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Challenges and Opportunities in Municipal Solid Waste Management: The Case of Addis Ababa City, Central Ethiopia

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ABSTRACT Solid waste, which is a consequence of day-to-day activity of human kind, needs to be managed properly. Addis Ababa, like other cities in developing countries, faces problems associated with poorly managed solid waste operation. This study deals with analysis of the city's current municipal solid waste management problems, opportunities and existing solid waste management practices. The survey was conducted in Bole and Akaki Kality sub-city. Different sampling methods were employed to select the study units including: stratified sampling, systematic random sampling, and purposive sampling. Though the bulk of the data collected were qualitative in nature, it was also supported by quantitative information collected through survey and secondary sources. The study revealed that the reasons for low performance of SWM in the city includes: inaccessibility of the city due to the geographical and urban structure, lack of properly designed collection route system and time schedule, inadequate and malfunctioning operation equipment, open burning of garbage, poor condition of the final dump site, littering of the corner around the skips which encouraged illegal dumping are the technical problem identified. Insufficient funds as well as lack of promotion on-waste reduction: recycling, absence of cost recovery, practice of energy option, waste separation and composting are among the financial challenge. Social problems encountered include: lack of public awareness,illegal dumping, poor condition of waste workers, lack of private sector and community involvement. Incompetence of organizations in terms of equipment required for operation and man power /staff qualifications, training and human resource developments/ and unreliable service are the institutional challenge that the city encountered in the sector. Finally, the study forwarded some important recommendations towards improving the statuesque.

1. BACKGROUND

Dealing with the environmental costs in rapidly growing economic development, urbanization and improving living standards in cities have led to an increase in the quantity and complexity of generated waste, representing a phenomenal challenge (UNDP 2004). This is particularly true in the area of solid waste management. While cities are generating an ever-increasing volume of waste, the effectiveness of their solid waste collection and disposal systems are declining. In urban centers throughout African regions, less than half of the solid waste produced is collected, and 95 percent of that amount is either indiscriminately thrown away at various dumping sites on the periphery of urban centers, or at a number of so-called temporary sites, typically empty lots scattered throughout the city (Mohammed 2003).

Addis Ababa city started its solid waste management some three decades back. The service cannot meet changing demands. The social waste collection service is unsatisfactory, and scenes of scattered waste are common in most part of the city (UNDP 2004). As a result, the population has the opinion that the municipal solid waste collection service is not functioning properly. As a result of this, the willingness of the population to cooperate with waste collection operation and to pay for the service is low. With respect to the organization of operations and management structure, collection and disposal are parts that are poorly organized. A disposal site situated at one corner of the city is also the main determining factor for collection and disposal of wastes in the city. This means that it is only those people close to the dumpsites that benefit. Dump sites and trucks for solid waste disposal are insufficient. In densely populated Kebeles, the majority of people live 0.5 – 1.00 km from accessible roads where transfer containers are located, when the recommended distance is 150 m from the housing units (Zerayakob 2002). Solid waste collected from hospitals, residential and business areas is dumped at the landfill sites on the outskirts of the city. It is common to find refuse pileup at road intersections or strewn in open spaces.

With context to processing and recycling of social waste, little is done at all level of its management i.e. there is no source separation or

sorting and this happens at disposal sites too. But some scavengers at landfill sites practice an informal type of waste recovery. Other options like energy recovery and composting are not practiced as alternatives for waste recovery. Most of the waste is administered by the government with no or little involvement of private sectors and tends to be costly and inefficient (ENDA 2006). Some communities receive little (in some cases no) solid waste collection services because local governments have no resources to cover all households. Thus, in the absence of collection services, households use forms of disposal most of which are heavily polluting. According to ENDA (1999), the city has a limited sewerage system, designed for 200,000 households, but presently covering only 6000 households.

Data on the composition, volume and weight of solid waste generated and collected in Addis Ababa carried out in early 1980s and mid 1990s by Nure consultancy with the support of Louis Berger Company indicates that the estimates of waste generated per capita per day varies in volume from 0.4 to 1.23 lit/capita/day, in weight from 0.11 to 0.25 kg/capita/day and in density from 205 to 370kg/m^3 (MAA 2002; Yami 1999). In other studies, the daily waste generation is estimated to be 0.35kg/capita/day (AASBPDA 2003). Regardless of increasing volume of waste generated, the performance of the city's solid waste collection and disposal system is poor (WHO 1996). Currently only 65% of the solid waste produced per day is collected and disposed by the municipality in the dumpsite, 5% is recycled, 5% is composted and the remaining 25% of the solid wastes are uncollected and dumped in unauthorized areas such as open fields, ditches, sewers, streets and many other available spaces in the city (AASBPDA 2003). Uncollected garbage is a serious environmental hazard for all, especially in areas where the roads are not accessible for collection by the municipality. These cause bad smells and attract various disease vectors and pests resulting in deteriorated aesthetic quality of the city. Thus, the health situation of the community is under serious threat (ENDA 2006).

These studies by international consultants (only some for partial fulfillment of master's degree) were geared towards quantifying refuse generation rate. They came up with figures, which show daily waste generation unit. Even though plan is made based on annual generation, the performance of the collection operation is still very low. To this effect, some researchers focused on the city's opportunities and challenges. These research efforts on the city's solid waste management in general were on determinants of household choices of collection methods. They have limitation in that they didn't consider the collection process in general. Usefulness of potential application of the research's findings is based on the problems associated with collection and disposal. Therefore, it can be concluded that there is a relative neglect of the specific research problem of variables that affects effective solid waste management. The determinants of poor solid waste management practices observed in the city were very much unclear until two decades ago. The main objective is identification of the determinants of poor management system to improve the performance of the system as a whole for the benefit of the public. As far as the problems exist and the condition gets worse, it is important that research is done in this area.

2. CONCEPTUAL FRAMEWORK

According to UNDP (2004), solid waste management is a complex task which must go beyond purely technical considerations to political, institutional, social, financial, and economic aspects (Fig. 1). Based on literature review, discussion with experts, empirical studies, and personal observation, the conceptual framework for the study is formulated.

3. DATA SOURCES AND METHODOLOGY

3.1 Description of the Study Area

Geographically, Addis Ababa is located between $8^0$55'and 9^0 0 5'N Latitude and 38^0 40' and $38^0$50' E Longitude. The city is located at the center of Ethiopia with an area of 540 km^2 of which 18.174 m^2 is rural and its altitude ranges from 2000m - 2800 masl (AACA 1998).

Addis Ababa is a seat both for Federal Democratic Republic of Ethiopia (FDRE) and Oromiya National Regional State Government. It is bordered with Oromiya National Regional State in all directions. There are 10 sub-cities (*Kifle ketema*) and about 99 Kebeles (AACA 1998).

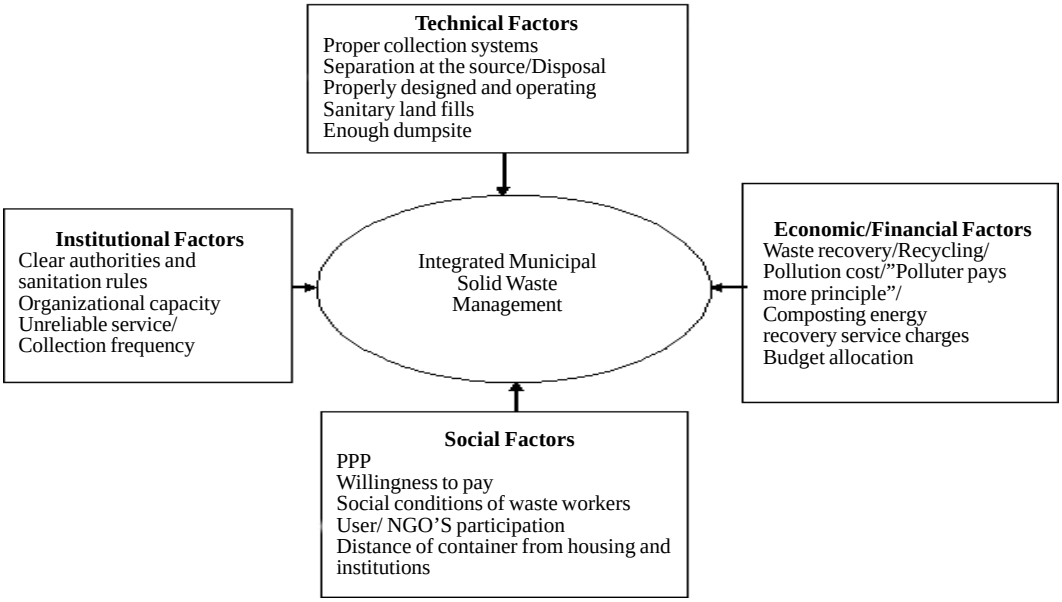

Fig. 1. Conceptual framework

The period of heavy rain (*kiremt*) is from June to September and accounts for 80% of the annual rainfall (MAA 2002), while the small rain (*Belg*) occurs between March and May. The dry period (*Bega*) is between October and January. The temperature is mild Afro alpine temperature and warm temperate climate with annual average temperature between 10^0c to 20^0c and average annual rainfall is 1200 mm.

According to the new Census (2007), the current size of the population is 3,147,000, of which 1,511,000 is men and, 636,000 is women with eight percent annual growth rate and density of 5936.2/km^2. The household size varies from 7.6, 6, 5 persons per household in lower, middle, and higher income families respectively (Benti 2007).

The city is home to 23.8 percent of all urban dwellers in Ethiopia due to its position as capital of the country. The major ethnic groups represented are the *Amhara* (48.3 %), *Oromo* (19.2 %), *Gurage* (17.5 %), and *Tigray* (7.6 %), while others constitute 7.4% of the population (Mehret 1999).

About 82 percent of the population are Orthodox Christians, 12.7 percent Muslim, 3.9 percent Protestants, 0.8 percent Catholics, while the remaining 0.6 percent are followers of other religions, such as Hindus, Jews, Bahá'ís, and Agnostics (Benti 2007).

Literacy rate in Addis Ababa is about 83%. But it is expected to be higher nowadays. Net enrolment ratios in primary, junior and senior secondary school are 73, 35, and 36% respectively with relatively similar representation for both boys and girls (Taddesse 2004).

3.2 Data Source and Data Type

All required data for this study were collected both from primary and secondary sources. The primary data were collected from sampled HH respondents and key informants. Similarly, thorough review of all available published and unpublished documents of relevant organizations was conducted.

3.3 Sampling Technique

The study employed a range of sampling techniques including stratified sampling, systematic random sampling, and purposive sampling.

Addis Ababa city is purposively selected being the interests of the sponsor of the research. With regard to the sub-cities, it is understandable that the sub-cities are diverse and need to be stratified to get adequate representation from each stratum. To have uniformity, stratification was done for the ten sub-cities by their similari-

ties on success or failure on waste management. Within a stratum, simple random sampling was applied to select one sub-city from each stratum. The same procedure was employed to have a total of four Kebele Administration (KA)from the sub- stratum to minimize biases. Once the KA's were selected, households in the selected KA's were randomly picked from the master lists of the KA's using simple random sampling. This was done by lottery system, where the Households (HHs) were written on pieces of paper, rolled out and one was randomly picked and continue until the required number of HHs was selected.

Considering the objective of the study and representativeness of the sample, from the ten sub-cities, four Kebeles were selected from each stratum based on homogeneity in the success or failure in municipal solid waste management. According to the yearly review of AACBPA in the year 2008, *Nifas silklafto, Yeka, Kolfekeranio* and *Bole* sub-cities were identified as sub-cities with successful story/ sub-cities which are effective in their management of municipal solid waste. While the rest, namely: *Kirkos, Addisketema, Lideta, Akakikality* and *Areda,* are among the list of sub-cities with poor municipal solid waste handling condition. The classification was done by the agency on the bases of their solid waste handling starting from collection to properly dumping of solid waste to the disposal sites.

Accordingly, under stratum with successful story in municipal solid waste management *Bole* sub-city was randomly selected. The randomly selected KA's from this sub-city was Kebele 08/ 09 with specific name "*Haya Arat*', and Kebele 01 with specific name "*Bole Mickael*" with story of success and failure respectively. On the other hand, *Akaki-Kality* sub-city was randomly selected to represent sub-cities stratum with failure story. The randomly selected KA's from this sub-city was Kebele 05/06 with specific name "*Kera Seffer*" under classification of good municipal solid waste management practices. From Kebele stratum with poor MSWM under this subcity was Kebele 01/03 with specific name "*Abeselom Mehber*" was the randomly selected KA.

Although CFthe proposed sub-cities to be included for the sample were two, another two Kebele's namely, *Kilinto Fache Koyo* and *Galaan Gurra Kersa* which were formerly rural and newly incorporated under Addis Ababa city administration, were purposely included in the sample to assess the existence of rural-urban linkage with respect to solid waste handling. In addition, household from *Kolfekeraniyo* specifically from "*Rapi"* was purposely selected and included in the sample households to assess existing condition in municipal solid waste management.

Purposive sampling was applied to select key informant respondents which includes waste workers / *Kuralio's, MI organized by the KA for waste collection/*, AASBPDA, Kebele Administrators, Cleaning Committee's in Each KA, health office in each Woreda, Beautification and Cleaning Section/Department at subcity and KA level, AAHB, AAEPA, and Federal Environmental Protection Authority and other relevant organization.

3.4 Method of Data Collection and Analysis

The data collection was done using checklists which were pre-tested prior to the actual field work. The bulk of the data generated for this study were qualitative. At least one group interview, two focus group discussions, and three case studies were made in each specific Kebele with cleaning committee members who were selected by Kebele section of beautification and cleaning agency, community leaders, and interested and purposely selected key informants. Waste Collection sites where containers are placed, market places where waste handling is expected to be difficult and dumping sites, were also used as sample units to collect qualitative information.

The supportive data was collected from 120 randomly selected household heads in the three sub-cities. Enumerators were assigned to collect the quantitative data using the structured interview schedule. The data were analyzed combining the information collected from secondary sources, qualitative and quantitative survey.

4. RESULTS AND DISCUSSION

4.1 Solid Waste Composition

The result of the survey in the study area showed that municipal waste is an aggregate of all substances ready for disposal. The composition of the solid organic waste was almost

homogenous in nature across the study households. As it was observed in this study, majority of the waste was of plant origin while the animal and the industrial origin was almost none in most of the households. Of the plant source, vegetable residues take the greatest portion. Overall composition includes paper, vegetable peelings, onion seed coats, broken plastic and festal, soil and dust, pieces of thread, animal dung, grasses, used shoes, pieces of cloth, small bottles, soot, etc. The waste aggregate more frequent in the whole mass of household waste was house sweeping, which is composed of soil and dust followed by pieces of paper and vegetable peelings. Ash swept out from kitchens is more in quantity than other waste. However, it is not removed every day. Households having regular *chatt* chewing members are found to have a lot of waste in the form of *chatt* sticks and leaves.

When considering the solid organic waste production across different origin/nature (plant, animal and industrial), the plant origin was found to be higher (94%). While percentage composition for animal origin is 1% and 5% accounts for industrial origin.

4.2 Solid Waste Generation Rates

With regard to waste generation rate, even though the solid waste trend is expected to increase in general, recent and up to date data were not available. Hence, the data were taken from the city government's SBPDA as given in Table 1.

Based on different studies conducted so far, the amount of the solid waste generation rate in Addis Ababa city per day, month and year has been estimated based on the 1993/94 population census of Addis Ababa (Table 2). The estimation considered constant growth rate of 3.79% (including both natural and net migration).

4.3 Solid Waste Sources

According to Nor Consult estimate, MSW generation by source in Addis Ababa has the following distribution (Fig. 2).

Table 1: Solid waste generated and disposed in Addis Ababa

Year (E.C)	*Population in millions*	*Waste generation (kg/capital/ day)*	*Total generation (m3)*	*Amount disposed (m3)*
1987	2.09	0.221	482550	281633
1988	2.09	0.221	520961	275200
1989	2.25	0.221	540167	264049
1990	2.34	0.221	561774	317377
1991	2.43	0.221	583381	362797
1992	2.5	0.221	602587	393972
1993	2.7	0.221	648201	45005
1994	2.8	0.221	672208	472722
1995	2.91	0.221	704815	452,192
1996	3.02	0.221	731460	544,689.37
1997	3.13	0.221	758105	623,625
1998	3.25	0.221	787305	540,266.9

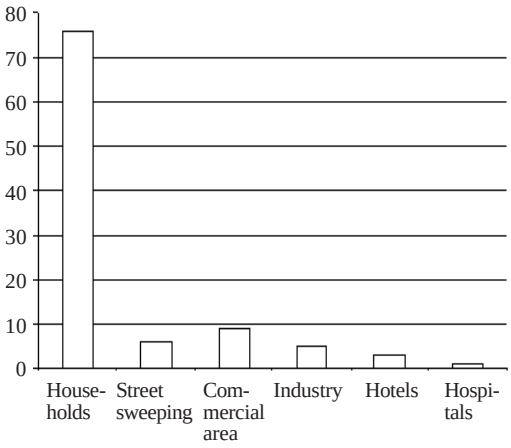

Fig. 2. Municipal solid waste generation by source of Addis Ababa

Figure 2 shows municipal solid waste generations by source in Addis Ababa. The percentage of waste generated from domestic is 76 %, commercial waste 9 %, hotels 3 %, industrial waste 5 %, street sweeping 6 %, and hospitals 1 %.

One can clearly see from Table 3 that there is a change in the percent composition of the wastes from year to year. Some constituents of solid wastes such as paper, plastics and ferrous

Table 2: The solid waste generation rate in Addis Ababa city per day, month and year

City/	*Population 1993/94*	*Population 2005 projection by 3.79% growth rate*	*Solid waste generation kg/capita/day*	*Solid waste generation kg/day*	*Solid waste generation rate kg/month*	*Total waste generation kg/year*
Addis Ababa	2,255,000	3,395,000	0.252	851,540	$2.56x10^7$	$3.07x10^8$

metals showed an increase in percent composition. These types of wastes are more common in developed countries. Therefore, this might be a clue for the city to be on the way to development. However, if we see this from the recycling point of view, all of the three constituents are recyclable materials, and hence it indicates that recycling practices are not effectively practiced, and this is why we see a lot of paper and plastic substances thrown out in river banks, ditches and open areas.

Table 3: Percent composition of waste by weight provided in different years in A.A.

Major constituents	*Weighted percent composition by weight and year of information*		
	1982	*1994*	*1995*
Vegetables	8.7	4.185	2.90
Paper	2.2	2.47	3.37
Rubber	0.5	1.0	0.28
Wood	N.A	2.33	2.29
Bone	N.A	1.06	1.62
Plastics	0.7	1.93	1.98
Textiles	1.5	2.37	1.44
Ferrous metals	0.8	0.9	1.16
Aluminum	N.A	N.A	0.02
Glass	0.5	0.445	0.80
Combustible (leaves, grasses)	25.2	15.13	22.63
Non-combustible	6.3	2.53	2.96
Fines < 10mm	N.A	29.93	28.04
10 < fines < 55mm	N.A	35.65	31.43
All fines	53.6	65.58	59.44
Total	100	100	100

Source: Secondary Data: AAHB 1997

Other constituents like vegetables, leaves and grasses showed a decrease in composition, which could have been from change in eating habit, or change in land use that reduced the percent composition of leaves and grasses. Even though it has been said that the percent composition of these wastes are reduced, they have still higher proportion compared to the other wastes. As these wastes are categorized under organic decomposable substances, they may potentially undergo composting.

In addition to solid waste generation rate, higher income and economic growth also tend to have an impact on the composition of wastes. Wealthier individuals consume more processed and packaged products, and to some extent contribute for changing composition and this has a profound impact on waste management practices.

4.4 Existing Solid Waste Management Practices

The management of Addis Ababa waste is a history of institutional trials and abandonment, with most issues remaining unsolved. The new established authorized organization on the sector, cleaning and beautification department/ CBD/ at Kebele level was assigned the responsibility for the management in 2008. The assignment came as a result of the failure of previous authorities-the Ministry of Health and Sanitation, and the private sector to effectively manage City's solid wastes. Unfortunately, the CBD is also struggling with tight budgets, lack of qualified manpower, and experience in waste management.

Box 1: Case study

In congested neighborhoods, roods are small, and provide less space for staring wastes, eithr on the streets or within the yards of dense houses. Most of the city's drains are choked with rubbish. Where special dumps or public "dustbins" or condainers (skips included) are provided, garbage is often dumped outside due to lack of capacity, poor collection, and/or public insensitivity. Many existing skips (large containers) that also act as transfer station for the solid waste are broken. Often, the garbage is strewn around, where scavengers, mostly children and wondering dogs, birds, pigs, and other stray animals, forage amongst the rubbish, spreading it aroud. Open dumps allow free access to waste pickers, animals, and flies; and often produce unpleasant and hazardous smoke from slow-burning fires.
Garbage can be seen everywhere, scattered, or in small or large piles, some of which are regularly set on fires used as a waste disposal option. Waste gereration in city far outstrips its collection and transport.

On Site Handling

A proper waste handling at household level has positive implication on waste management. The responsibility of household waste handling also varies between the well to do and the poor families. In poor families, it is the mother assisted by her daughters (if she has), who handles the household cleaning and separating of the waste. The male members of the family do not participate in these activities, except that they sometime involve themselves when the waste is bulky and some physical help is required to transport it to damping places. In case of the well to do families, it is servants who collect and dispose of household wastes.

The survey result showed that the mothers

took the highest proportion in low income households which accounts for 82% followed by the middle income households. In high income households, mothers took only 16%. This could be due to the income situation of the households.

Sorting

Sorting is an essential component of solid waste management. It is a kind of activity which is separating different types of wastes in their respective nature. It makes waste management easy and simple. However, it should not be a one time activity, rather should be a habit for proper and sustainable solid waste management. A portion of the respondents said that they don't separate waste at the household level. On the contrary, there are households who replied that waste is separated at the household level: into organic and inorganic only. Inorganic wastes like cans are usually sorted for sale. In few households, organic wastes like plant origin are sorted for the purpose of reusing in their gardens and as fuel after the waste gets dried; this is seen in low income households. Animal source (meat and bone) is used to feed domestic animals like dogs. Some households give the waste away to their neighbors who use it for different purpose like for animal feed. The purpose of separated waste is different for different surveyed areas and income group. The manure is to plaster walls and floors and for fuel when dried up, whereas the grass and *chatt* leaves are fed to domestic animals in rural Kebeles.

Composting

With regard to composting, the households practicing composting are very few, while 95% of this refuse is largely plant origin /biodegradable/ organic waste. According to Gardner (2001), as cited in Bezaye (2008), composting is an ancient practice where more cities in the world nowadays are reclaiming the benefits of reusing solid organic waste material. It is a natural way to prepare the waste for use.

During the study, it was observed that there are people who know at least the use of organic waste for soil fertility improvement. There are also some people who have training in composting, but are not practicing. The major limitation for not practicing compost as indicated by the respondent is lack of market and a piece of land for urban agriculture.

The selected respondents were interviewed whether they have practiced incineration or not, and if there is incineration, is it practiced at secured places or not, as shown in Table 4. Accordingly, 24.2 percent responded they practiced incineration at secured places and the practice takes place only sometimes. The rest (75.8%) responded that there is no incineration taking place in or near their compound. However, they consider incineration as burning of solid waste, which is not the formal one, and for them the secured place means prepared holes without any external lid coverage during incineration. The increase in percentage of the respondents who do not practice incineration could be due to the fact that incineration at hh level is prohibited by the municipality.

Table 4: Practice of waste incineration

Response	*Frequency*	*Percent*
Yes	29	24.2
No	91	75.8
Total	120	100.0

Source: Own survey

Waste Reuse

Reuse is an important factor to reduce the amount of waste to be dumped at the final disposal site. The study result indicates that there is practice of waste reuse for different purposes like industrial waste like can for sale, plant origin waste for fuel, animal source (meat and bone) waste for domestic animals feed. Others/ give the waste away to their neighbors who use it for different purpose like for animal feed. However, the practice of reusing waste is varied among different income classes as shown in Table 5.

Table 5: Practice of waste reuse among different income groups

Practice of waste reuse	*Household income*			*Total*
	low/ <5000 Birr/ month/	*Medium / 5000-10000 Birr/ month/*	*High >10000 Birr/ month*	
Yes	40	13	1	54
No	14	17	27	58
Total	54	30	28	112

Source: Survey result

As far as waste reuse is concerned, there are some people called "*Korales*" who move through the city to buy recyclable items such as glass, plastic, tin cans, metals, shoes etc. from different houses, hotels, restaurants, repairs services and sell them to small recyclers and industries. There are people involved in similar types of job called "*Liwach*" who go around the city and exchange used clothes and shoes with new household utensils and sell them to low-income people.

Collection

Waste collection service is one of the chief components of municipal solid waste management. The survey showed that containers are placed in some neighborhoods. However, the number of containers are not enough with respect to waste generated and a portion of the neighborhoods are obliged to throw their garbage into an open area. Some of the households, who are not enjoying municipal services, have their own way of household waste disposal.

During the interview there were respondents who stated that there are no collection services in their Kebele. According to the survey, this is due to the topographic location of the houses or due to inaccessibility caused by lack of roads. This study identified that the high income households have more access to collection services than the low income groups.

Generally, there are three basic types of collection equipments: these are human powered, animal powered, and engine powered. Under the Addis Ababa situation, both human and motorized collection equipment are being used. With regard to the human aspect, transportation of wastes to the containers is possible using hands and hand pushed carts. In each Kebele, strategic locations are assigned where collectors make ready for the motorized collection. Most of the areas in the city are inaccessible for motorized collection; therefore, the human powered collection system is mostly used. The current trend of storage bins used in the city of Addis are not standardized bins, and dust bins are located only on main roads with the assumption that those roads are the popular ones. For temporary storage, households prepare different types of receptacles such as baskets, card boxes, bamboo made containers, cans, plastic bags, barrels, etc.

Only 65% of the MSW generated in Addis Ababa is collected and disposed off by the municipal in the land fill, about 5% is recycled, 5% composted and the rest 25% is dumped in uncontrolled environment like on/in streets, empty spaces, and river banks (AASBPDA 2003).

There are different waste collection services given in the study area. Of these services, the majority use door-to-door and central and communal container collection services. While others don't use any of the services rather they dispose into river systems, burn and reuse for their gardens even though they didn't mention. From Table 6 it can be realized that majority of households are using door to door service (84%) which can indicate the community's adaptation to better service. High income households use door-to-door collection system than in middle and low income households. This can imply that the households are determined by their income situation to use a better collection service.

Table 6: Types of collection system/service the studied households using.

Collection system/ service	*Income groups (%)*			*Group Total (%)*
	High	*Middle*	*Low*	
Container	2.4	23.0	58.6	84
Door-to-door	5.3	2.2	8.5	16
Block collection	-	-	-	0
Group Total				100.0

Source: Own survey 2010

In Addis Ababa, there are different actors who are directly involved in a wide range of solid waste management activity including Non Governmental Organizations(NGOs), private companies ,individuals/young children from poor households are the pioneers in providing door-to-door solid waste pre-collection service in the city. They provide service of collecting and transporting solid waste from households to temporary collection sites. The collection of waste through MIs has provided job opportunities for many jobless youth. The majority operates in the middle and high-income hhs to collect solid waste using door-to-door method.

The private sectors have the accumulated experience on waste collection and entrepreneurship due to their close engagement in the sector. This activity was less attractive to the government officials and easily left to be done by

the informal enterprises until the year 2007. It is since then the government officials viewed the sector as one of the employment generating fields. Waste collection has gradually attracting the attentions of the officials as one of the untapped employment generating sector. Now government organizes those private actors and all are indirectly government employed. The payment for the service is first done by negotiation between waste workers who are assigned for specific location and individual households in that area. However, from experience, the government realizes that the private worker collect payment from the households while they dump the waste anywhere after they collect the waste from the households. Hence nowadays, the waste is collected by the waste workers while payment for the service is collected by the government. The payment is on the bases of the waste disposed to collection site which is 30 birr/1m^3. None of the data revealed the existence of private waste workers in the study area and any other place outside of the sampled sub-cities.

Households who have a better income do not use container services (only 2.2%). This is due to their access to door-to-door service since they can afford the payment for the service. In some areas of the study, especially in the formerly rural Kebeles, the containers were not even available the way they were in the former years. 73% households responded that there are no containers in their surroundings.

Concerning the regularity of removal (emptiness) of containers, almost all the interviewed households (98%) responded that containers did not get emptied regularly. They explained that wastes in containers are usually scattered around. Other reasons identified for the scattering of waste around the container include: the lift over height to the container, which made it different for women and children to empty waste in to the container; people often have to travel more than 100 meters to reach the nearest containers which means that containers are scattered and this apparently discourages households from dumping waste in the containers .The irregularity of waste removal from the containers is affecting the health of the nearby community and the surrounding environment (AAHB 2007).

The households using door-to-door collection service were asked if they had seen any improvement after using the service. All of the households who were using the service responded that they had seen improvement in the area of solid waste situation in their surroundings. It was found that 53% of households were not willing to pay for the private waste collection service due to different reasons like the availability of containers nearby, unable to pay for private collectors and large number of hh members who can dispose waste to the container. Respondents from the formerly rural KA's also reason out the availability of a large size of backyard in their compound where they can dump the waste for use as fertilizer, is a factor which determines their refusal to pay for door to door services. Some of them are willing but they cannot afford to pay for the service due to low income situation.

Waste Disposal

Disposal at Transfer Station

Waste disposal is one of the most important management activities which needs to be carefully planned. With regard to waste disposal at transfer station, the study identified that almost all solid waste generated in households is disposed together i.e. there is no sorting habit of organic waste at the household level. Huge amount of organic materials comes from the rural areas depraving nutrients from the rural soil to feed the urban population, the leftovers after consumption have no way to return to the source to build the soil, rather lost and create problems to human health and the surrounding environment in the city due to mismanagement. Different studies described that this waste is creating health and environmental problems in Addis Ababa, where there is no proper waste management (Tamiru 2004).

A study by Tamiru (2004) described that disposing household waste into a river system is a common practice in the study area. The result of the study also reveals there are households who dispose the waste in to a river/ stream, drainage system and any open place. This is especially observed in the case of *Akaki Kality* sub-city where *Akaki* River seemed to be the sink for any waste; still the water is used for different purposes by rural dwellers who reside around the river. Similarly, 74.6% of respondents in the study area indicated that they burn organic waste together with the other solid waste, and they

have pits prepared for the burning purpose. This has its own negative implication on the organic waste management where the nutrient composition of the organic waste will totally be lost.

There was a question on whether or not there is a responsible body for disposal of waste on unauthorized places. Currently, there is relatively strong monitoring due to the established government structure with respect to waste management at local/Kebele/ level. They were further interrogated as to why there is still improper waste disposal. Some respondents blame paucity of inspection on the physical condition of the village, which they stated were not amicable for inspection, loose management action for punishment and lack of accountability of the community member. Government official pointed out that authority given to other body locally named *Demb* for punishment regardless of waste management is the authority of CBO at KA is the main factor for loose punishment action. Whether or not penalty is being given to outlawing community member was also asked. Response indicated that previously, let alone the penalty, even that system for inspection was nonexistent. These days monitoring is relatively strong and monetary penalty for mismanagement of wastes is given and the amount used to be birr 5-200 in most instances. The respondent also point out that the punishment rate is small in amount; thus. people preferred to dump waste anywhere instead of carrying waste to pre collection sites which are far from most hhs. On the other hand, the survey showed that nobody is responsible for the waste dumped in the river nearby. Some of the waste is taken away by the river water. The rest remains piled in the river gorge and on its banks.

Box 2: FGD in Akaki-Kality sub-city Kebele

"There is punishment on individual who dispose waste in unauthorized place. However, regulations are not obeyed at all by the households. This is especially relevant in case of institution like hotels, restaurants and business institution owners. This is because business man only looks for his benefit since whatever amount of waste he/she dump anywhere, the punishment is only 5 birr. This is much less than the payment they pay for pre collectors which could be one birr for informal private individuals. Therefore, we plea to GOs and anybody for increasing the rate of punishment."

Final Disposal

Currently there is one open dumpsite known as "Rappi" or "Koshe" which serves as final disposal site in south- west part of the city located 13 kms. away from the city center. It was established 43 years ago and has a surface area of 25 hectares. The present method of disposal is crude open dumping: hauling the wastes by truck, spreading and leveling by bulldozer and compacting by compactor. The major problems associated with the disposal site are:

Box 3: FGD at "Koshe" land fill site

"We are suffering from horrible smell from the land fill site that you can notice now. If it could be normal smoke, we can tolerate. Smoke hardly stopped; even though it stops, we are obliged to live in unsightly place and unpleasant smell. Two schools were closed because of it and hence, our children are exposed to long distance walk for schooling. People very closed to the site closed their house and displaced to live in rented houses elsewhere. We are living here because this is where our ancestors have been living. We are sinker of every waste from this big city including human body. No one wants to take the responsibility to solve the problem, and we request everybody who can help us"

Personally, the researchers observed the following technical and social problems: The site which is surrounded by residences is getting full; many human scavengers work continuously and obviously living nearby the site and interfering work operation at the site for collection of materials such as wood, scrap metals and discarded food. The site is characterized by no leached treatment, no odour or vector control, no rainwater drain-off, no fencing, the area is unprotected area for children, women and scavengers and there is no large scale composting facility available as a disposal option. All of waste collected from the city is dumped in this single place without separation of even organic waste (see Fig. 3). One of the amazing actions observed in the dump site during data collection was that there is continuous burning of the dumped waste due to internal ignition by the waste itself. According to a study conducted in 2005, the organic waste that goes to landfill sites not only pollutes the land and water but also contributes to global warming by producing methane (CH_4). So there should be a way to divert the organic fraction of the waste from the landfill to where it can be used for soil fertility.

Polluted water flowing from waste dumps and disposal sites can possibly cause serious pollution of water supplies. Chemical wastes (especially persistent organics) may have seri-

Fig. 3. Observations at "Koshe" open dumping site

ous effects if ingested, inhaled or touched and can cause gas generation due to continues burning of waste dumped, water resources contamination due to hazardous waste which is toxic to human health. Additionally, smoke from waste causes air Pollution and finally affect ecology.

Solid Waste Transportation

Each sub-city is responsible for transporting site to the final dump site "Rapi" by means of trucks. According to the interview held with the agency, the main challenge in this regard includes trucks that are very old, maintenance difficulties, negligence of drivers, and frequent accidents. The vehicles carry only a single container at a time to disposal site with maximum capacity of $8m^3$ or 2160kgs. Private institutions which have capital of up to 10,000 are obliged to transport their refuses to the landfill site using their own trucks.

5. CONCLUSIONS AND RECOMMENDATION

Solid Waste Management is one of the important obligatory functions of not only urban local bodies but also of rural local bodies. But this essential service is not efficiently and properly performed by the concerned bodies of Addis Ababa resulting in various sanitation, social and environmental problems. Waste management problem is complex because it involves a multitude of scientific, technical, economic and social factors. Similarly, it is observed that lack of financial resources, institutional weakness, improper selection of technology, transportation systems and disposal options, social problem associated with apathy towards environmental cleanliness and sanitation have made this service unsatisfactory and inefficient in the study area.

Though there is no single readymade solution to control the waste problems, the authors found it important to indicate issues requiring serious attention of concerned bodies:

The data on generation rate was done more than two decades ago and the percentage contribution of each solid waste source might have changed through time due to the change in demographic and socio-economic conditions of the residencies. Therefore, further study is needed to gene-rate more valid data for current and future planning.

Due to the complexity of the situation, cooperation among different parties/citizens sho-uld be methods of choice and industries and individuals should work as partners rather than adversary to find a long-term sustain-able system.

The estimates indicate that over 95% of the

refuse from most households is largely vegetable, biodegradable organic waste which has a potential for replacing inorganic fertilizer to save foreign exchanges earn-ing, also strengthening and implying rural-urban-linkage. Composting has to also be promoted by all actors who have the concern in poverty alleviation's and environmental protection. Also, attention should be given to reusable household wastes.

Land filling requires special attention; standard measures should be exercised to control contamination of surface and ground water as well as air. But none of these practices are apparent in the land fill site of the city. Being reluctant on the issue needs accountability for environmental cost/ pollution cost of water resource contamination from dump site/, cost of closing an old landfill and developing a new one

Waste generation is increasing from time to time, as a result the dump site is getting full and beyond the capacity to sink the waste generated. Therefore, new landfill site is urgently needed with proper selection of the site/ environmental impact assessment and construction.

Waste needs proper management. The first priority should be to segregate wastes, preferably at the point of generation, into re-usable and non-reusable for waste reduction and changing in to financially viable mate-rial; hazardous and non-hazardous com-ponents for avoidance of hazardous/ con-taining products and waste worker safety. Some wastes are highly hazardous, e.g. hospital and industrial wastes, requires care-ful collection and storage, and can be ex-pensive to treat. Nevertheless, minimization and raw material substitution options should be preferred in dealing with this waste.

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