

*Review*

# Domestic waste management and its environmental impacts in Addis Ababa City

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Addis Ababa city's solid waste is a threat to the environment as only 65% produced per day is collected and disposed, 5% is recycled, 5% is composted, while the remaining 25% is uncollected and dumped in unauthorized areas. As the municipal wastes are dominated by domestic wastes, their management and associated environmental impacts is worthy of attention. The review aimed to examine the sources and impacts of domestic wastes and evaluate the existing waste management practices through field visit, discussion and review of documents. The solid waste generation rate is 0.45kg/capita/day; while around 100,000 m<sup>3</sup> waste water is also produced per day from domestic activities alone. Wastes collectors participate in the waste management, with service charges of 20% of the water consumed for residential houses. The city is still dependent on 'Reppi' dumping site that receives over 750 tons of solid waste per day. Inadequate domestic waste management creates a range of environmental problems. The collection and treatment of waste water is complicated by the absence of sewerage networks and treatment plants, as sewer network coverage accounts for 7.5% of the built-up areas. Segregation, treatment, proper disposal, policy and law enforcement and capacity building are potential areas of improvement and research interventions.

**Keywords:** Domestic waste, Addis Ababa, Repi/Koshe, impact of waste, waste management.

## INTRODUCTION

### Background information

The estimated quantity of Municipal Solid Waste (MSW) generated worldwide is between 1.7–1.9 billion metric tons making cities a threat to the environment. It is also expected to increase to approximately 2.2 billion metric tonnes per year by 2025. While in sub-Saharan Africa is approximately 62 million tonnes per year (UNEP, 2013; Hoornweg D. and Bhada-Tata P., 2012).

Despite the accelerated pace of production, waste collection rates are often lower than 70% in developing

countries. More than 50% of the collected waste is often disposed of through uncontrolled land filling while 15% is processed through unsafe and informal recycling. Household waste takes the lion's share in African countries. The estimates of waste generated in Addis Ababa 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<sup>3</sup> (AACAA, 2002). Regardless of increasing volume of waste generated, the performance of the city's solid waste collection and disposal system is poor (WHO, 1996, Edwards S., 2010).

Uncollected garbage is a serious environmental hazard for all, especially in areas where the roads are not accessible for collection deteriorating aesthetic quality of

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the city. Thus, the health situation of the community is under serious threat (ENDA, 2006). Improper waste disposal has resulted in poor hygiene and lack of access to clean water and sanitation in particular by the urban poor. Since wastes are inevitable by-products of consumption and production processes, sound management of waste is therefore necessary to avoid substantial adverse human, health and environmental effects. The urgent need to expand, improve and establish waste collection and management systems will have to be supported by institutional and legal reforms and changes in attitude. However, legal, institutional and administrative framework for the environmentally sound management of waste remains either lacking or inadequate despite considerable progress in formulation and adoption of waste management policies.

Adopting Environmentally Sound Management (ESM) of wastes focused on the promotion of the “3Rs” – Reduce, Reuse and Recycle is needed. Moreover, waste to wealth Initiatives; Corporate Social Responsibility by producers of consumer products; involvement of multiple stakeholders; Public-Private Partnerships and Waste Exchange programmes should be explored.

We live in a world of increasing scarcity. Raw materials from natural resources are limited, financial resources are often insufficient, and securing land for waste disposal is getting more difficult due to the prevalence of the ‘Not In My Backyard’ attitude (e.g. Kotebe solid waste disposal site). Although waste management responsibilities primarily lie with cities and municipalities, the key to success is to collaborate with private sector, communities and in some cases with the informal sector (UN-HABITAT, 2009).

Moreover since the majority of Municipal Solid Wastes come from households (domestic), emphasis should be given to the management system and the associated impacts on the environment (e.g. the surrounding rivers and their services). Even though the city administration is working towards tackling these problems through different initiatives but the result is not clear and not that much perceived by the society. Hence, the current status of the waste management strategy is worthy of assessment and evaluation.

## Objectives

### General objective

This review aims to examine the source and impact of domestic wastes and evaluate existing domestic waste management practices in Addis Ababa city.

### Specific objectives

The specific objectives include:

- Assessing the main components of domestic wastes in Addis Ababa,

- Examining the impacts of domestic wastes on the environment,
- Evaluating the existing waste management strategies at Addis Ababa
- Proposing potential improvement areas in the waste management system.

## MATERIALS AND METHODS

### Study area description

Addis Ababa is a seat both for Federal Democratic Republic of Ethiopia (FDRE) and Oromiya National Regional State Government and is a diplomatic capital and head quarter for different organizations. Geographically, Addis Ababa is located between 8°55' and 9°05'N Latitude and 38°40' and 38°50'E Longitude and covers an area of 540 km<sup>2</sup>. There are 10 sub-cities (*Kifle ketema*) and about 99 Kebeles (AACA, 2002) with a population of about 3.5 million with eight percent annual growth rate, density of 5936.2/km<sup>2</sup> (CSA, 2007).

### Data collection

The necessary data for the review were collected from both primary and secondary data sources. Important discussions were made with representatives of Addis Ababa Environmental Protection Authority, Addis Ababa Water and Sewage Authority, and Addis Ababa Solid Waste Management Agency representatives. The primary and secondary waste management sites and practices, Repi/Koshe (the city's solid waste disposal site) and the City Rivers were visited. Moreover, informal discussions were made with residents living at riversides and near Reppi/koshe. Secondary data from published and unpublished documents were referred.

### Domestic waste management

#### Definition and components of domestic waste

Domestic wastes are wide variety produced from household activities such as food preparation and consumption, sweeping, washing clothes, burning, and garden wastes, and used items like clothing, furnishings, and abandoned equipments. It includes both solid and liquid and sometimes hazardous wastes generated from residential areas and sometimes referred to as household wastes.

#### Domestic solid waste

Domestic solid waste refers to wastes produced from residential areas from day to day activities called

**Table 1.** Solid waste generation and disposal in Addis Ababa city from 2010-2012.

Detailed information	2010	2011	20012
Average amount of solid waste generated (m3 /day)	2,585	5,367	5,613
Number of vehicle in charge of waste disposal	79	99	78
Capacity of vehicle in collection of waste product (m3)	943,518	1,178,935	1,304,340
Waste disposal in m3	60,225	72,570	*
Amount of waste used for composite (m3/day)	2,749	3,450	3,574
Number of institutions engaged in waste disposal	529	527	539

**Source:** Addis Ababa Cleansing Management Agency, 2012.

**Table 2.** Daily solid waste generation (2005).

Sector	Contribution (%)
Households	76
Street sweeping	6
Industries	5
Hotels	3
Commercial and other institutions	9
Hospitals	1
Total	100

**Source:** Addis Ababa Cleansing Management Agency, 2012.

"household" solid wastes (Edward, 2010). These kinds of wastes in lower income countries are dominated largely by food and ash wastes and accounting for the highest proportion of municipal solid wastes, for instance, about 75% in developing countries (Solomon, 2006). According to the city government (AACCA, 2009), of the total solid waste generated 76% is from residential, 9% from commercial areas, 6% from street sweeping, 5% from industries, 3% from hotels and 1% from hospitals. The Per Capita solid waste generation rate is 0.45kg/capita/day and as a total 1,020,000 kg or 3,063.06 m<sup>3</sup> with density of waste per year and 330 kg/m<sup>3</sup> per day. There is 5% rise urban waste generation per year (EPA and WB, 2004; AACCA, 2009). From the daily solid waste generated 65% is collected, 5% recycled and 5% composted. The remaining 25% is simply dumped on open sites, drainage channels, rivers and valleys as well as on the streets. 70% of the waste generated comes from households, 9% from commercial areas and 6% street sweeping, 5% from industrial waste and the remaining from hotels, hospitals etc. and the estimated physical composition is as follows: vegetables 4.2%, paper 2.5%, rubber/plastics 2.9%, wood 2.3%, bone 1.1%, textiles 2.4%, metals 0.9%, glass 0.5%, combustibles leaves 15.1%, non-combustible stones 2.5% and all fines 65% (AASBPDA, 2003). However, the contents vary along with the change in the socio-economic situation of the society and the seasonal variation (World Bank, 2010).

The composition of the residential waste is also changing into higher proportions of plastics, papers, packaging

materials and alkaline batteries. Residential solid waste contains rapidly decomposing animal and vegetable matters which are the bi-products of the handling, preparing, cooking and consumption of food, paper, cardboard, textile, ash, wood, old furniture, old household utensil and so on (Edward, 2012; WB, 2010).

The rapid population growth rate of 3.8 percent (CSA, 2007) is also resulting in a rise of approximately 5 percent of urban waste generation. This implies that the current waste collection and disposal capacity of the city could not match with the growing population and generation of waste. Consequently, the sectoral and compositional contribution of wastes has shown tremendous growth (see table 1 and 2) (Abdulshukur, 2007).

The remaining 20 percent of waste is disposed off through informal means, except smaller percentage going to incineration, dumped on open sites, drainage channels, rivers and valleys as well as on the streets. The rivers that cross the city, are widely used as disposal sites, although the hygiene and environmental sanitation regulation issued by the Addis Ababa city administration [Proc.No.1, 1994] prohibits people from disposing waste along roads, avenues, rivers, ponds, and other sites. Due to lack of proper means of discharging their day to day waste, it becomes difficult to implement the proclamation, directives and rules that result in a continuous violation of regulation by the people.

### Domestic liquid waste

Domestic liquid waste from overflowing and seeping pit latrines, septic tanks, public and communal toilets, open

ground excreta defecation, etc. comprise the municipal liquid waste. It is estimated that approximately 100,000 cubic meter waste water is produced in Addis Ababa per day from domestic activities such as bathrooms and kitchens alone as 80% of the consumed water is disposed in the form of waste. In addition to this 30% of the city dwellers have no facility at all to dispose of their liquid waste (Mohammed and Elsa, 2003). The city administration is only capable of treating 10% of the liquid waste produced in the municipality. So, sanitation and sewerage management and disposal is a serious socioeconomic problem of the city as the system is not well developed.

The sewage system which was commissioned in 1981 serves only the central part of the city and less than 10 percent of its residents. Moreover, the system does not operate its full capacity. For example, the Kaliti plant, which according to the 1993 Addis Ababa Master Plan Study for the Development of Waste Facilities, should be capable of serving up to 1 75,000 people, actually serves less than one third of its capacity. The available on-site sanitation systems include septic tanks and various types of dry-pit latrines. Of Addis Ababa's total population, about 1,459,000 use dry-pit latrines, 175,000 use septic tanks and some 700,000 people do not have access to any sanitation facilities. According to the 2011 survey study of CSA, 14.9% of housing units of Addis Ababa had flush toilets, 70.7% pit toilets (both ventilated and unventilated), and 14.3% had no toilet facilities.

Girma (2004) examined that most public and private shared latrines in the city are unventilated, overused, unlined, collapsing and overflowing. On average, 34 people share a pit latrine. The shared latrines, sandwiched in between houses in collapsing superstructures, are overused and overflowing with raw sewage. Due to the lack of toilet facilities, roads often overflow with human excreta and garbage. The communal latrines provided are often blocked with all types of garbage and overflow into the streets. However, since most of these toilets are not connected to the main sewer network, septic tanks, cesspools and open waterways are used instead for discharging sludge. Most of the sludge is washed into the nearby streams during the rainy season or percolates into the underground water table - the main source of borehole water for domestic use in most parts of the city.

Recently, efforts have been made to restructure and improve the system through utilization of new technologies in the existing treatment plant and establishing three centralized waste water plants in three catchments: Kaliti, Akakai and one at the eastern catchments. And decentralized waste treatment plants will be installed in selected areas especially around condominium houses (AAWSA representative).

### **Domestic hazardous waste**

Household hazardous waste is the discarded, unused, or leftover portion of household products containing toxic chemicals. Although the quantity is small when compared

with non hazardous components, these wastes cannot be disposed of and treated in regular garbage. Hazardous wastes cannot be treated like other kinds of garbage. Examples of hazardous wastes that may be found around homes include: antifreeze, batteries, brake fluid, chemical strippers, chlorine bleach, contact cement, drain cleaners, fire extinguishers, flea collars and sprays, herbicides, insecticides, kerosene, lighter fluid, lye, nail polish remover, old propane tanks, paints, pesticides, prescription drugs, solvents, toilet cleaners, used motor oil, e-wastes (<http://www.ns.doe.ca/udo/put.html>).

### **Environmental Impacts of domestic wastes**

#### **Ecological impacts**

Due to inadequate domestic waste collection and disposal considerable amounts of waste in developing countries ends up in open dumps (World Bank, 2012) or drainage system, threatening both surface and ground water quality and provide a breeding ground for pests.

Open air burning and spontaneous combustion in dumping site, are among the causes of air pollution and unpleasant odour (Nigatu et. al., 2011), more exacerbated in slum areas where there is lack of garbage collection containers. It also leads to loss of productive land due to the presence of non-biodegradable items and contamination of soil, ground and surface waters by leachate. Buried hazardous domestic wastes can filter down through the soil and contaminate groundwater. Pouring hazardous liquids on the ground can poison soil, plants and water (EPA, 2004).

Current literatures also reveal that most of the Addis Ababa city waste ultimately finds its way into the clogged city streams and rivers ending up in inland water bodies such as the Aba-Samuel Dam, one of the main sources of water supply to the city. In addition to solid wastes, household liquid waste is an environmental problem. Liquid waste disposed to sewer drains into surface water courses causing pollution of the aquatic environment with resulting health hazards. And the consequences are very clear as the trend persists (Abebe, 2001; Tessema, 2010).

#### **Socio-economic impact – health, conflict around landfills**

More than 200-300 waste pickers per day work continuously and obviously living nearby the site for collection of salvageable materials such as wood, scrap metals and discarded food. The adverse effect of inadequate waste management service on productivity and economic development of the city is very significant. Inadequate collection, transport or improper disposal of household waste can have adverse health impacts.

**Table 3.** Solid waste related diseases and morbidity in AA (annual report 1997-1999).

Diseases	1997	1998	1999
1. Parasitic infection	7887	36827	36845
2. Bronchitis	38100	28 849	28 780
3. Skin diseases	34426	27 119	27 047
4. Broncho pneumonia	30219	25 744	25 158
5. Dysentery	20782	13 596	14 631
6. Bronchial asthma,allergic	11607	7 677	6 291
7. Other respiratory diseases	7 932	3 845	7 532
8. Typhoid	6 596	3 622	4 046
9. Influenza	3 593	1 905	1 858
10. Trachoma	1 619	1 015	1 346

Potential health hazards from accumulation of polluted water, which provide breeding grounds for mosquitoes and attract flies, vermin. Lack of the most basic waste services in crowded, low-income areas is a major contributor to the high morbidity and mortality among the urban poor (see table 3). Also, there may be injuries from infected sharp materials leading to transmission of HIV virus, etc (Mazhindu et. al., 2012).

The surveys by Abebe (2001), Tadesse (2004) and Tessema (2010) attribute the proliferation of pathogens in the living areas of poor homes and neighborhoods to a combination of inadequacies in the provision of sanitation facilities, inappropriate anthropogenic practices of sanitation at household level and the current waste management problems. The cramped living conditions and the presence of pathogens in the home environments due to the lack of basic infrastructure; the dangerous and unhealthy sites of some neighborhoods due to the irregular or non-collection of garbage and the city-wide problems of toxic or hazardous waste disposal pose the major threats to the health of most residents in city (Mazhinda et. al. 2012).

According to Alebachew *et al.* (2004), deficiencies of sanitary services, low capacity for urban waste management and the absence of regulations and scientific criteria for enforcement pose increasing environmental and public health hazards in the major towns of Ethiopia. The studies by Girma (2004) and Tadesse *et al.*(2005) suggest positive relationships between the worsening environmental health status of Addis Ababa and the current uncoordinated waste management and refuse disposal practices playing out at all levels in the ten administrative sub-cities of the capital. The current uncoordinated approach to waste collection and disposal led to the high incidence of waterborne pathogens such as cholera, typhoid, and amoebic infections accounting for four fifths of all diseases in the country (Girma, 2004). Other health impacts include: respiratory tract, dermatological and sight problems,

noise nuisance, diarrheal and children less than 10 years play with condoms and other used medical utensils including syringes and needles.

### Existing waste management of AA city

#### Domestic solid waste management

Conventional waste management dominates: waste collection, treatment (composting and incineration) and disposal (landfills). Only limited attempts are made to adopt integrated waste management practices: waste reduction at the source, resource recovery and recycling. The collection rate remain low and the quality of collection services are poor (Abdulshikur, 2007; Nigatu et. al., 2011).

Limited technological and economic resources result in the prevalent low standards of waste management which is exacerbated by public perception of waste disposal. Involvement of the private sector and communities in waste management services is still very limited. The wastes collected typically end up in open dumps, where they may be burnt, and in some cases are deposited in illegal dumping sites. While an ever-increasing volume of waste is generated, the effectiveness of the solid waste collection and disposal systems are declining in Addis Ababa city (Mohammed and Elsa, 2003).

As an effort to improve SWM, the service provision was transferred to Addis Ababa City Sanitation, Beautification and Park Development Agency in 2003 to make the city naturally balanced, green and favourable environment through integrated solid waste management and urban recreational area development.

#### Waste collection and transportation

Addis Ababa city started its solid waste management some four decades back but currently the service cannot meet the changing demands. The social waste collection

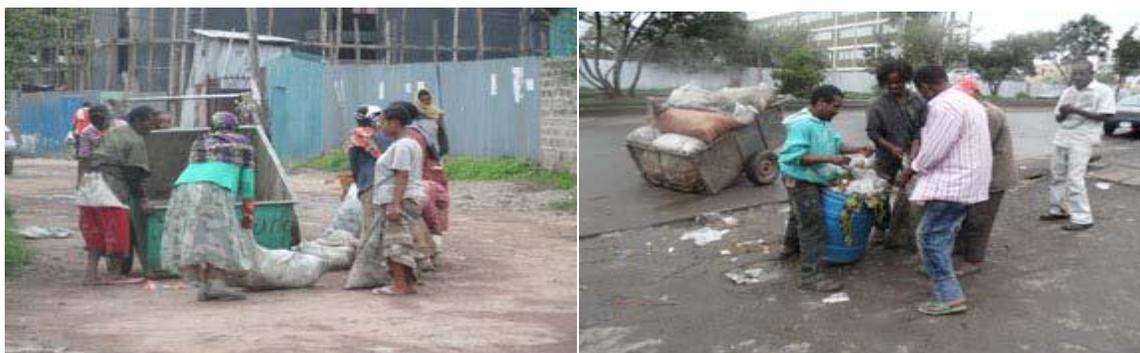


Figure 1. Waste pre-collectors in Addis Ababa.



Figure 2. Waste containers in Addis Ababa.

service is unsatisfactory, and scenes of scattered waste are common in most part of the city (UNDP, 2004). According to the existing policy, solid wastes are collected by the government employees, private companies' based on contractual agreements and Micro and Small Enterprise. However, the principle, stating that the waste producers are subject to put their wastes into different containers based on specific type of wastes, is not practiced in the city (Hayal et.al., 2014). There are two sub-stages of waste collection: primary and secondary collection.

**Primary collection**

Is done by micro and small enterprises having formal agreement to collect from households and dump them in designated containers. There are about 750 micro and

small enterprises organized to pre-collect waste from household. They use door-to-door method (see figure1) to collect and dumped in another container to be picked by secondary collectors, the sub-city and private companies, and then dumped at the City's landfill. The collection is currently handled in different types of collection systems namely the door-to-door, curbside, set out, the block (container) collection systems and the street sweeping. The door-to-door collection system is applied for households and is carried out by MSEs by walking the short distances from house to house. Each house owner put wastes in baskets, sacks, plastic bags or other suitable materials at the door side so that the collectors pick using the pushcarts (see figure 1) to a common temporary storage for the trucks to pick them up to the disposal site. Some of the storage areas could be street sides and pedestrian walkways (see figure 2).



**Figure 3.** 'Reppi', waste disposal Site (top) and compaction of the site (bottom).

However, the regularity and frequencies of collection are not always maintained due to the less number of laborers with their low payment (Hayalet. al.,2014).

Curbside collection is the most common practical method where different sized containers are kept near the street corners and street crossings so that householders deposit their wastes on them using baskets, bags, sacks, or other suitable materials. Payment for the collectors is volume based rate (30birr/m<sup>3</sup>). Service charges are collected with water consumption rate. Residential houses pay 20%, commercial houses 42.5% of the total water consumed.

Although large proportion is collected by the MSEs, private companies and employees also participate. However the contribution of private companies is still low as compared to the government share. Due to shortage of containers collected wastes are improperly stored on open spaces and roadsides (see figure 2) (Hayalet.al., 2014).

### Secondary Collection

Is a system of transporting solid wastes from containers to final dumping site, undertaken by the municipality which represents the highest level in transportation system. The role of the private sector in this system is limited.

### Waste disposal

Until the start of 2016, Addis Ababa city was using 'Reppi' or 'Koshe' open dumping site for all solid wastes, which has been in operation since 1950s receiving over 750 tons of waste per day. It is located 13 km South West of the city covering about 25 hectare. It is bounded by ring road and residential areas straight without any protection for human and animals (see figure 3). It is

managed by Addis Ababa City Sanitation, Beautification and Park Development Agency (AACSBPDA) since 2003. The method of disposal was crude open dumping; the waste is placed on flat land: hauling by truck, spreading and levelling by bulldozer and compacting. Since the start of 2016, Reppi was closed and shifted to another disposal site constructed at Kotebe area, north of the city, although it didn't last long.

Latest figures show that about 765 tons of wastes are being produced daily and is expected to increase significantly in the future. It has been estimated that about 80 % of the wastes are municipal waste, which is highly dominated by domestic waste. Solid waste segregation at the point of generation is not carried out, 80% of the waste produced is dumped with a low percentage being reused or recycled. Since once in the dumping site, paper, garden and food waste decompose under microbial action into various gases, water and other compounds, it can be deduced from table 1.1 that more than 80% of the wastes are biodegradable (shown in figure 4).

### Domestic liquid waste management

The absence of sewage networks and treatment plants complicates the collection and treatment of waste water in Addis Ababa. It has a very limited sewer network coverage accounting for 7.5% of the built-up areas (MUDHCo, 2012). Since parts of the older sections of the city are only connected to the central sewer system, both residential and business premises use septic tanks although their availability is severely limited in many of the old neighborhoods (MUDHCo, 2015). Even though the city has a centralized sewerage system (sewer line) and two Waste Water Treatment Plants (at Kotebe and Kaliti) they are currently operating below their capacities of, 350 and 7500 cubic meters per day respectively due



**Figure 4.** 'Reppi' solid waste dumping site.

to inefficient waste collection. Nowadays it can be said Kality site is the only functional waste water treatment plant. The majority of the transportation service is covered by private vehicle owners and investors.

### **Measures to combat waste management problems**

#### **Integrated Waste Management (IWM)**

As a consequence of conventional waste management practices, Addis Ababa is facing environmental and health risks as well as losing economic opportunities in terms of the resource value of the waste. Hence, a paradigm shift from conventional waste management practices to Integrated Solid Waste Management (ISWM) is essential to effectively manage the waste stream. ISWM is a comprehensive waste prevention, recycling, composting, and disposal program that considers how to prevent, recycle, and manage waste in ways that most effectively protect human health and the environment. The main areas to be focused in implementation of ISWM strategy for Addis Ababa city are discussed below.

#### **Waste avoidance and minimization**

The generation of waste should be reduced to a minimum in terms of quantity and/or hazard potential. The marketing of goods in reusable containers, which could be returned to the supplier and be reused, is one example. Waste generation could sometimes be reduced if commodities were available in bulk quantity to a retailer who would sell the goods in smaller quantities, thereby eliminating the need for as much packing. Packaging of goods for aesthetic reasons could be discouraged, as

could the supply of a small item in a large package for marketing reasons. Waste avoidance and minimization practices in Addis Ababa city is considered as absent or negligible.

#### **Segregation at source**

The resource value of waste cannot be realized unless separation is practiced at the source. 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, or at a number of temporary sites (Mohammed and Elsa, 2003). This will promote recovery operations, and prevent pollution or damage to human health. There is no formal segregation and separation of wastes in Addis Ababa city. However, informally some households separate few recyclable wastes and sell for informal recyclers (EPA, 2004).

#### **Solid waste transfer stations**

Transfer stations are intermediate places where solid wastes are deposited and stored until transported to the final disposal site. However, they are not given due consideration in the solid waste management system of Addis Ababa development plan. The collected wastes are stored at roadsides and other corners of the city until they are transported to the city's disposal site. Moreover, the collected wastes are totally kept open without cover and exposed to rain and sun making them to produce superfluous odor, cause hideous urban panorama, attract vectors and disturb human activities in the surrounding

area (Hayal et.al. 2014). So, the city administration is expected to solve this problem.

### **Solid waste preliminary treatment**

The ISWM principles state that the collected solid wastes need to be segregated into various types for the purpose of recycling, reuse or transformation at various levels. Therefore there must be treatment processes before disposal to separate the recyclable and reusable resources out of the wastes. However, almost all the collected wastes are transported to the open disposal site without segregation. It is not also binding at present to separate recyclable or reuse materials from the collected wastes at the city level. However, informal recyclers at small-scale level are accomplishing some form of sporadic recycling manually though it is insignificant. There are craftsmen, who recycle metal, wood, rubber, clay to provide essential goods to great number of customers. Participation of the informal waste collectors and recyclers need to be encouraged with financial or technical support from the city government (Hayal et.al., 2014).

### **Solid waste transportation**

Like other cities of the developing world, Addis Ababa is facing shortage of equipment to transport its waste. Waste collecting trucks are not available to the level demanded and even some of the available trucks do not perform at daily bases due to their old age, accidents and maintenance issues. All the trucks carry a single container with maximum capacity of 8m<sup>3</sup> or 2160 kg at the time of disposal. Since the trucks have no cover for the waste containers, they drop wastes in the city on their way to the disposal site (Hayal et.al.,2014). With the increasing trend of waste production comparable transportation and equipment should be available.

### **Solid waste disposal**

Disposal is the ultimate stage in solid waste management system for those wastes that have no further use to society. However all the generated solid wastes have not been collected and disposed properly. There are still some city dwellers who dispose wastes in their respective premises which have to be avoided. Addis Ababa was using open dumping at 'Koshe' at 'Reppi', located 13 km away the outskirts of the city. The site is part of the city now due to expansion affecting the residents and institutions found there. The disposal system is unhygienic having a negative impact on health of the surrounding neighborhoods and the environment (World Bank, 2001, Mazhindu et. al. 2012). However, the existing situation has pushed the city government to construct sanitary landfill as it was

proposed in the city's development plan to establish four landfill sites in the eastern, northeastern, west and southwest part of the city. However according to Hayal et al. (2014) this plan was changed into constructing a landfill site some 35 km away from the city centre around Sendafa, north of the city. The preparation for the establishment of the landfill site has been ongoing since 2010 and started functioning at the start of 2016. However, after 6 months service the local farmers opposed and conflict broke out. Now the city government has returned to the old site despite the site has reached its full capacity. This shows the need of ISWM decisions on how to handle wastes in a way that must take into account the environmental, economic and social dimensions (Hayal et. al., 2014). The city government in collaboration with a foreign firm is building a facility to convert the solid waste dumped at Repi/Koshe site in to methane and produce energy.

### **Policy, Legal and institutional framework**

The SWM strategy mentions lack of strong political commitment for SWM; challenges to streamline existing legal and regulatory frameworks; absence of mechanisms that would ensure inter-institutional collaboration; limited managerial and technical competencies in municipal SWM operations; and lack of service delivery standards as gaps in waste management (MUDHCo, 2015).

The Addis Ababa City Administration was the first to issue a SWM policy in 2004 and SWM regulation in 2005 in response to the enormity of the SWM-related problems faced by the city. The SWM Proc. No. 513/2007 (FDRE, 2007) recognized SWM related challenges as a nationwide concern. Other key legislations related to waste management include Environmental Pollution Control Proc. No. 300/2002 and Environmental Impact Assessment Proc. No. 299/2002, Amendment of the Basel Convention Proc. No. 356/2003, Ratification of Kyoto Protocol Proc. No. 439/2005, Environmental Protection Organs Establishment Proc.No.295/2002 and Establishment of the Environmental Protection Authority Proc. No. 9/1995, which is recently reorganized under a new Ministry for Environment and Forests. However, the existing SWM proclamation does not provide a comprehensive framework for sustainable SWM. Existing legislations do not elaborate on all principal waste streams, namely municipal, industrial, construction, biomedical, agricultural and e-waste as well as all phases of integrated solid waste management (ISWM). They also fail to specify the need to institutionalize the licensing and regulation of SWM operations by municipalities and other actors (MUDHCo, 2015).

Ethiopia has national solid waste proclamation dealing with comprehensively with all aspects of SWM being

used in all its federal states. Federal Environmental Protection Authority (EPA) is given the authorization in setting rules, laws, regulations, and standards as well as imposing penalties for non-compliance regarding the management of solid waste. Ministry of Health is also responsible at the Federal level to play a principal role in issues related to "Public Health and Sanitation" for which SWM has been given to Addis Ababa Solid Waste Management Agency since January 2010. National Environmental Policy, National SWM Proclamation, City Charter, City's SWM policy and City's solid waste regulation are existing policy and legal issues being used. As per its development plan Addis Ababa has started encouraging private companies and Micro and Small Enterprise Unions to participate in SWM since 2004. Currently there are 6 private companies and 521 MSEs with more than 10,000 operators collecting from households, institutions and commercial areas.

### Research interventions

One of the critical gaps in improving waste management operations is the absence of institutionalized research on different aspects of waste management. On the other hand, the absence of accurate and reliable data on waste management is among the major factors determining the quality of operational plans. Moreover, neither environmental protection agencies nor waste management service providers are engaged in research, as they are bogged down with routine operations (MUDHCo, 2015). As a result the necessary information with regard to waste characteristics, impacts and management practices are not available in an organized manner. Hence, a coordinated approach should be implemented in conducting specific research with regard to waste management in the city.

### CONCLUSION

The main burden of the city's municipal wastes comes from residential areas, making them the main focus for the waste management strategy. Despite the long history of the practice, for almost 60 years, of waste management the progress when compared with the degree of urbanization and population pressure is not as expected. Nowadays wastes become more complex and the quantity has also increased from time to time. Addis Ababa city administration is also working to increase the efficiency of waste collection and disposal practices. Although the burden of managing the municipality's waste is on the city administration, recent involvement of private sectors and micro and small enterprises is the good decision. It plays a great role in creating job opportunities and improving the socio-economic status of

the city's poor. Lack of awareness and enforcement are some of the challenges facing SWM.

### RECOMMENDATIONS

The city administration should focus on integrated waste management technologies and increase the capacity of the informal sector participating in waste management hierarchy. Institutional capacity building must also be considered. Strong networking opportunities within the sub-cities is also required to facilitate information flows. A system of fees for the treatment of collected solid wastes should be gradually introduced. The legal frameworks must also be put in place along with effective enforcement mechanisms to implement the existing pertinent laws and policies. Penalties should be practiced on those who do not obey the laws. Enhancement of the participation and role of NGOs, private sector and communities must also put in place.

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