baskets. In general these equipments require some sort of smooth surface on the canes to be effective.

Animal powered collection equipment: - animals powered collection equipment either takes the form of drawn carts or the animal may be directly backed with containers such as basket. This type of collection is applicable in the cities where there is no much traffic.

Engine-powered collection equipment: - This includes all motorized collection equipment. There exist three broad types of refuse collection systems namely door-to-door, block an communal collection that are facilitated by three types of collection vehicles i.e. side load truck, closed compacting type trucks and containers lift trucks, and these ways of collections are used in Addis Ababa solid waste collection systems.

Door-to-door collection:-The side loading and compacting trucks are usually serve for door-to-door collection systems where container transfer stations are lacking and road accessibility

is not limited, in such collection system the disposing people and the truck along accessible street collection points met at a defined time.

Block collection: - It consists of large refuse containers ranging from 0.1-8 cubic meters located at the premise of the blocked houses or buildings. This mode of waste storage and collection system is suitable to Addis Ababa especially to the newly constructed condominium houses.

Container system: - The public at large gets collection services through a transfer station in a container collection system, which is composed of refuse containers of large capacity located at accessible sites of community and where large waste generation is assumed.

In order to handle the growing volume of wastes collected in various ways proper policies need to be performed and implemented. For instance in the developed world the approach to waste management regarded as the most compatible with the environment and sustainable development. (McDouglas, 2001).

Environmentally sustainable approach of solid waste handling reduces pollution, seeks to maximize recovery of reusable and recyclable materials and protect human health and the environment. Integrated waste management aims to be socially desirable, economically viable and environmentally sound approach in the process of waste handling (Medina, 2004; McDougall, 2001; Cointreau, 1993).

Environmentally sustainable approach of solid waste handling has the following structure:

Waste prevention: - this is a preventive action that seeks to reduce the amount of waste that individuals and other organizations generate. By not creating waste fewer collection vehicles, and fewer number of refuse collectors would be needed; smaller waste handing facilities would be required and ultimately it would extend the life of the land fill (Tchobonoglous, 1977; Conitreau, 1993; Medina, 2004; and SKAT, 2005).

Reuse: - once the waste prevention program has been implemented, the next priority is promoting the reuse of products and materials. It consists in the recovery of items to be used again, so as to reduce pollution and save energy and water. Therefore reuse of products and

material can be prevent environmental pollution, reduce waste and improve industrial and economic competitiveness (Samuel, 2006 and Birke, 1999).

Recycling: - it can render social, economic and environmental benefit. Recycling provides an income to those who recover recyclable materials. Factories that consume recyclable materials can be built for a fraction of the cost of building plants that consume virgin materials. Hence, it saves energy, water, and generates less pollution than obtaining virgin raw materials, which translate in to lower operating costs. Besides, recycling reduces the amount of wastes that need to be collected, transported and disposed of and extends the life of disposal facilities and money (Eshuan, 2002 and ADB, 2002).

Composting: - it is process of decomposition of organic waste material considering the high proportion of organic matter in the waste generated composting can be an option to reduce the amount of wastes that are land filled. When composting is conducted under controlled condition, it reduces the cost of waste disposal, does not produce odor produce a clean and readily marketable finished product. Composting also increases nutrients by returning them back to the soil (Sturdy, 1995; Schaper, 1986; Zurburg, 2002).

However, lack of adequate waste prevention, collection, reuse, recycle composting, and proper disposal systems cause public health problems resulting in diseases. This aggravated poverty and leads to negative consequences such as loss of income due to illness, increased spending on health care and deprivation of the Poor capability to live in a safer environment.

2.6 Impact of solid waste on health

Health issues are largely interlinked with the process of rapid urbanization, industrialization and modernization. There are certain changes in the human environment that increase the incidence of many diseases. In developing countries, urbanization and modernization processes, with out adequate capacity to collect and dispose solid waste or proper effluents from the industry and emission from transport are leading to a deepening crises due to environmental pollution and damage to human health. These are a result of poor environmental conditions, and its association with communicable disease control activities.

The World Bank (1993) stated that *"In adequate sanitation is a major cause of degradation of surface and ground waste and is a principal cause of high morbidity and mortality"*. In less developed regions of the world, how-ever, diseases that are associated with poor sanitation, faecal contaminations of water and food, contaminated indoor and outdoor air, and infections via insect or animal vectors continue to cause significant mortality and morbidity. Deaths due to diseases associated with poor water supply, sanitation and personal and domestic hygiene alone are estimated to have accounted for 5 per cent of global deaths and 9 per cent of all premature deaths in 1990. As a result of major improvements in sanitation, community water supply, housing and indoor air quality, most of the diseases associated with traditional environmental factors are no longer of major significance in more developed regions (Murray and Lopez, 1996).

Moreover, the improper handling of waste, besides being a health hazard has an impact on the environment cleanliness. Hogland (1996) pointed out that if SW is not handled properly the scale of health problem is enormous. The indiscriminate discharge of SW in to the environment causes disease and squanders valuable nutrients that could boost food production and alleviate malnutrition. In addition to this, the American public health service states that there are about 22 SW affiliated diseases in the world. Among the many diseases the following are some: Chronic bronchitis, Lung cancer, Mumps Influenza, Common cold, Measles, Pneumonia, Diphtheria, Amoebiosis, Hepatitis-A, Cholera, Dysentery and the like. Therefore all these health risk factors, unless properly managed, will continue to be difficult subject for public health managers and a challenge of developing countries at large where the level of collecting, transporting and disposal facilities are inadequately provided.

Today, the process of rapid population growth, industrialization and urbanization is further leading to a greater volume of waste generation. Although, according to Medina (2004) globalization and economic growth may find a solution to factors of SW problems, such as economic growth, population increase and urbanization will seriously affect municipal resource to deal with a booming amount of wastes. With increase in the global population and the rising demand for food and other essentials, there will be a rise in the amount of waste to be generated daily by each household. This increment in the amount of waste creates a problem of collection, transportation and disposal or handling of the waste. Nevertheless,

either due to the scarcity of resource or inefficient infrastructure, not all this SW is collected and transported to the final dumpsite. Such accumulation can cause serious impacts on health and several other problems to the surrounding environment (UNEP, 2004).

2.7 Determinants of solid waste handling

Globally, the per capita amount of MSW generated on daily basis varied based on many factors. Population size, population distribution, mobility, age structure, rate of growth and other factors affect the environment. These factors affect resource utilization, where, when, how and to what extent SW to be handled and conserve the environment. A change in population size results in a change in the amount and composition in SW which ultimately affect the system of SW handling.

A data collected from India and Addis Ababa shows that SW generation rate of 0.3kg/ca/day and 0.252 kg/ca/day respectively (Sturdy, 1995 and Zurburg, 2002). It shows that less amount of SW generation is observed in Addis Ababa at that time when we compare with India. However, one can observe that there is a gap in level of population size and urbanization between the countries. Further more, Ehrlich pointed out that as the number of population increase so does industry which powers into our environment an array of contaminants, refuse, debris, craps, garbage and so on, which is created by improper handling and treatment of wastes (Ehrlich, 1970). He also further stated that as population and industry grow, so does the need for increased agricultural production, which results production of waste and heavier environmental pollution. Thus, giving much emphasis to proper collection, treatment, transportation and final disposal of waste is essential than other practices. This is mainly due to; all forms of SW problems are occurred not on their generation stage rather handling process.

Many cities are facing disposal crisis as population growth simultaneously produces more solid waste and use the available land for dumping. In other words, SW disposal is another classic case where per capita costs for disposal tend to soup as population grows (Ehrlich, 1970). The report of SBPDA in 2003 indicated that out of the then annually generated solid waste amounting to 838,405 tones only 540,789(64.5percent) tones was disposed in to the land fill. The rest 297,616(35.5percent) tones were simply dumped on open sites, drainage,

channels, rivers and valleys as well as on the streets. The city administration during the time had allocated about 2 million Birr for solid waste collection and disposal purpose. If it is distributed to sub cities it is almost negligible, this showed that the attention given to the sector is very low.

The inefficient status of SW handling in every country may lead to a potential pollution of the environment, water, air and even agricultural products. Parallel to this point Berry (1997) points out that there are three SW problems, those of generation, proper handling and disposal of which, potential pollution by solid wastes is by imagines what would accumulate. If collection systems were not operating in many Cities today this is the handling problem due to industrialization and urbanization (Berry, 1997) one can think from this saying that in the case of Addis Ababa, there will be an obvious problem due to uncollected SW in city (about 35-40percent). Managing population growth, resource use and waste is essential in ensuring that the total impact of these factors with in the bounds of sustainability.

Population size, distribution, industrialization and fast growing of urbanization have an impact on solid waste reservations and proper handling. Besides, their interest in waste reduction and minimization, the degree to which they separate wastes and the extent to which they refrain dumping and littering are influenced by their income, household size, educational level, environmental condition and attitude of h community.

2.7.1. Income and solid waste handling

Income is the major factor, which determines the magnitude of solid waste management at large and solid waste handling in particular. The level of economic development is an important determinant of the volume and composition of wastes generated by residential and at the same time the effective demand for waste management service. The willingness and ability to pay for a particular level of service is also influenced by income level of the residents of the country (Sunni Kumar, 2005).

According to Medina (2004), there is a positive relationship between community's income and the amount of solid waste generated and capacity to remove. This is also true in the case of Addis Ababa. Those who consumed more disposed the waste by paying a higher amount of birr than low in come communities.

Economic development plays a key role in solid waste management. Obviously an enhanced economy enable the community to allocate more for the removal of solid waste, provide a more sustainable financial base. However, developing countries have weak economic base and, hence, insufficient fund for sustainable development of solid waste management (Hisashi Orawa, 2002).

The poorer areas in Africa are the least likely to have any way to safely dispose of their household trash and garbage. In kampala Uganda, for example, less than 20percent of the population benefit from regular collection of household waste and less than 20percent of the SW generated within the city are collected, (ENDA 2002). ENDA further stated that, though collection is performed by micro enterprise collectors the communities do not have any capacity to pay. As the result, organic wastes filled public spaces, backyards lanes, path ways and vacant lots. Therefore, income size of the household is directly affect and influence the proper handling of municipal solid waste.

2.7.2. Educational level and solid waste handling

People's attitude influences not only the characteristics of waste generation, but also the effective demand for waste collection service. According to UNDP (1996) people's attitude towards waste may positively affect their interest and willingness to pay for collection service. In addition, through awareness campaigns and educational measures attitude may be positively influenced and in turn it can change the negative impact of inadequate waste handling with regard to public health and environmental conditions. Such educational campaign also informs people of their responsibility as waste generators and of their right as citizens to waste management services.

Therefore awareness campaigns should be coordinated with improvements in waste collection, reuse, recycle, composting and other integrated approaches. Whether adopted handling systems are similar or not, people's waste handling patterns are influenced by their neighbors, so a collective logic should be involved, because improved waste handling practices will only yield significant environmental impacts if most households in an area participate in the improvement. Thus, besides general awareness campaigns, improved local WM depends up on

the availability of practical option for waste handling and a consensus among neighbors (Kumuyi, 1999 and Berry, 1997).

Solid waste handling by the community is a function of people's attitude and thus the reflection by their socio economic characteristics (UNDP, 1999). The attitudes of the society towards SW and their patterns of material use and solid waste handling, interest in solid waste reduction and minimization degree to which they separate solid wastes and the extent to which they refrain from indiscriminate dumping and littering (SKAT, 2005).

Therefore, attitude towards solid waste may be positively influenced by public information and awareness measures. At the same time improved waste handling patterns can't be maintained in the absence of knowledge. However, even practical knowledge is maintained, some individuals either due to negligence or dissatisfaction of the existing service delivery system in a city may take opposite action towards SW handling. As a result their action may have a negative impact on storage, collection and transportation of SW.

2.7.3. Environmental condition and solid waste handling

Environmental condition, size and structure of the settlement have an important influence on the character and urgency of waste handling needs. Sunil (2005) points out that at the level of natural system the interaction between waste handling procedures and public health conditions is influenced by climatic condition and characteristics of local natural and ecological systems. The degree to which uncontrolled waste dumpsites become breeding ground for insects, rodents and other disease vectors and a gathering place for poisonous reptiles-depends largely on prevailing climatic and natural conditions. In practical terms climate determines the frequency with which waste collection and storage points must be serviced in order to limit negative environmental consequences.

A study that took in India showed that (2002) in quite low density, semi-urban settlements for example, some form of local or even on site solution to the management of organic solid wastes may be more appropriate than centralized collection and disposal. In urban areas, the physical characteristics of a settlement which includes factors such as density, width and condition of roads, topography and others need to be considered when selecting and designing

waste collection measures and allocating equipments such as containers and vehicles (DBA, 2007).

Many sources of waste might only be reached by roads on narrow streets which may be in accessible to certain method of transport because of their width, slope, and congestion of surface. This is especially critical in unplanned settlements such as slum or low income area and thus largely affects the selection of equipment like CWB location. In the case of Addis Ababa, since the city was established for the purpose of garrison the settlement made after establishment were unplanned and became highly congested through process. The settlement also did not consider slope places and land use classifications which ultimately cause serious obstacle to infrastructure accessibility particularly for solid waste management.

2.7.4. Household size and solid waste handling

The other variable that influences process of solid waste handling, which is assessed in this literature, is family size of the households. There was evidence that the handling of wastes depends up on the type and nature of the waste. For example wastes of durable and non durable or compostable and non- compostable wastes do not stay equal length of time.

Further more the nature of households and its size determine these classification of waste category, for example multiple households may have a better opportunity to use durable or no compost able goods in common that of single households. Thus, use of common non material goods and families may result a reduction in SW production and handling (Ryde, 2005).

To conclude, in this literature review it is assessed that SW generated in developing countries differs from that of developed countries, in respect to amount, composition, moisture content and density. As a result its handling approaches varied according to and nature and characteristics of the waste; moreover, influencing factors of solid waste handling such as income, household size, educational level, and distance of CWB from house have a significant negative or positive impact on solid waste handling.

CHAPTER THREE

3. Research Methodology

3.1 Preamble

Research method is an enabling instrument that helps a researcher to investigate research problems and seek the solutions. It is a set of tools developed to generate the answers to the objectives of the study and to test hypothesis posed earlier. It is the procedure for collecting, analyzing and interpreting data. Above all it is a means for the realization of the objectives of the given study at hand (Tripath, 2002 and Johanston, 2001).

Therefore, this chapter presents a systematic account of the research method employed to generate the answer to the research questions and hypothesis formulated earlier. The method used in this research is both qualitative and quantitative methods as a tool of analysis. The chapter therefore explains the type of sample design, sample size determination, the data collection methods and the type of analysis.

3.2 Sample Design

An appropriate research design is important to any research as it will guide the process for collecting the desired data. The main function of research design is to enable the researcher to anticipate what the appropriate research decision should be so as to maximize the validity of the eventual result (Mouton, 19996). Research sample design is also critical issue to the validity of the data until final completion. Therefore, to make it the sampling design effective percentage probability proportionate to size of the house hold was used.

The theoretical population is the dwellers of Arada sub-city. In the sub-city there are 10 newly formed Kebeles. The ten kebeles in total had a population of 330,344. The total household size of the sub-city is 33,031 (Arada Sub-city Information Bureau, 2006) and each kebeles household size is displayed in table 1 (Addis Ababa city administration, 2003). For each Kebele, to get the representative results the number of household size was determined by a proportion of total household size (See Table 3.1) and their number of sample units was identified by house number. The pattern of selection of sampled household of each kebele was

based on systematic random sampling. The sampling frame was based on listing the whole house numbers in the ten kebeles. The sampling frame was taken from each kebele and selected the sampling households with an interval of 78-82.

Table 3.1:- Population, total HH and size of sampled HH in Arada Sub-city, 2007

Old Kebele	New Kebele	House-hold size	PPPS to Keble household size	Size of sampled HHs selected from each kebel	Size of sampled HHs actually studied
01/02	1	3829	11.6	50	45
03/09	2	3930	11.9	50	41
04/05	3	3556	10.7	45	43
06	4	2110	6.4	27	27
07/08	5	4109	12.4	52	50
10	6	2248	6.8	29	29
11/12	7	2677	8.1	34	34
13/14	8	4240	12.8	54	51
15/16	9	3739	11.5	48	45
17	10	2593	7.8	33	33
Total		33031	100.00	422	398

Source: Computed from Addis Ababa city Administration kebele and sub-city establishment proclamation, January 24, 2003

Then for each Kebele, the first sample households were selected based on simple random and the remaining dwelling house were chosen at an interval of N/n. This was done until the required samples from each Kebele were achieved. Thus the minimum of 27 and a maximum of 51 households were chosen from each Kebele. The numbers of households actually reached and studied from each Kebele are presented in table 3.1.

To select the participating households, the number of households was first established with house number and if the house number has more than one household each house holds were given a unique number starting from one and the participating households were selected using a lottery method other wise the housing unit itself was taken as a participating house hold.

3.3. Sample Size determination

Determining the desirable sample size was based on the following formula and assumptions.

The sample size determining formula was

$$n = \frac{P(1-p)Z^2}{e^2}$$ (Bulman, 1992)

n= sample size (population)

p= Proportion of either properly or improperly waste handling population, since there is no information about the proportion of population who either properly or improperly waste handling research works in the previous studies at the study area the value of P was taken as 50 percent. Then P=0.5

z= The standard normal value corresponding to 95 percent confidence interval

e= The maximum occurrence of sampling error. Five percent allowance for random error in estimation was taken and also ten percent contingency was added.

1. in the absence of reliable date on population under this study to obtain the maximum sample size p was assumed to be 50percent or 0.5
2. margin of error is 5percent or 0.05
3. A confidence interval of 95percent was assumed, z= 1.96.

Thus the sample size was

$$n = \frac{0.5(1-05)\,(1.96)^2}{(0.05)^2.}$$

$$= \frac{0.5(0.5)\,(1.96)^2}{(0.05)^2}$$

= 384 + 10percent contingency

When a contingency of 10 percent for non response i.e. 38 is added to the above computed result the total sample size was 422 sample households were chosen for the study .However, 398 were responded. Thus, from the existing kebeles in the sub-city, based on the percentage

of probability proportionate to size, a minimum of 26 and a maximum of 52 households from each kebele were chosen as a unit for the study. The result are presented in table one

3.4 Methods of Data Collection

The means of data collection for this research were both primary and secondary source of data. The primary sources of data, the main source of the study, were collected through questionnaire, interviews and field/personal observation to achieve the objective of the study. While secondary source of data were the reading and interpretation of various related materials.

A questionnaire (see Appendix 1) was prepared to assess the socio-economic and demographic variables in the study area. The questionnaire had four parts. The first part of the questionnaire consists of background questions, which was forwarded to the heads of the household and the second part was designed to collect data focused on characteristics of the household wastes as well as about ways of waste handling in the third part. The final part was concerning of CWB and institutions.

To make the data collection process attain maximum precision, the questionnaire was translated in to Amharic language. Before the questionnaire came into effect, discussions were made among the survey supervisors and corrections had been taken. Training of a day was given to enumerators as to how they should fill out the questionnaire, what sort of approach they needed to have towards sampled households.

Before the actual survey was conducted, a pre-test was held on 12 randomly selected households. After the pre-test some corrections were made to the previously prepared questionnaire. To ensure full cooperation the sampling program, the rationale behind it was well explained to the heads of the households. In the study a total of 18 interviewers (Nine males and nine females) and 2 supervisors were involved. The researcher under took in depth interview with official and experts of different SWM experts. The survey group, which was

assigned to one Kebele, had two best-trained and qualified enumerators[1], who were assigned to perform actively and filled out the questionnaires.

Interviews has for long been applied as a technique in social science research to uncover social problems and every day life experiences of individuals. Communities or societies Kevale (1996) also points out that a research interview is on whose purpose is to obtain a description of the life world of the interview with respect to interpreting the meaning of the described phenomena. Interviews were conducted using topic prepared to guide the specific questions during the interview. And it was intended to obtain information about institutional involvement on solid waste handling and the relationship between the community and institutions on how to handle wastes.

At the time of data collection the principal researcher checked all the collected data and investigates some of the questions which need special attention. These were type of waste, segregation habit, type of storage material, composting habit and their method of disposal. In addition those who replied that they paid to waste collectors were checked with waste collector associations like Birhan Sanitation and Gardening, Fikat Waste collectors Association and other two waste collector associations.

3.5 Methods and Level of Analysis

The level of analysis that the researcher had chosen was at household level. After conducting the survey, the completed questionnaires were returned to the principal researcher. Then, the data was edited, coded, entered in to the computer and analyzed using version thirteen SPSS soft wares. Uni-variate, bi-variate and multi-variant analysis of data were used. In the uni-variate analysis the frequency distribution of respondents and their background information were analyzed in the form of description. In bivariate analysis cross tabulation of independent variables with dependent were analyzed and chi-square test was employed to identify those independent variables that have association with the dependent variable.

[1]The recruitment criteria for both enumerators and supervisors were academic qualification. Grade 12 and above of interviewer and BA degree for supervisors, previous survey work experience was also considered.

Further more, logistic regression analysis was used to identify the predictor variables among those that have an association with the dependent variable in the chi-square. This was because of logistic regression can be used to predict a dependent variable on the basis of continuous and/or categorical independent and to determine the percent of variance in the dependent variable explained by the independents. Furthermore logistic regression helps to rank the relative importance of independents, to assess interaction effect, and to understand the impact of interval independent control variables (Agresti, Alan 1996).

3.6 Ethical Consideration:

Ethical issues were considered in this study. A formal letter was obtained from PSRC, Addis Ababa University and communication with the heads of the Sanitation and Beautification agency in the study area were made with this letter. Besides, this letter was also given to kebele officials to got house number for the purpose of sampling frame designing. Thus, permission had been obtained from them before data collection from the respondents. After the selection of study subjects objective of the study was clearly explained for the participants to get verbal consent. It was also told to the participants to that the whole process of questionnaire administration was set up greatly with secrecy.

CHAPTER FOUR

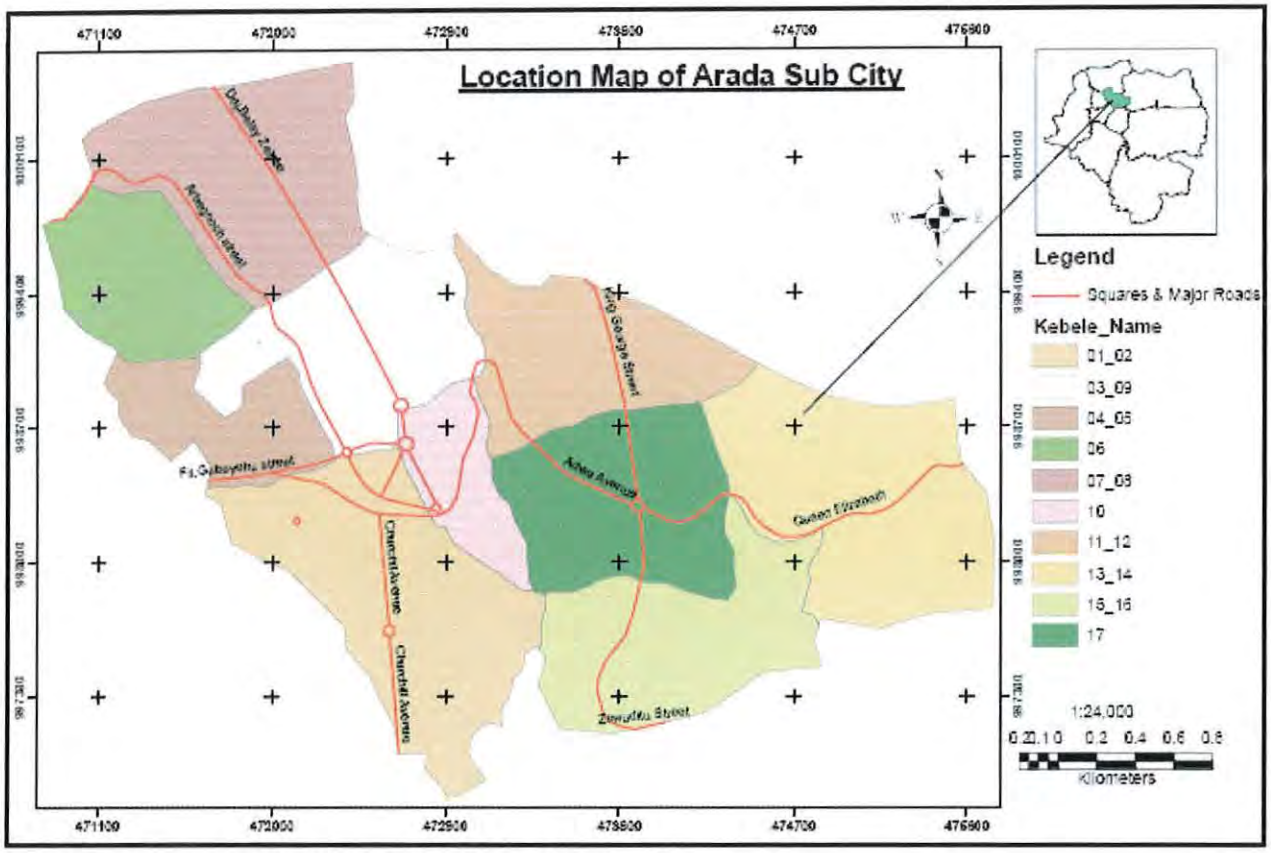
4. BACKGROUND OF THE STUDY AREA

4.1. Physical description of the study area

Addis Ababa, the capital of Ethiopia, is located at the geographical center of the country. Astronomically, it lies between $8^0$55' and $9^0$05' North latitude, and $38^0$40' and $38^0$05' East longitude (AACAIB, 2004). The foundation of the city like most Ethiopia urban centers was related to garrison. Owing to their legacy, the topography of the city has its own constraints on the development of physical infrastructure. Currently the city is a diplomatic capital for Africa (AU, ECA, UN) and seat of regional head quarters for various international organizations like UNDP, UNICEF, UNHCR and FAO are a few to be mentioned.

The jurisdiction of the Addis Ababa city administration assumes an area of 540 km^2 of which 18km^2 is accounted by rural areas. The city is also entrenched by several rivers and streams which generally originate from the mountain ranges of Entoto in the north and Wechacha in the North West. Most of the rivers and streams in the city are serving as open waste dump site and sewage systems. (AACG, 2003 and Mesfin, 2006).

Currently the city is divided in to ten sub cities, of which one is Arada sub- city with a total area of 11.56km^2. It is also bordered by Gullele sub- city in the north, kirkos in the south, Addis Ketema in the west and Yeka sub- city in the East (see on the following, map).



Map 1 Geographical location of Arada sub-city

4.2 Background Characteristics of the Study population

This section describes the major socio- economic and demographic characteristics of the households. The variables illustrated subsequently are sex, age, occupation and marital status of the household heads. Educational level attained by the household heads is included as well. Additional socio- economic and demographic characteristics of the households such as household size, annual income of the household are also incorporated.

4.2.1. Socio- economic conditions

A) Population size: - According to the 1994 census the population of Addis Ababa was 2.3 million. The official projected population for the year 2005 was a round 2.9 million. However, most unofficial data claim a figure well over 3 million. The city shows a rapid population growth rate estimated at 3.8 percent per year. This in turn resulting in a rise of approximately 5 percent of urban waste generated (Tadesee, 2004, UN HABITAT, 2000). In the following

section the demographic characteristics of the study population is generalized and presented in the form of table with its description.

I) **Sex**

Table 4.1:- Frequency distribution of Sex of the household head respondents of Arada sub-city, 2007

Sex	Frequency	Percent
Female	190	47.7
Male	208	52.3
Total	398	100.00

Source: Computed from surveyed data (2007)

Table 4.1 showed that sex of the household heads. In general, male headship number is found to be higher than females; nevertheless there is no considerable difference in the number of headship in both sexes. According to table 4.1 male heads account for 52.3 percent of the households and females are found to be 47.7 percent of the sample households. Sex of the household heads has an influence on the process of waste handling in respect to labor division. Most of the time females are engaged in the process of residential waste collection and disposal.

II) Age

Table 4.2:- Frequency distribution of Age of household heads respondents of Arada sub-city, 2007

Age	Frequency	Percent
30 and below	26	6.5
31-40	82	20.6
41-50	114	28.6
51-60	99	24.9
61 and above	77	19.4
Total	398	100.00

Source: Computed from surveyed data (2007)

The age distribution of the household head is important for determining his/her ability to participate in the process of solid waste handling. Table 4.2 revealed the current age distribution of household heads. It is indicated (Table 4.2) that most of the household heads are found in the working age group. There household heads that are found in old age group

make for 19.4 percent of the total respondents. About 24.9 percent of the heads belong to the age group 51-60; there who are aged in between 41-50 make 28.6 percent and 20.6 percent of the household heads are in the age group 31-40. The rest 6.5 percent of the household heads are aged below 30 years. About 44.3 percent of the respondents were in the age group greater than 50 which is highly influenced the process of waste management however; it may be compensated by income amount generated from various sources like house rent, business activity and others.

III) Marital status

Table 4.3:- Frequency distribution of marital status of the respondent households of Arada sub-city, 2007

Marital status	Frequency	Percent
Never married	51	12.8
Currently married	240	60.3
Divorced	38	9.5
Separated	21	5.3
Widowed	48	12.1
Total	398	100.00

Source: Computed from surveyed data (2007)

Family is central to income maintenance, economic status and social adjustment. Therefore, marriage statistics has economic and social implications. Table 4.3 gives the distribution of marital status in the sample household heads. The table should that about 60.3 percent of the household heads were married currently. While the other 12.8 percent were never married or single, 9.5 percent divorced, 5.3 percent separated and 12.1 percent widowed.

IV) Household size

Table 4.8 shows the average household size in the study area. It is used as a measure of crowdness of population and has great implication on health and collection of SWs. A little below half of the population is found to have 4-6 member of the household. The second highest 24.3 percent less than or equal to 3 members and lesser amount 21.4 percent of the

household got 7-9 members. The remaining 7.4 percent of the household have more than 10 members.

Table 4.4 Frequency distribution of family size of respondents household size of Arada sub-city, 2007

HHS	Frequency	Percent
<3	97	24.3
4-6	187	46.9
7-9	85	21.4
>10	39	7.4
Total	398	100.00

Source: Computed from surveyed data (2007).

B) Employment: A rapid population growth is parallel by an increase of the economically active population. The labor force in the city has grown by 6 percent between the 1984 and 1994 censuses. Consequently, un- employment is a very severe problem in the city and has increased at alarming rate in recent years (NPO, 2003 and UN- HABITAT, 2000). Besides, about 61 percent of the employment could be classified as 'informal' (AACG, 2003)

Table 4.5:- Frequency distribution of Employment status of the respondents in Arada sub-city, 2007

Employment status	Frequency	Percent
Self employed	82	20.7
Government employed	107	26.9
Unemployed	89	22.1
Non-government employed	120	30.3
Total	398	100

Source: Computed from surveyed data 2007

Table 4.5 indicated that the type of employment of the sample households of the study area. The table revealed that about 20.7 percent of the households were self employed, 30.3 percent of the respondents were NGOs employers while government employers account only 26.9 percent. The remaining 22.1 percent are unemployed. Though amount of income is not determined by the type of employment those who pay for collection and disposal are expected

to be high income earning employers. Therefore, type of employment and income level are interrelated which ultimately associated to solid waste handling.

C) Amount of income: - The other socio-economic factor that lead to the increasing volume of solid waste, as well as increasing problem of SW handling. From the socio- economic conditions, amount of annual income of the household has an impact on solid waste management.

In Addis Ababa city more than 50 % of the population falls under low-income groups earning less than 300 Birr per month per head. The socio - economic condition of Addis Ababa city has been described in many literatures. The 1980 Addis Ababa household social survey stated that low (57 %), middle (35 %) and high (8 %) income of the population earns less than 100, 100-400 and more than 400 Birr /month respectively. The 1993 Addis Ababa waste water master plan study claimed that the low income, middle income and high income was 91.5 %: 5.6 %and 2.9 % respectively as a function of housing density. This income group classification has been used for World Bank consultant study results for 1994 and 1995 evaluation of generation rate. But the 1997 region 14 administration claims that the low (60 %), middle (25 %) and high (15 %) income groups earns less than 300, 300-600, and plus 600 Birr per month, respectively. Socio-economic changes, consumption patterns, waste prevention and demographic dynamics are the main factors that affect the domestic solid waste generation, composition and handling which in turn affects the waste management.

Other study which took place by ENDA (1999) indicated that in Addis Ababa about 60 percent of income of the household is below the poverty line. In the case of Arada sub-city, out of 197 sample households, 47.2 percent of the respondents live under poverty line. The incidence of poverty showed that in 1997, and 49.5 percent of the population was below the food poverty line. Moreover, about 51.4 percent of the population falls below absolute poverty line. Similarly, poverty has declined slightly from 1995 but the absolute number of people fall below the poverty line increased during the period between 1995 and 1997 (AACG, 2003: UN-HABITAT, 2002).

Table 4.6:- Frequency distribution of Annual income of the respondents of Arada sub-city, 2007.

Annual income	Frequency	Percent
Less than 4500	84	21.3
4501 up to 9000	216	17.3
9001 and above	98	45.6
Total	398	100.00

Source: Computed from surveyed data (2007).

Table 4.3 indicates the annual in come of the households in the study area. As this table points out, 22.1 percent of the households earned less than 2000 birr annually, 17.1 percent of the households earned between 2000 to 4199 birr, about 16.2 percent annually earned the highest of all n come category which was birr 9000 and above and the majority about 44.6 earned between 4200 up to 8999 annually.

D) Education: - The majority of the households in Addis Ababa have low educational background. According to UNDP study 28 percent of the households are grade 12 and below of which 35.1 percent is below grade six. This low educational background of the households influences their full participation and handling of SWs. Therefore, to upgrade their understanding about problems caused by wastes continuous and organized training and awareness campaigns are needed. This problem is also occurred in the study area. Table 4.5 shows the highest grade completed by the sample household heads. It revealed that those household heads that never crossed formal education system makes for about 23.8 percent. About 34.8 percent of the household heads completed their primary school education, while about 25.7 percent of the household head completed secondary school education. A relatively smaller proportion of the household heads followed and completed grade 12. The remaining 8.8 percent of the respondents are one year and above college graduates (see table 4.6).

Table 4.7:- Frequency distribution of Educational level of the household respondents in Arada sub-city, 2007.

Highest grade completed	Frequency	Percent
No formal education	95	23.8
Primary school (1-6)	139	34.8
Secondary school (7-10)	102	25.7
Vocational school (11-12)	27	6.9
College graduate	35	8.8
Total	398	100.00

Source; Computed from surveyed data (2007)

CHAPTER FIVE

5. RESULTS AND DISCUSSIONS

5.1. Assessment of waste handling and storage at source

On the basis of information gathered from surveyed households in Arada sub-city, the result of solid waste handling patterns is presented as follows. This chapter of the paper will try to show how the socio-economic, demographic and physical factors affect solid waste handling. It also used appropriate statistical tests like bi-variate and multivariate analysis; in the bi-variate analysis chi-square test is used as an indicator of the association between the dependent and independent variables. In the multivariate analysis logistic regression is used to show the net effect of each predicting independent variables on the dependent variable.

The study further assessed useful elements associated with waste management, mainly; onsite handling and storage. In the study sub-city collection, transportation and disposal of solid wastes have been carried out by both private and governmental organizations. In the sub-city, (According to Ato Dawit[2])" *there are about 40 micro and small enterprises engaged in primary collection or pre-collection from households and to some commercial organizations to community containers* ".

In the context of SWM, municipal wastes can be divided in to two groups: namely the domestic or residential waste and the non- residential wastes. The domestic wastes are mainly made up of food preparation, gardening, sweeping cleaning and fuel burning while the non residential wastes are generated from institutions, commercial centers, construction debris and street sweepings.

As noted in chapter two, most residential wastes of developing countries are organic in nature and made from food preparation. The data which was collected from households of Arada sub-city indicated that, organic wastes accounted for 64.9 percent. About 23.7 percent of residential wastes were made from inert materials in the form of ash. The remaining wastes were plastics, papers, metals and glasses which accounted for 11.4 percent. For further description see table 5.1.

[2] Team leader in the sanitation and beautification agency of the sub-city

Table 5.1:- Waste type and composition of sampled households in Arada sub-city, 2007

Type of waste	N	Percent of total
Organic Food wastes	249	64.9
Ashes	94	23.7
Plastic and papers	57	10.6
Metals and glasses	3	.8
Total	398	100.00

Source: Computed from surveyed data, 2007

As noted in table 5.1 the major component of waste originated from household were food wastes including 'Chat'. Table 4.4 also revealed that most respondents are categorized under low income group, hence they do not have the capacity to use semi finished or finished industrial products. Therefore, the only option is passing through food and agricultural products which are too much roughage and ultimately generate so much amount of refusal as a waste having high moisture content.

The other food waste organic matter is 'Chat' which is increasingly used by most the population of the city. It is consumed as a means of recreation by many young people and serves as a stimulant. As a result the increasing number of people using 'Chat' and its disposal in ditches, open spaces and drainage systems which block the drainage systems and leads to the damage of the environment and harm to the health of the population.

Ash is the other major components of waste originated from households. Electricity has never been an important source of energy for the larger proportion of households. The study conducted by Beyene (1999) indicated that fire wood, charcoal, dung cake and other traditional byproducts are the major source of energy for domestic use. For instance the 1994 census result indicates that the domestic energy requirement of about 47 percent of housing unit of the city is meet from firewood and leaves, charcoal, cow dung and manure and combination of all these and kerosene. Therefore the amount of ash and smoke generated through the combustion of these materials is immense. Dissemination and popularization of energy saving appropriate technology product may have tremendous role in reducing the amount of energy sources used and waste generated.

And finally industrial waste like plastics, glasses, metals and papers are insignificant, which accounted for only 11.4 percent of the total volume of waste generated in the sub-city. Although, there is proportionally low, emphasis should be given to proper disposal, because they have serious negative consequence on environmental and economic value.

As Sturdy (1995) indicated that low income households happen to depend more on organic common goods such as frequent consumption of fresh fruits and vegetables as well as other unpacked foods. Since the moisture of these consumable goods is high as compared to canned foods, it resulted denser SW. On the contrary, the effect of consumption of inorganic material by higher income households results in less dense SW production. This was because households having more income used more packaged products which contain large size of inorganic materials.

Therefore, to determine the type and way of waste handling; waste prevention, recycling, reuse, composting and incineration, knowing the composition and characteristic of waste is essential. Fore example, according to Medina (2004) and Cointreau (1993), if wastes have high proportion of organic matter, the possibility of composting and biogas regeneration as a means of handling wastes is better mechanism than incineration, reuse and recycling. Moreover, using incineration as a means of waste disposal has been mostly negative experience due to, when they accomplished, fuel had to be added to maintain combustion, which increased costs significantly.

Besides, relative to other waste management options incineration do not play significant role in waste handling system, because it has limited infrastructure of mechanical and institutional resource, high content of inert in the waste stream suggest that it is an in appropriate system in Africa (ADB, 2002).

Therefore, using the waste in a sustainable manner is advisable. To make it sustainable an integrated way of waste management system should be practiced in the process of storage, separation, reuse and recycling of wastes. In the study area waste is mostly stored in temporary containers such as plastic bags, sacks and local baskets or any container considered appropriate for such purpose. However, the uses of plastic bag gain popularity than other waste storage materials.

The types of waste storage used by the households have great impact on waste handling. According to Samuel (2006), those persons that use plastic bucket as a waste storage minimizes solid waste generation by increasing service duration of the storage. While those who use non-durable storage like plastic bag will not get long service from the storage, rather they pay costs for the disposal of the storage as a waste.

Table 5.2:- Types of waste storage in the sample households of Arada sub-city, 2007.

Type of waste storage material	Number	Percent
Local basket	46	11.7
Plastic bag	220	55.5
'Jonya' (sacks)	55	13.8
Plastic bucket	24	5.9
None	53	13.1
Total	398	100.00

Source: Computed from surveyed data, 2007

Table 5.2 revealed that about 69.3 percent of the respondents used non-durable waste storage. while, around 17.6 percent of the respondent used durable waste storage. From 69.3 percent non durable storage users about 55.5 percent of the respondents used plastic bag. The remaining 13.1 percent of the respondents had non any type of waste storage material.

Since waste storage and segregation determine the feasibility of recycling and composting in an economically and environmentally sustainable way, it plays a vital role in waste management system. It also significantly influences the quality of the recovered materials, and in turn the quality of the recycled products and their market value.

Collection is the contact point between waste generators and the waste management system, this crossing point requires careful management. According to Read (2003) the households waste collector interface is like a customer supplier relation ship where the householder's solid waste must be collected with a minimum of inconvenience and the collection must also be give the waste in a form well sited with intended treatment methods.

However, most respondents in the sub-city did not segregation wastes to be convenient for various methods of treatments. According to the data collected from the field and summarized

in table 5.3, about 97.3 percent of the respondents said that segregation of wastes did not practiced. Segregation is unusual due to lack of awareness about reuse and recycling. Moreover there is cultural bias about waste handling which is considering wastes as a useless out put. The high proportion of food wastes by weight in solid wastes may also affect the effort of segregation in general and recycling in particular. According to Pavoni (1975) the heterogonous nature of solid waste is the major factor in the fall of recycling effort aimed at recovering valuable material from solid waste refuse.

Besides, lack of segregation habit further leads to an expenditure of labor and money involved in separating desirable material from the remainder of the waste stream, such as transportation costs for recycled materials, general lack of acceptance of the recycled material and the consequent lack of market (Samuel, 2006, Yetayal, 2005 and Pavoni, 1975). This is the main reason for the effort failurity of recycling and reuse which is caused by lack of awareness and poor separation habit of the households.

As stated above in table 5.1 most waste type of the sub-city classified under organic wasted generated from kitchen food waste. Considering the high proportion of organic matter in the waste generated composting can be an option to reduce the amount of wastes that are land filled. In addition it does not generate odors, and attract flies or other animals. However, in the sub- city only 4.3 percent of the respondents (Table 5.4) are used home compost from their domestic solid waste. This may be due to lack of space to composting. It is clear that Arada sub-city is one of the oldest and densely populated sub-cities in Addis Ababa, hence thinking free spaces for composting is considered as a worthless chore. The second reason is lack of knowhow about the preparation of compost.

In spite of its relative simplicity and suitability for developing countries (like Ethiopia in general and a densely populated economically poor and physically undulated topography) economic and environmental benefit of composting should not be enclosed by lack of awareness. However, in need of trained personnel in controlling daily operation, results in low quality end product. Therefore, encouraging private entrepreneurs in composting of agricultural wastes to fertilizers, encourage involving in recycling is essential.

According to UNDP (1996) composting is the most promising area for the recovery of organic materials. Besides reducing the volume of waste which needs to be transferred and disposed, composting generates valuable soil conditioner for agriculture and horticultural use. However, decision to introduce composting must be market oriented and based on careful economic and financial analysis.

Table 5.3:- Frequency distribution of Segregation habit of wastes by respondents in Arada sub-city, 2007.

Do you separate waste	Frequency	Percent
Yes	11	2.7
No	387	97.3
Total	398	100.00

Source: Computed from surveyed data (2007)

Table 5.4:- Frequency distribution respondents that use home Compost in Arada sub-city, 2007.

Do you compost wastes	frequency	Percent
Yes	17	4.3
No	381	95.7
Total	398	100.00

Source: Computed from surveyed date (2007).

5.2. Solid waste handling and collection systems

Those households who have no collection service from municipality (due to in accessibility of areas and for different reason) and pre collectors (due to in ability to pay for the service they got from the pre-collectors[3]) take burning and informal waste collectors[4] as their best waste disposal options. The majority of the respondents did not use municipal community waste bins (CWBs) and pre-collectors rather they used burning, informal collectors and river banks for waste disposal (see Table 5.5). Samuel (2006) and Yitayal (2005) considered those who used burning, informal collectors and river banks as non-proper waste handling users (62.4 percent) and the remaining as proper waste handling users (37.6 percent).

[3] Legal associations performing collection and transferring waste to CWB and vehicles.
[4] Illegal waste pickers from households and dispose especially in river banks and streets.

The researcher also follows the pattern of both researchers as a background to classify the dependent variable for analysis. In the sub-city there is also practice of waste removal by paying either to formal or informal pre-collectors. The households payment ranges from 0.50 birr up to a maximum of 20 birr for pre-collectors based on the quantity of their waste and income status (see table 5.6). Even with this low payment the households that get solid waste collection services from pre-collectors are relatively high and middle income groups.

Table 5.5:- Frequency distribution of way of waste disposal by respondents of Arada sub-city, 2007.

Way of disposal	Frequency	Percent
Pre-Collectors	58	14.5
Informal collectors	106	26.8
Burning	68	17.1
Community waste bins	92	23.1
Others(rivers and streets)	74	18.5
Total	398	100.00

Source: Computed from surveyed data (2007)

Table 5.6:- Frequency distribution of Payment of respondent households to collectors per month in Arada sub-city, 2007.

Payment for household collectors	Frequency	Percent
< 1 Birr	6	3.6
1 Birr	9	5.3
2 Birr	17	10.4
3 Birr	13	7.8
4 Birr	8	4.6
5 Birr	54	32.6
>5 Birr	59	35.7
Total	166	100.0

Source: Computed from surveyed data (2007)

Effective SWM depends up on an appropriate distribution of responsibilities and authorities to institutions (UNDP, 1996). The different ways of solid waste handling explained before came to implementation, if there is an active involvement of the sub- city sanitation and beautification unit. Thus, the strength of the institution in terms of logistics, finance and community based involvement is essential so as to be efficient in the career.

According to Ato Dawit," *logistically the sub-city had 40 community waste bins and 9 trucks. Among the 9 trucks only 4 of them give service to the community the rest found to be idled due to long years of service and lack of spare parts*". As noted in chapter 4, the total estimated number of population in the sub-city is around 330,334 and when it is compared to the current waste handling service it is almost immaterial. In addition, the location of CWBs is not in the appropriate site, which reduces the service given to the community. According to him *this was due to absence of suitable road, severe financial constraint and lack of free space to CWBs.*

SWM is also influenced according to the social status of the community, this is due to pattern of waste generation and handling of the households, and other users' community based waste management and social condition of waste workers are conditioned by the attitude and culture of the society. Medina (2004) and UNDP (1996) also indicated that in many low income residential areas, community based SWM is the only feasible solution. Therefore, functional links between the community and the municipality is essential. However, even where waste collection services are provided efficient participation of the community is low. This was mainly due to lack of promotion through general awareness building programs as well as focused SWM information campaign.

Table5.7:- Frequency distribution of the respondents on the Participation of the sub city in SWM practices in Arada sub-city, 2007.

Is there participation of the sub-city in your locality	frequency	Percent
Yes	93	23.4
No	305	76.6
Total	398	100.00

Source: Computed from surveyed data Arada Sub- city (2007).

Table 5.8:- Frequency distribution of respondents on Awareness about laws of WM in Arada sub-city, 2007.

Do you know laws about WM	frequency	Percent
Yes	59	14.9
No	339	85.1
Total	398	100.00

Source: Computed from surveyed data Arada Sub- city (2007).

The study also revealed that about 76.6 percent (Table 5.7) of the respondents said that the involvement of the municipality is very low and they are not satisfied with the current waste management system of the sub-city. The respondents also confirmed that except a few annual anniversary days no community mobilization and awareness creation activities done by the concerned body. Even they did not have information about laws drafted by EPA concerning SWM. To assess the responsiveness of the respondent's questions were asked about laws drafted by EPA accordingly their reaction were not good.

Table 5.9: Waste management collection and disposal regulations of Addis Ababa city government.

No	Type of offences	Article of the regulation	Amount of penalty
1	Littering or mismanagement of wastes by house holds	Article 3(1)	Birr 10.00
2	Not keeping the household or organization areas 20m in front of it and away	Article 3(6)	Birr 5.00
3	Fixing or anchoring advertisement papers in an unauthorized places	Article 4(1)(d)	Birr 100.00
4	Dump waste outside the dumpsters	Article 7(3)	Birr 10.00
5	Dumping solid wastes in an unauthorized places from households	Article 4 (1)(a)	Birr 30.00

Source: Addis Negari Gazeta,

The city government of Addis Ababa drafted a law about waste management collection and disposal. Some of the rule and regulations are shown in Table 5.9. According to this regulation littering or mismanagement of wastes, dumping the waste outside the dumpster and dumping

solid wastes in an unauthorized places from households is illegal and in turn results with penalty of 10 birr for each offences except that the act of article 4(1)(a). However, the majority of respondents confirmed that they were not familiar with the law. Table 5.8 revealed that awareness of the respondents concerning the law. Based on table (5.8) about 85.1 percent of the sample replied than they did not know about the presence of the law. While the remain 14.9 percent have had know-how about the law drafted by the city government; at the same time among 14.9 percent respondents that know about the presence of the law, about 9.2 percent which is 37 persons knew only article 3(6) which says:

> *"Any person shall have the responsibility to keep the area clean covering up to 20m in front of and away from the end of his household on which he has possession."*

Therefore, there is a wide information gap between the society and sanitation and beautification agency of the sub–city concerning awareness creation activities especially about the law. This is also reflected on mobilization of the society (community) to participate in surrounding sanitation process.

The introduction of community based solutions calls for an awareness creation measures as well as organizational and technical support. More over to local NGOs and community leaders may provide essential input towards community based collection systems which should be carefully linked to the municipal system (Medina 2004 and UNDP1996).

Households and CBOs have important roles to play, not only a consumers or users of waste collection services but also as provider and manager of local level service. In many low income residential areas, community based solid waste management is the only feasible and affordable solution. If we saw sanitation days of Addis Ababa every body participate in the practice. This is mainly due to all group of the society woman and men, girls and boys are involved in different waste related activities, partly because of cultural traditions and conventions, partly because of the wish to gain recognition as a worthy community member, because of practical interest such as earning income and maintaining a healthy living environment.

Effective SWM depends upon an appropriate organizational structure of the institutions responsibility for MSWM, including the coordination between MSWM and other sectors like CBOs. The city governments of Addis Ababa also confirmed by drafting the law in 2004 and give the responsibility to the sub-city. The law stated as:

> *"The sub- city shall direct, coordinate and encourage community based organization to volunteering carry out sanitation campaigns "(Addis Negarit Gazeta, 2004, article 24(4) (a)).*

According to Ato Tesfaye[5] and Ato Dawit," *mobilization and coordination of CBOs is the responsibility of the subordinate section of the agency that is kebele Sanitation and Beautification Office*". At the kebele level an office which emphasize on sanitation and beautification was existed but it has no any community mobilization unit in it. This may be one of the main reasons for the poor quality of WM in the sub-city and was institutions irresponsiveness to community based organization like Idir. Therefore, to implement an integrated SWM approach in the sub-city and Addis Ababa as whole, concerned bodies should be accountable and coordinated to the community.

5.3 Observation

Field observation is also one of the data collection methods which are part of gathering the primary data. It is a method implying a face-to-face interaction and understanding of what is happening socially, politically, environmentally, economically and culturally among the people on the spot. Observation lets the researcher know what the people actually do rather than what they say may do (Kitchen and Tate 2000). With personal observation the main task of the researcher is to observe and document the behaviours and interaction patterns as they occur in their natural setting.

From field observation, it has been seen that in Arada sub-city there are so many sanitation problems of which both solid and liquid waste are the most problematic. In riverbanks and market areas it is common to see piles of rotting vegetables and other organic wastes including dead animals, and persons are observed at the plies rotting wastes one scavenging and the other using for sanitation. While in recreation and street areas littered plastics, papers and

[5] Head of the research center in the sanitation, Beautification and Parking Development Agency.

dumped solid wastes, which filled in plastics bags, are common. The community misuses drainage ditches/channels. They serve as solid waste disposal waste sites. In some places it is common to observe accumulated solid wastes inside the ditches and as a result the liquid waste does not move through the ditches/channels. Rather, it is motionless. More over, all types of solid wastes including dead domestic animals dumped in rivers.

Plate 1: Solid wastes including dead domestic animals dumped in Riverbanks (in the study area, at Ginfile locality and around Nigerian Embassy.)

5.4 Factors that affect solid waste handling

Beside, the description of various approaches and ways of waste handlings, the relationship between waste handling and a set of independent variables were analyzed using bi- variate and multivariate statistical techniques. The results are also shown in table 5.9 and 5.10; in the bivariate analysis, chi–square test was used to show weather there is an association between the dependent variable solid waste handling and independent variables like annual income, educational levels, household size, awareness and distance of CWB from house. In the

multivariate analysis logistic regression was used to show the net effect of each independent variable on dependent variable.

Logistic regression is used to predict a dependent variable on the basis of continues and/or categorical independents and to determine the percentage of variance in the dependant variable explained by the independents; to rank the relative importance of the independents, to assess interaction effects and to understand the impact of independent variables. To run the means of analysis software which is known as Statistical Package for Social Scientist was applied. The software was chosen by its nature of convenience to compute uni-variate, bivarite and multivariate statistical techniques

Table 5.10:- Percentage distribution and measure of association of solid wastes handling by selected socio-economic, demographic and physical variables.

Variable	Solid wastes handling.				Sign. at 95% of CI
	Proper handling		Improper handling		
	No	percent	No	percent	
Educational level					
Illiterate	35	29.9	82	70.1	
Primary	68	37.4	114	62.6	0.029*
Secondary and above	47	47.7	52	52.5	
Total	150		248		
Annual income					
<4500	27	32.1	57	67.9	0.048*
4501--8000	76	35.2	140	64.8	
>=8001	47	48.0	51	52.0	
Total	150		248		
Distance of CWB					
<1Km	80	52.3	73	47.7	0.000**
≥1Km	70	28.6	175	71.4	
Household size					
≤6	107	37.9	175	62.1	
≥7	43	37.1	73	62.9	0.910
* Significant at 95%of CI **= significant at 99% CI					

Source: Computed from surveyed waste handling.(2007)

5.4.1 Income and solid waste handling

Solid waste handling of households was associated with the annual income in order to measure the relationship between these two variables; and to see its impact on solid waste handling. The result shows (Table 5.10) a significant positive association between income of the households and SW handling (0.048). Thus the P- value was much better than the convenient cut off point of 0.05, so that the relation ship was statistically significant.

The result further implies that the proportion of those respondents, which were, used proper waste handling increases from 32.1 to 48.0 percent from low income to high-income category respectively, while proportion of households that follows improper waste handling practices reduced from 67.9 to 52.0 percent.

The result of logistic regression on the effect of income on solid waste handling also shows that (Table 5.11) there is a significant improvement in the handling of wastes as the income of the household increase. Households having an annual income of between 4501-8000 handle wastes properly with an odds ratio of 69.8 percent better than those of low income groups. Similarly high income groups (>=8001) handle wastes properly with an odds ratio of 94.6 percent better than those of low income groups in waste handling practices. In other words, as the income of households increased the capacity of the households to treat wastes properly also increased. Thus it is possible to say that there is a strong likelihood effect and association with solid waste handling.

The study asserted that as the amount of income of household increase the capacity of proper solid waste handling also increased and vice versa. This was strongly supported by Hisashi (2002) that enhanced economy enables the community to allocate more for solid waste handling, by providing more sustainable financial base. The possible explanation for the positive relationship between income and solid waste handling in the survey area are explained below.

The primary function of consumption pattern and its consequence proper handling are influenced by the socio–economic patterns of the community. In this survey income had a significant effect on proper handling of wastes. When the income levels of households increase the level of consumption of the household also rises. This is may be due to a high

significant variation in per capita income of the groups, and this shows that the average waste generation rate is increasing as per capita increase. This is in agreement with common understanding that waste quantities generated are directly proportional to house hold income level (Diaz, 1993 and Medina, 2004).

There is also variation in the type of waste among the different groups of income. It is expected that plastic and paper would increase with increasing income levels since they can be used for package of variety ready made food stuffs, which are mostly purchased by high income groups. However paper is high in poor and lower income groups and lower in high income groups. This may be due to the poor and lower income groups often use paper for packaging of bread and other food items.

Plastic is increasing with increasing income level as expected. However, the generation of plastic in high income group is the lowest. This may be due to the high income households purchase durable bags or food item containers that use for packing variety of food stuffs from the market or they may purchase their weekly or monthly food budget once; and as a result they minimize their daily plastic waste generation while in the case of low income group their lifestyle is different from those of high income group. This create a variation in the type and composition of wastes This was witnessed during field survey and sample collection, that low income groups (especially women whose lives depend on prostitution) almost always spend their scarce money for high yard wastes (especially grasses) for their coffee ceremony and this has great contribution to their waste generation rate.

As stated above, low income group of the society generated bulky SWs, but small in amount. In the case of high income groups of the society their consumption is much higher than low income groups of the community. Therefore, they handle their generated waste properly and dispose it by using either formal or informal collectors. Low income group of the society generated bulky SWs, but high income groups of the society produce small in amount. Therefore, they handle their generated waste properly and dispose it by using either formal or informal collectors. The reason may be due to high income group of the society have an access to information from Radio, TV, Magazine, Newspaper and others.

However, low income groups of the society dispose wastes either by themselves or by using informal collectors. They used informal collectors due to its amount of payment is lower than formal collectors. It is also observed during field observation and data collection that there were also informal collectors who collect and dispose wastes in the banks of Genfile and Mariam rivers in 50 cents. Therefore they develop their awareness about proper handing of wastes by paying monthly fees for waste collectors. Hence, from the above facts the researcher concluded that there is a positive relationship between income and solid waste handling of the households. For example in Kampala- Uganda less than 20 percent of the population benefit from regular collection of household waste, since the community does not have the capacity to pay to pre- collections (ADB,2002)

Table 5.11:- Logistic regression analysis result of impact of socio- economic and demographic variables on solid waste handling.

Variables	B	Standard error	Significance level	Exp (B)
Educational level				
(Illiterate)				1.00
Primary	0.416	0.253	0.010	1.515
Secondary and above	0.750	0.285	0.008	2.118
Annual income				
(<4500)				1.00
4501-8000	0.529	0.247	0.032	1.698
>=8001	0.666	0.309	0.031	1.946
Location of CWBs				
(< 1km)				1.00
≥ 1km	1.008	0.215	0.000	0.365
Household size				
≤6				
≥7	0.124	0.236	0.600	0.884

( ) = Reference category

Source: Computed from surveyed data (2007)

5.4.2 Educational levels and solid waste handling

Solid waste handling of the sampled households was associated with the level of education of the heads of households. Solid waste handling taken as a dependent variable and level of education of the heads of the household was taken as independent variable and different testes were computed. And the following outcomes were obtained.

One, the bi-variate analysis indicated (Table 5.10) a significant positive association between the two variables at 0.029 Thus, the p-value was much better than the convenient cut off point 0.05 so the relationship was statistically significant. The result of table 5.10 further described that the proportion of these respondents which were used proper solid waste handling increases from 29.9 percent to 47.5 percent. At the same time, the habit of the respondents which accomplished inappropriate handling of wastes decreased as their level of education increase from 70.1 percent to 52.5 percent.

The result of logistic regression also confirmed that educational level of the house hold was found to be a significance predictor on solid waste handling. Based on Table 5.11 primary education completed households handle wastes properly with an odds ratio of 51.5 percent better than illiterates; at the same time secondary and above completed households treat and handle wastes properly 111.8 percent better than the reference category and its variation was also statistically significant. The possible expansion for the existence of association and difference in the prediction of the independent variable on the dependent variable are explained as follows.

Solid waste generation and handling is conditioned by people attitude towards SW, their pattern of material use and SW practices , interests to waste minimization, the degree to which they separates wastes, the extent to which they refrain from careless dumping and littering. These are influenced by public information and awareness creation measures; at the same time education speed up the ability to gather information and develop positive attitude towards SWM.

Awareness of the people towards solid waste handling varied according to their educational levels. In the sub-city of Arada majority of the households have low educational background.

This low educational level of the households affect their handling pattern can hardly be maintained in the absence of practical knowledge about system of handling wastes but no always (Kumuyi, 1999, Mesfin, 2006 Samuel, 2005). Because some educated individuals either due to negligence or dissatisfaction of the service of the office, take pessimist action towards solid waste storage and collection practices.

It is clear that public awareness to waste can affect positively or negatively the whole solid waste management system. Since waste handling is a function of people's attitude and their socio-cultural development, the attitude of the society towards solid waste handling; degree of separation and response to laws are developed through education. Because, the perception and attitude of residents towards SWM are not similar among different educational level, the knowledge and interest of the people to clean and healthy environment changed as their level of education increased.

All steps starting from household waste storage to final disposal depend on public awareness and participation. To develop the awareness of the community on how to manage and properly dispose wastes, continuous awareness creation education is needed. However; institutional arrangement of the city concerning solid waste management (from SBPDA to kebele sanitation and beautification office) is logistically poor, financially insecure and have shortage of skilled personals. Moreover the perception of the sub-city sanitation and beautification agency and knowledge of the respondents regarding the law of SWM was inversely related. As stated in Table 5.8 about 85.1 percent of the respondents do not know about the presence of the law. Even those who knew about the law are familiar due to punishment not by awareness creation system. Therefore, mass based information dissemination is required since it determine the success or failure of SWM system in general and solid waste handling in particular.

To explain the responsibility of institutions in the dissemination of information Zurbrug (2004) and UNDP (1996) pointed out that effective SWM depends upon an appropriate distribution of responsibility, functions and authority among national provincial and local units based on the community interest until household level. In the sub-city there is a loose relationship among the community, kebele and sub-city sanitation and beauty office. In the sub-city according to Samuel (2006) and Yetayal (2005) it is common to see rotting vegetables and other organic

wastes including dead animals along the river banks and market areas. Besides, persons are observed at the piles rotting wastes are scavenging and others using for sanitation.

To sum up, educational level of the household has a significant impact on the process of solid waste handling. Therefore, promote education and increase their awareness on waste prevention, separation at the source, and environmentally sound waste management approaches should be implemented starting from its source.

5.4.3 Distance of CWBs and Solid waste handling.

The other variable which was associated to solid waste handling was distance of CWB from house. Distance was taken as an independent variable and solid waste handling as a dependant variable. According to table 5.10 a significant negative association revealed between distance of CWB and way of solid waste handling (0.000). Thus the P value was much better than the convenient cut off value 0.05. So, that the association between the two variable was statistically significant.

The result further showed that the respondents which were nearer to CWB used the container than those of at distant. Table 5.10 indicates that as the location of CWB started to be far-off from residential area, way of proper handling reduced from 52.3 percent, to 28.6 percent while those respondents who were disposed waste improperly increased by 24.3 percent.

The result of logistic regression also asserted that (table 5.11) there is a significant reduction in the handling of waste as the distance and location of CWB increased. It is also affirmed on table 5.11 that their relationship is negative the likelihood to proper handling of waste was also reduced by 0.362 (64.8 percent) times than the nearest location of CWB. This implies that the community will be forced to use either pre-collectors or other improper ways. Those middle and high income groups may use pre-collectors but the majority (low income group) took the second option. Therefore, distances of CWBs have an impact on solid waste handling.

In principle, community wastes bins should be bunged and put at platforms. Platforms are safe and help not to spoil the surrounding area. Because it encloses the container at the three sides and only one door is left for community access to the bins and for loading and unloading the container (Techobanglous, 1997). However, in the sub- city there were only two sites with

platform namely BisJinad and Eribekentu. Besides its nature of openness, location of CWB does not fulfill factors that govern the selection of CWB site locations like;

- Social factors such as proximity to the community.
- Economic factors such as minimize distance from roads so that the collection vehicles can travel easily; and
- Environmental factors such as eyesores, surface water and atmosphere contamination due to emission of CO2 and methane (CH4).

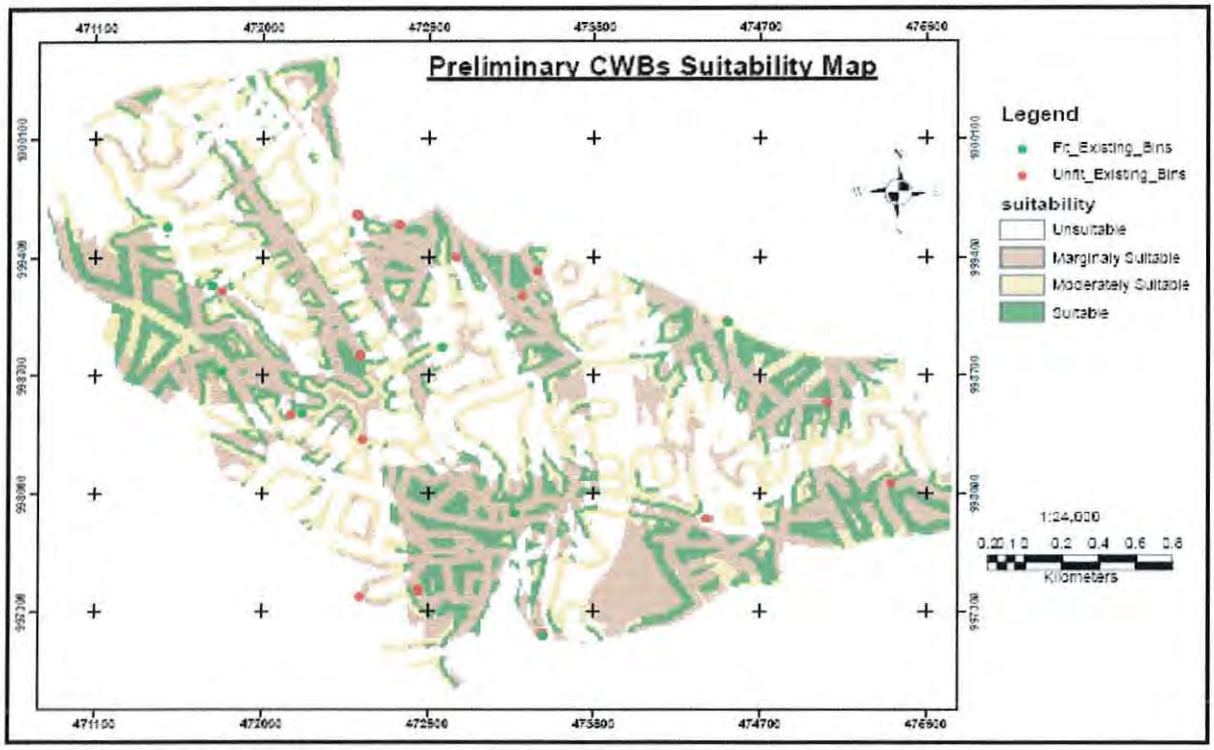
Cointeau(1993) and Tchobanoglous (1977) also stated that these factors are almost similar all over the world with some constraints related to implementation at the local level. Accordingly, there is no specified criterion for solid waste CWB, site selection developed for Addis-Ababa city in particular and the country in general. Therefore, the researcher have collected the criteria below through formal interview with the sub-city's sanitation and beautification, SBPDA research center authorities and AACG Environmental protection authority. Based on these interviews, the location and distance of CWB could be;

- 80m away from squares, major roads and rivers.
- With in a distance of 25-50m from secondary and tertiary roads.
- Where there is much solid waste density.
- Accessible to public.
- Where the average surface slop is not steep and
- Greater than $100m^2$ vacant places.

There are also other factors which should be incorporated with these criteria to make the site selection more unambiguous. According to the interview which took place at EPA and SBPDA expertise for site selection, in addition to the above criteria type of settlement, indigenous knowledge of the community about solid waste management, cultural assimilation of the society and technological innovation and usage of the society should be take in to consideration.

Most countries of the world implement such criteria to select best suitable location of community waste bin to make solid waste handling efficient and sustainable. Moreover, such measures help to practice various methods of waste management systems.

However, among the above listed criteria the city government SBDA applies the 3rd criteria as the basic factor of site selection. The evaluation of the existing CWB, against suitability map generated based on the above criteria was measured using GIS 9.2 Spatial Analyst software. The evaluation revealed that about 80 percent (32 CWB) of the existing CWB are not located on suitable sites. The following map can clearly show how unsuitably located according to previously stated CWB site selection parameters.

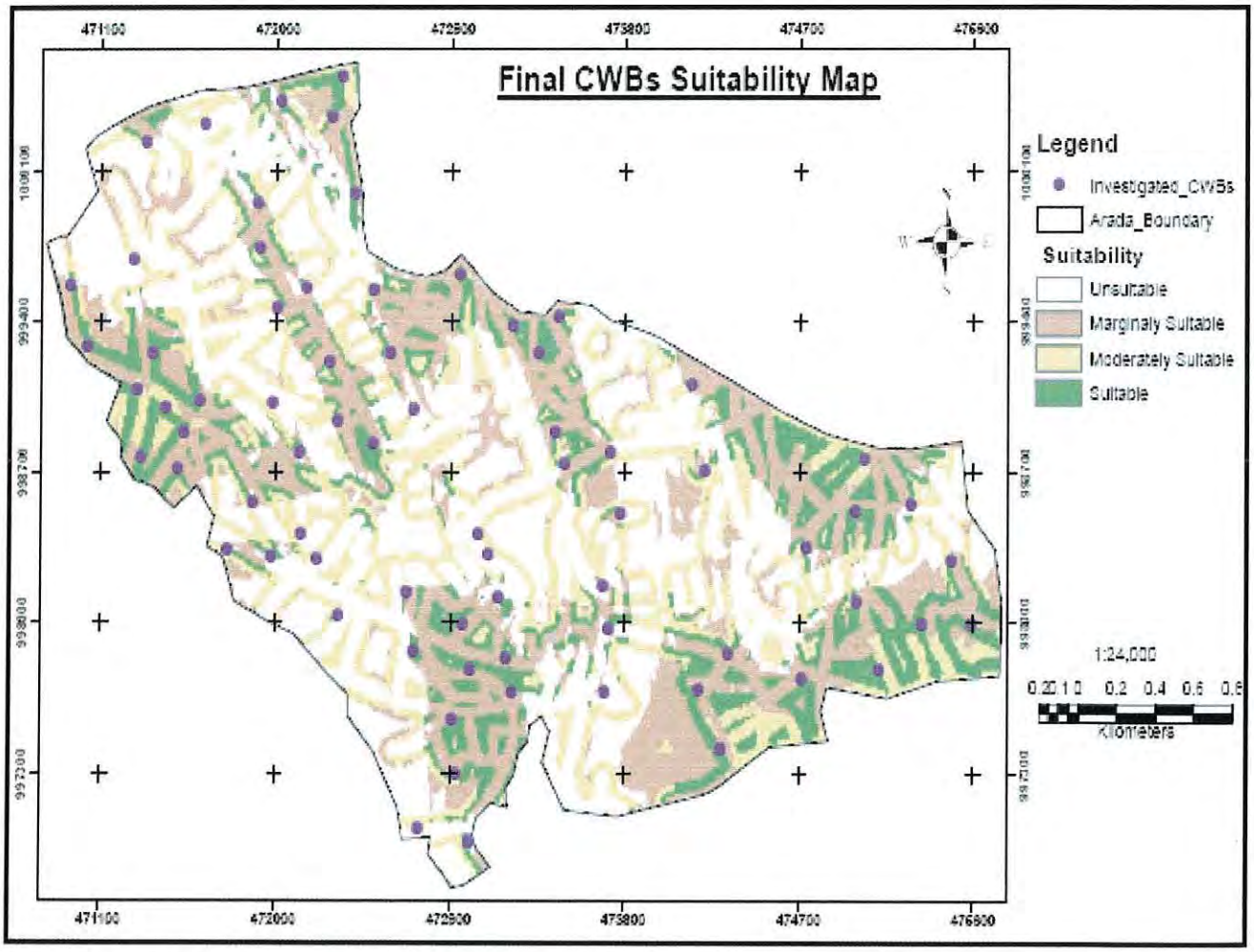


Map 2 Current CWBs map of Arada sub-city

Thus the final suitability map was generated by adding the existed fitted CWB, as the other factors. Distance from squares, roads and rivers have had considered as an influential factor on deciding which areas are more suitable than others are. Suitability map shows the best suitable site for the distribution of events that we want to locate. These factors were selected and applied to evaluate and investigate new location for the following reasons. For the sake of aesthetic value, to subsist environmentally sound management, consideration of its health impact (especially if CWBs are located in areas where there is high congestion and near river banks), easy accessibility of vehicle that is to collect the containers easily, to accumulate

wastes with out polluting the surrounding areas and by considering low income groups of the residents (This is due to high income groups could pay and dispose where CWBs are found).

Therefore, the new CWB will be located 200-300m away from the existed CWB. According to this suitability map more than 80 new CWBS sites are investigated which are adequate to accommodate the generated solid waste from the above mentioned sources. As we can see from the map most of the CWB sites are located in peripheries and some hinterland areas. These areas are places where most of the criterion for site selection is fitted and suitable but neglected by the concerned bodies. Besides, the selection was emphasized on areas where roads, squares and rivers were given due attention which ultimately forced to far away from these areas.



Map 3 Suitability Map of CWBs in the sub-city

5.4.4 **Household size and Solid waste handling**

Household size was also tested to show its association with solid waste handling. Household size was considered as an independent variable and SWH as a dependant one. The statistical analysis (on table 5.10) revealed that the P-value was much higher than the cut off value. Therefore, there is no association between the dependant variable (solid waste handling) and independent variable (household size). According to the table (5.10) and figure 5.4 as the number of households increase the system of proper solid waste handling decreased from 37.9 percent to 37.1 percent. It was also indicated that as the number of household size increased, inappropriate waste handling system also increased from 62.1 percent to 62.9 percent.

The result of logistic regression (on table 5.11) asserted that there is a negative relation ship between household size and waste handling. According to the result as the size household increased the likelihood to handle wastes properly reduced by 14 percent. Figure (5.4) further shows a negative correlation between households with members of six and less than that of greater than or equal to seven household members. The possible explanation for this may be household size is influenced by other variables. From the result of the study it was asserted that, solid waste management is highly influenced by income amount and educational level of the households therefore; number of family size could not affect the process of waste handling.

CHAPTER SIX

6. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary

The rapid increase in urbanization and industrialization in cities has resulted in an increased volume of waste generation. Municipalities all over the world and especially those from the developing countries are faced with the problem of effective solid waste management. It is explained that solid waste problems are global; every where collection and proper handling of garbage is not adequately executed (Eshuan, 2002 and Van Demculen, 1996).

Solid waste management in urban area is becoming difficult and complex because the generation of residential and commercial industrial waste is a diffuse process that takes place in every home and every commercial as well as in the street, parks and in the vacant areas of every community. It is becoming a major public health and environmental concern in urban areas of many developing countries; it also continues to be a major challenge in urban areas through out the world, particularly in the rapidly growing cities and towns of the developing world. The consequence of this ineffective waste management results an increased morbidity and mortality in urban areas (Lee, 1997; Eshuan, 2002; Agrawal, 2002).

It is clear that improper waste handling leads to substantial negative environmental impacts, health and safety problems. The objective of this research was to identify the major factors that cause an impact on solid waste handling. The outcomes of this study, which was described in the previous chapter, also revealed that different places of the community depend on different ways of solid waste handling according to the level of socio-economic, demographic and physical factors.

The main socio-economic, demographic and physical factors which determin solid waste handling in this thesis, namely educational level of the household head, income amount of the household, location of CWB and its distance from house and household size have shown a reasonable association and impact on solid waste handling. Moreover, institutional involvement on solid waste handling especially from collection sites is poor and un integrated.

The study was conducted in Arada sub-city to assess the socio-economic and demographic determinants on solid waste handling. From the 10 Kebeles found in the sub-city, 398 households were selected through systematic random sampling. Information related to socio-economic and demographic features of solid waste handling and physical factors were collected by means of questionnaire, interview and observations for two weeks, three and many days respectively.

Each sampled household's educational level, per-capital income, household size and distance of CWB from house was associated with their way of waste handling. To analyze the data collected from various sources both descriptive and inferential statistical tests were computed using SPSS version 13 and the results are concluded as follows.

6.2 Conclusions

Based on the literature revised, the data collected, the analysis made, the findings obtained and discussions help the necessary and relevant conclusions drawn are attempted to be presented as here under:-

In Arada sub-city, where waste handling system is very poor, there is problem of solid waste storage, separation, collection, reuse, recycling, compositing and disposal. The majority of the households which live along the rivers side disposed their solid waste inside drainage channel and littered on the street or other places.

The rule and regulations of the AACG concerning WM collection and disposal are not well-known by the community. Mobilization and participation of the community in Sanitation process was not well practiced. This is mainly due to low involvement of the sub-city's Sanitation and Beautification Agency. Therefore, unless it improved its current status of SWM services the growing SW generation is likely to cause major health problem on the inhabitants of the sub-city and environmental deterioration

The first identified influencing factor of solid waste handling was per-capita income of the households Based on the result of the study, the higher the household income the higher to pay for collection and disposal of SW, while the lower per-capital income of the people the

lower to pay and dispose wastes which ultimately forced and lead to improper handling of wastes.

Educational level of the household was the second variable that has a direct influence on solid waste handling. Education improves the awareness and knowledge of solid waste management among residents of the city. Because, if communities are educated on how to handle, separate, reuse, compost and dispose SWs, the outcome will be encouraging.

Location of CWBs also has strong impact on solid waste handling. Its association test indicated that there is a negative relationship between CWB location and solid waste handling. Though we paid money to disposal and have awareness about proper handling of wastes, if disposal sites are not at suitable place it is irrelevant to the practice of waste management. Therefore, hypothesis two, three and four are accepted while the first hypothesis is rejected due to it is neither positively nor negatively correlated.

Finally, in this study household size did not revealed any directional relationship and influence on solid waste handling. This is mainly due to solid waste handling is influenced via awareness creation and knowledge of SWM practices among residents. Therefore awareness creation programs supported by community waste bin accessibility and allocation of capital to proper handling, institutional arrangement to involve in the community to mobilize CBOs like "Idir" in sanitation activity is very essential. In order to handle the growing volume of wastes, proper policies need to be enacted and implemented. The approach to waste management should also be socially desirable, economically viable and environmentally sound. This way of waste management encourages waste prevention, recycling, reuse, segregation and composting. But all these are going to be practical with strong institutional arrangement. Therefore, institutions should be strengthened financially, logistically, personnel wise and relations with the community.

6.3 Recommendations

Assessment of the prevailing SWM situation in Arada sub-city shows that the attention of the community to handle wastes properly and the services given by institutions are poor. Besides, the sector has given relatively low attention compared to other services. It is clear that SWM is a complex process comprising collection, transfer, recycle, separate, treatment, hauling and final disposal. Its impact is also wide which includes social, economic, environmental and institutional. However, the community awareness about the handling of solid waste is low. Therefore, based on the empirical findings of the research the following recommendations are forwarded:

- Raise educational level of the households, which is vital to develop public awareness, not only on the importance of creating healthy environment but also on the mechanism of handling wastes at the source.
- One of the basic obstacles to proper waste handling in the sub-city is inefficient and few accessibility of CWBs. Therefore, establish additional CWBs sites in all direction at accessible site depending on roads, squares, and rivers consideration is essential.
- Since the overall waste handling practices of the sub-city is so poor, establishing municipal structure at Keble level to work with the community based organizations and traditional institutions like "Idir" in educating the public on proper handling and disposal as well as its enforcing regulations enacted by the government is preferable than being silent.
- Encourage the private sector to involve in waste management like encouraging private entrepreneurs in composting of agricultural wastes to fertilizers, encourage involving in recycling.
- Charge the users of waste collectors according to the amount of waste generated. To make it the situation easy and efficient dividing the entire area of the sub-city into defined number of zones for effectiveness of SW collection
- Creating conducive environment for controlling waste generation and provide mechanisms for managing (handling) at a source, which should be given more emphasis prior to enforcement of regulations, but without compromising enactment and enforcement of regulations.

Finally, further researchers should be encouraged to work on waste management related issues like waste collectors and their problem faced at the time of collection in the sub-city and other sub-cities, solid waste generation, composition, and ways of handling. Moreover; since the study emphasize only on handling of solid wastes from the source to the first disposal site other parts of SWM have to be studied .

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Appendix 1

Questionnaire form: To be completed by household heads

This questionnaire was intended to examine and better understand the impact of socio-economic, demographic and physical factors on SWH. Moreover, it was believed to help concerned bodies and the locality to plan and prevent the community from waste associated problems based on the residents' needs and priorities. You are chosen so as to give your free opinion, concerning any of social, economic, demographic and physical factors that create an impact on how to handle solid waste at the community and household level. Thus, your cooperation is very essential for the study.

Thank you in advance for your kind cooperation.

I. Identification Date

Kebele _____ HH. House No _____

Interviewer code Date of interview

Checked by super Date

II. Background information on households' demographic characteristics.

101	Types of household head	1. male headed 2. Female headed 3. son /daughter 4. others	Remarks
102	Age of the household head	1. <30 2. 31-40 3. 41-50 4. 51-60 5. >61	
103	Type of occupation	1. self employed 2. government employed 3. NGOs employed 4. unemployed 5. others	

104	Marital status	1. never married 2. currently married 3. divorced 4. separated 5. widowed	Remarks
105	What was the last grade you completed in school?	1. No schooling 2. primary 3. secondary 4. vocational completed 5. one year college and above	
106	Nature of the household	1. single family 2. Nuclear family 3. multiple family	
107	How many people are living in this household including babies?	1. 1-3 2. 4-6 3. 1-9 4. >10	
108	Monthly total income in birr?	1. <200 2. 201-*420* 3.421-750 4.>750	
109	What the total amount of annual income of the household (computed by data collectors).		

III Household Waste Characteristics			
201	Do you have waste storage for your daily generated wastes?	1. Yes 2. No	Remarks
202	If yes, what type of storage do you use?	1. Local basket 2. plastic bag 3. Jonya 4. Plastic bucket 5. other,specify	
203	If No, where do you put		
204	How do you put your solid wastes?	1. All together 2. separate	
205	Which type of wastes is generated more?	1. Food wastes including 'T'chat' 2. paper and plastics 3. Ashes and wood 4. glasses and metals	
206	For how long do you store solid wastes at home?	1. a day 2. two days 3. three 4. A week 5. other specify	
V. Waste handling and disposal habit			
301	Do you dispose your solid wastes? (If No skip Q 302)	1. Yes 2.No	
302	If yes, how do you disposed your wastes, (skip Q 303)	1. Using formal pre-collectors Using community waste bins. 2. Others specify.	
303	If No, where do you disposed?		
304	When do you give to your pre-collectors?	1. every day 2. two days interval 3. A week 4. others, specify	
305	Do you pay to your waste collectors?	1. Yes 2. No	
306	If yes, how much per month?		
307	Do you know where pre-collectors disposed the collected wastes?	1. Yes 2. No	

308	If yes, would you specify it?	1. CWBs 3. river banks 2. Trucks 4. others, specify	Remarks
309	Are they regularly come and collect?	1. Yes 2. No	
310	Do you use other ways of waste handling (disposal) systems?	1. Yes 2. No	
	If yes, which type	1. Reuse (go to Q 311) 2. recycle 3. Compost 4. Incineration (go to Q 315) 5. Others specify	
311	Which types of wastes were reused?	1. --- 2. ---- 3. ---- 4. --	
312	Do you have wastes that you sold?	1. Yes 2. No	
313	If yes, what type of solid waste you sold?	1. Tin cans 2. glasses 3. Tin cans & glasses 4. plastic and glasses 5. Tin cans, glasses and plastics 6. None of then	
314	For whom do you sell	1. for qoralew 2. others specify	
315	Do you have pre pared place for burning?	1. Yes 2. No	
316	If yes, what type is it?	1. Closed ditch 2. open space 3. others specify	
V. Questions related to CWBs and institutions			
401	Is there CWB in your locality	1. Yes 2. No	
402	If yes, how far from your house (home)?	1. < 0.5km 2. 0.5-1km 3.1.1km-1.5km 4. others specify	

403	Do you have road facility in your locality?	1. Yes 2. No	
404	If the CWBs is full, where do you dispose?		
405	For how long the CWBs stayed with out picking out by municipality?	1. 3 days 2. 5 days 3. A week 4. more than a week	
406	Is the municipality participating on SWM in your locality?	1. Yes 2. No	
407	If yes, what type of involvement is it?		
408	Is there any governmental or NGOs that guide households to dispose wastes at the appropriate place?	1. Yes 2. No	
409	If yes, would you mention it?		
410	Do you know about laws related to SWM?	1. Yes 2. No If yes, would you mention the law that you know? If No what is the reason behind it?	
411	What type of household waste handling system do you recommend?		
412	Why do you recommend these systems?		

Thank you, again in advance!!

Interview guide for Municipal officials

1. What is the current city's waste regulatory framework?
2. What are the goals and objectives of the sub city in relation to waste management? At community level

   At household level
3. Are there stalk-holders in waste management apart from the sub-city?

   Yes ☐ No ☐
4. What is the sub city's plan regarding waste management in the household level?
5. Is the sub-city prepared to extend its service to the lower income group community?
6. What form of cooperation does the sub-city expect from the community?
7. What is the contribution of your office to increase their attitude to wards solid west management?
8. Do you have integration between your institution and the community / residents?

   Yes ☐ No ☐
9. If yes why do you want to integrate with them?
10. Do you have enough resource to embrace all forms of wastes from each household?
11. Would you estimate the total amount spent on west management by the sub city per year to household wastes?
12. In your own view how can the sub-city integrate the resident with the sub city to bring about clean environment and avoid spread of disease?
13. What is the appropriate way in carrying out integrated waste management?
14. Which approach of solid waste handling is acceptable by the sub-city at household level?

Thank you, for your kind cooperation

DECLARATION

The thesis is my original work, has not been presented for a degree in any other university and that all sources of materials used for the thesis have been duly acknowledged.

Name Ejigu Mulugeta

Signature

Date 20 Aug. 2007

This thesis has been submitted for examination with my approval as university advisor.

Tereffe Degefa		20 Aug. 2007
Advisor	Signature	Date