

URBAN WASTE MANAGEMENT SYSTEM AND ITS PROSPECTS IN LEGETAFO TOWN: THE VICINITY OF ADDIS ABABA

Nibretu Kebede¹ and Degefa Tolossa²

¹. Center for Environment and Development, College of Development Studies, Addis Ababa University.

². Center for Rural Development; College of Development Studies, Addis Ababa University.

ABSTRACT

Unscheduled waste collection and failure to take appropriate and timely measures on individuals disposing wastes in unauthorized areas are not given adequate attention and becoming a major threat to sustainable waste management in the town of Legetafo. The study assessed the current situation of wastes, the causes and consequences when disposed randomly and provides some insights as to how wastes are managed in the town. It attempted to relate the actual practice in the study area with the theoretical frameworks and experiences of other countries using narrations and deductive reasoning. The study indicated that the municipality has limited waste collection facilities, employed few waste collectors (only the municipality itself and micro enterprises¹), ignored the residents and Community Based Organizations (CBOs)² and adopted the customary top-down approach to waste management process. The study, then, concluded that setting differential service rates by considering the nature and volume of wastes generated, involving various stakeholders at different stages of waste management and adopting the matrix organization can ensure check and balance among them and enforce the waste management rules and regulations as well as the keys to sustainable waste management in the town.

Keywords: Sustainable waste management, Legetafo town, Municipality, CBO, Micro enterprise, Stakeholders

¹ Micro enterprises are informal groups that provide door to door waste collection service.

². Community Based Organizations (CBOs) refer to local organizations such as Idir, development associations organized by the society and welfare groups.

INTRODUCTION

Sustainable waste management is a major challenge of all cities in developing countries and failure to properly manage it can cause various problems on citizens (Cheever, 2011). The problem is much complicated due to accelerated population growth, urbanization, increased economic activities, lack of training in modern waste management practices, inadequate human and financial resources; facilities, infrastructure and technologies (Ahsan, et al., 2014).

The growth of population at a rate of 2.46% (UN, 2018) in Ethiopia, increased number of migrants to Addis Ababa and the surrounding towns, informal settlements and increased consumption has led to increased generation of solid wastes. The high cost of waste management, the limited facilities, capacity and performance of waste collection, processing and disposal in a cost effective system have made the efforts of waste management more complex in Legetafo. Above all, 25% of wastes of Addis Ababa (Mohammed & Eyasu, 2017), animal dung and residuals processed by butcheries in the surrounding areas are often disposed in the vicinity of Addis Ababa.

Disposal of wastes in unauthorized, public spaces, sewerage systems and ditches, lack of understanding the factors affecting the different stages of waste management and the linkages necessary to establish among the various stakeholders have complicated the entire waste handling system (Cheever, 2011; Guerrero, Maas, & Hogland, 2013). Particularly, inadequate waste collection and health problems in Legetafo are the most important manifestations of unsustainable waste management in Urban Ethiopia (Mahiteme, 2005).

Nowadays, this action has exacerbated social, economic and environmental hazards, contributing to the deteriorated quality of life in the town of Legetafo and becoming the cause for widespread political discourse. The problem is mounting in urgency especially in the hinterlands and areas where the roads are not accessible for collection.

Theoretically, solid wastes are categorized based on (Rushton, 2003; Cheru, 2016) 1) the origin such as residential, industrial, commercial and construction; 2) the place where it came from such as those generated within Legetafo, from the surrounding rural areas and the metropolis like Addis Ababa; 3) material content such as food scraps, organic wastes, plastic materials and packages, used cloths, broken glass and bottles, grass clippings, etc.; and 4) hazardous level such as flammable, infectious/toxic or non-toxic like dead bodies of animals, spoiled foods and human wastes that affect the lives of the residents and waste collectors.

In developed countries like New Jersey, wastes are clearly categorized and the amount is estimated. The experience of Middlesex County also shows that suburban, urban, and rural population generates about 2300 tons of refuse for disposal per day and recycling education reaches to all contributors (Middlesex County, 2012).

This study tried to assess the existing waste situation, causes and consequences of waste disposal and attempted to address questions such as “Where wastes come from? What are their consequences? What are the sources of financing? Who are the stakeholders? What strategies are needed to enforce waste management laws and ensure sustainable waste management practices?

STUDY AREA AND METHODS

The Study Area

Legetafo is one of the most populated towns in Oromia state located 9°2'43"N 38°52'26"E of Addis Ababa. It is situated at 2,388 meters above sea level and one of the capital city's major expansion areas. The city of Addis Ababa in the West and North and the town of Legedade in the East and the district of Gewassa in the South are bordering to it (Fig. 1).

It is one of the eight towns under the special zone of Oromia region (Zenebe, 2008) and the major attractions for manufacturing, food and agro processing, storage, and real-estate activities (OWWDSE, 2011). Its development mainly depends on natural resources and the potential development of the urban hinterland, Addis Ababa. The town is located on the upper stream of Addis Ababa and relatively sloppy where the major water supply of the capital such as Legedad Dam and Akaki Rivers originate.



Source: Adopted from (OWWDSE, 2011)

Fig. 1. The location of Legetafo town, the city of Addis Ababa and Oromia State

Methods

Even if quantitative data are scant, combinations of analytical and deductive reasoning methods were used in this study to assess the stakeholders and the factors influencing the performance of waste management in Legetafo. The paper tried to view the waste management process by taking into account of the legal framework, sources of financing, stakeholders' involvement and facility management including trucks and waste containers. Data were generated both from primary information generated through field visits and existing literatures. Informal discussion with inhabitants, interviews with waste collectors and personal observation of the study area were the major sources.

Above all, the frequency of waste collection, the way residents dispose wastes, the availability of waste collection facilities, the attention given by local authorities, the functioning of institutions in the outskirts of Addis, etc. are compiled from one of the authors' Knowledge and long years of living experiences with the community in the area.

Finally, descriptive and qualitative approaches were used to understand the existing waste management system in the study area and its complex reality.

RESULTS AND DISCUSSION

Laws Governing Waste Management in Ethiopia

Ethiopia has issued proclamations related to waste management and environmental pollution control. The Environmental Protection Authority is authorized to execute these and issue policies related to human settlement patterns, urban environment and health, control of hazardous materials, pollution from industrial waste and climate change (Cheever, 2011).

The first proclamation regarding solid waste management in Ethiopia was set in 2007. with the objective of enhancing capacities of waste management at all levels, promoting community participation, designing waste management action plans and prevents the adverse effects to create economically and socially beneficial environment to the residents (Negarit Gazeta, 2007). It coordinates the activities of various departments, specifies the responsibilities of urban actors in handling different types of wastes and sets guidelines for transporting and disposing wastes to ensure all Ethiopians live in a clean and healthy environment (Forum for Environment, 2010).

It identified the parties to be involved and their obligations in waste management at various stages. The Environmental Pollution Control Proclamation (EPCP) specifically gives an exclusive right to all urban governments to devise and implement safe and effective mechanisms (Table 1).

The rules and regulations impose various penalties and require residents and organizations to clean their surrounding areas up to 20 meters and 50 meter radius, respectively, from the place where they are. It enforces households to sort their wastes before disposing into waste disposal containers and obliges someone to go up to one km to find containers before randomly littering and disposing wastes. These laws and regulations are expected to be practiced in all cities of Ethiopia.

However, in most cases, residents of Legetafo do not follow these rules and regulations. Many people are consistently violating the rules and very little has been done to enforce them. The regulations are found to be considerably non-pragmatic. This is partly because the majority of the residents do not know the existence of such penalties imposed on them and waste disposal facilities and containers are nonexistent at all. As a result, some households who own private cars dispose wastes by transporting to the containers found in Addis Ababa. It is also necessary to note that failure to implement waste management policy can be associated with insufficient fund, lack of expertise, lack of technology and facilities, ineffective monitoring and law enforcement system.

Table 1: Waste management activities and responsible bodies

Major Activities	Specific tasks	Responsible body
1. Reducing wastes at the source	Segregation/sorting wastes	Residents/households
2. Collection and Storage	Providing waste collection facilities, install waste bins alongside streets and other public places, frequent collection waste from bins.	
3. Transportation	Set the standards to determine the skills of drivers and equipment operators and prevent overloads of solid waste.	
4. Waste treatment	Collections, transportation, recycling, treatment or safe disposal of municipal waste.	The city administration
5. Disposal/Landfill	Construction of waste disposal sites and auditing existing solid waste disposal.	
6. Recycling/reusing	collect and recycle glass or tins	Manufacturers/importers of glass, containers or tin cans
7. Hazardous wastes	Take appropriate precaution to prevent any damage to the environment or to the human health/well-being	Any person engaged in the collection, recycling, transporting, treatment or disposal of hazardous wastes

Source: Compiled by the authors from EPCP, SWM proclamation and other literatures

The claim that households should sort their wastes also seems worthless unless the city administration establishes a system of sorting collected wastes and provide substitute plastic containers and extra sacs designed for this purpose accompanied by awareness creation campaigns. It also seems unreasonable to oblige a person to dispose wastes by traveling over 1 km where there are no containers at all in the town that makes difficult for the city administration and residents adhere to the requirements of the law.

Composition and major contributors of wastes in Legetafo

In Legetafo the challenge of solid waste management is mainly associated with absence of data about the nature and amount of each type of waste generated while effective waste management requires a thorough assessment of the characteristics and composition, control of generation from the source, storage, transfer and disposal (Ejaz, Akhtar, Nisar, & Naeem, 2010). Effective waste management also **requires** proper identification of the various individuals and groups that generate and dispose wastes in unauthorized areas, understand their behaviors and waste management practices.

Though difficult to estimate the nature and amount of waste generated, the parties mainly contributing to the existing waste levels of Legetafo town at present are:

1. Regardless of income levels and amount of waste produced, residents permanently living in Legetafo and pay waste service fee regularly;
2. Residents permanently living in Legetafo but reluctant to pay the waste service fee and dispose their wastes in unauthorized place;
3. Temporal residents living in Legetafo (often by renting a house) who neither pay waste service fee nor properly handle their wastes;
4. Individuals walking along the streets and carelessly littering and throw away anything in open areas including their urines;

5. Individuals in the outskirts of Addis and surrounding areas crossing Legetafo and disposing wastes anywhere in the town;
6. Trucks transporting wastes from Legetafo and dispose in the landfill areas like *Gewassa and Woregenu*.³

Causes and Consequences of Wastes

Theoretically, rapid urbanization, economic growth, socio-cultural aspects, poor governance and institutional issues have complicated waste management in developing countries while environmental and climate change problems are the major drivers towards the current paradigms of integrated waste management in developed countries (Marshall & Farahbakhsh, 2013).

Likewise, residents of Legetafo indicated that these processes together with public awareness and participation problems and inadequate waste management led to dumping a large amount of wastes in uncontrolled areas, streets, walkways and sewerage systems. These actions have an impact on the social life, economy and the environment.

1. Social Impacts: Understanding the social implications of disposing wastes randomly is critical in ensuring waste management in equitable and sustainable way. It incorporates the willingness to avoid health outcomes, loss of quality of life and water quality (Cheever, 2011; Dick, 2014). The inhabitants of Legetafo town are more concerned for their hygiene, health hazards and spread of disease. But poor waste storage and disposal is frequently observed. Maids, mothers, travelers, temporary new settlers and people loading and transporting wastes in the town often negligently dispose in uncontrolled and open spaces, drainage, neighboring areas and create littering problems. As a result, the residents indicated the following health and safety related problems:

- Discarded bags generating nuisance and bad smell to humans and consumed by animals,
- Liquids and fumes escaping from deposits are creating fatal health effects by contaminating with the water and caused water born diseases,
- Failure to provide waste collection facilities and open trucks being used for waste collection caused the risk of injury and poisoning the community by dangerous items such as bones, broken glass, blades, and other wastes,
- Blocked drains that greatly contribute to the spreading of mosquitoes, breeding of flies and became a suitable living place for homeless dogs, cats and rats, rodents and insects that spread disease.

2. Economic Impacts: When residents of Legetafo feel sick due to waste related diseases, in addition to exposure to medical expenses, they frequently become absent from their regular work. A waste management activity, thus, should consider the society's access to basic needs, economic returns, welfare and the profitability to various stakeholders involved (Cheever, 2011; Dick, 2014). Waste management costs include investment cost on capital goods or cost of fulfilling various types of facilities needed starting from waste collection and storage to transportation and recycling, cleaning open areas, ditches, maintaining human health and protecting the environment. All these costs might be very high but the opportunity cost of waste management must be evaluated with societal benefits.

³. Gewassa and Woregenu landfill areas are located 9 Kilo Meters away from Legetafo town and selected by Legetafo town and City of Addis Ababa respectively.

3. Environmental Impacts: As revealed by key informants and some residents, improper waste management in Legetafo has the following environmental impacts.

- *Air pollution:* The gasses evaporating from open air dumps and burning of collected solid wastes has brought air pollution in the surrounding areas. When trashes go through incineration process in large volume at Woregenu, burned around residence areas when there is inadequate waste collection and during every November under the culture of “*Hidar Sitaten*,⁴” and when the landfill is over flooded during rainy seasons, it pollutes the air and severely affects the health of the residents in the nearby areas. Illegal slaughtering and throwing wastes in open ditches also caused them to clog and produced an offensive smell.
- *Water pollution:* In addition to blocking drainages and sewerage systems, dispersing wastes randomly in open spaces easily contaminated surface water and Legedade dam.⁵ It may even sink into the underground water and affect the entire ecosystems and the dawn stream residents and caused serious pollution to Akaki River.⁶
- *Soil pollution:* Trashes widely dispersed and easily mixed into the soil are found hurting domestic animals such as cows and donkeys and became very hard to clean it from the soil.
- *Spoiling the aesthetic beauty of the town:* It is common to find plastic materials, and other kinds of wastes thrown randomly, dispersed by wind, floods and animals and often remained uncollected for a long time on the streets, walkways, open spaces and ditches of the town of Legetafo. They spoiled the aesthetic beauty, damaged the cleanliness of streets and public areas.

Thus, environmental sustainability concerns the participation of all residents in the waste management process. Wastes that have intrinsic commodity value such as cans, rubbers, pigs of iron, plastics, etc. are collected by koralios⁷ and traded locally. The stakeholders must work together and play a major role in minimizing the negative effects of wastes and analyze the feasibility of waste management from social, economic and environmental perspective and everyone should evaluate his/her actions based on “*the polluter pays principle*. ”

Estimating and Financing of Wastes

Many literatures showed that the bulk of wastes are produced by households in residential areas followed by wastes disposed along streets, hotels and restaurants, trade and industrial activities. Of the total solid waste generated in Addis Ababa during 2009, 76% came from residents, 9% from commercial areas, 6% from street sweeping, 5% from industries, 3% from hotels and restaurants and 1% from hospitals and health care centers (Mohammed & Eyasu, 2017).

The residents of Legetafo explained that the majority of wastes constitute residuals of food production and consumption, ashes, plastic materials, scraps of construction materials, byproducts of animal processing, etc. The demand for waste collection service in Legetafo is frequently increasing over time associated with urban expansion and population growth while micro-enterprises that provide waste collection service and the facilities remained almost the same for many years. On the other hand the activity of waste picking has low-entry barriers or a job which is easily accessible due to its return

⁴ Hidar Sitaten is a cultural practice whereby every household in Ethiopia involves in burning wastes in the surrounding areas during the month of October.

⁵ Legedadi dam is one of the major towers that supply potable water for the inhabitants of Addis Ababa.

⁶ Akaki River is one of the main tributaries of Awash River (one of the largest rivers in Ethiopia) and the watersheds of Legetafo town and the capital city.

⁷ Korailio is a local language used to mean collectors and buyers of recyclable materials from wastes.

value. They are largely denied access to benefits such as health insurance and pensions, physically debilitate, lack education to accurately assess risks, emotional disable and income imperatives prevent them from protecting themselves. They face health risks due to contact with toxic substances, wastes, used syringes and other materials (Marello & Helwege, 2014)

This problem coupled with lenient supervision and weak enforcement by the kebele⁸ officials led to pile up solid wastes and dumped in the open spaces and the residents consistently claim that wastes are not properly collected and estimating the amount of wastes generated in Legetafo based on different categories is necessary to better understand the problem, decide the facilities needed and measures to be taken.

In financing waste management service in Legetafo, micro enterprises charge US\$ 1.09 (30 Birr) per month from each household without considering the amount and kind of waste generated and their ability and willingness to pay (WTP). Some residents like around Country Club Developers, Roseta Real Estate, near Abakiros Church and Mission have high income and WTP more than what is currently required for improved service. Some households whose income is even low are WTP a fair payment to be set as far as they receive the waste collection service regularly (i.e. at least once in a week).

A waste management activity is sustainable if the revenue generated at least covers the financial costs incurred by the service providers. If the partners do not benefit from the existing fee or any other financial arrangements, the frequency of waste management service cannot be reliable. Therefore, in order to deliver *adequate and equitable* waste collection service over a prolonged period of time, the waste collection fee must be fair, *adequate* to cover the cost of service, economically affordable and viable for waste collectors.

The Latin America experience indicated that embracing waste pickers and social inclusion of the poor in such areas and offers income opportunities to them that does not drain city budgets and an inexpensive way to green the city by increasing recycling and reducing litter (Marello & Helwege, 2014). In this regard, the residents of Legetago town do not believe that the service fee is sufficient unless it is subsidized by the municipality. They are WTP more or share some part of this cost if they are provided with scheduled and efficient waste collection service.

However, many residents are complaining the poor service provided by waste collectors. They give waste collection service once in every 2-3 weeks per month. Sometimes, this interval is even longer and unscheduled. Waste collectors never collect trashes scattered by cats, dogs, donkeys, cows, negligent residents and walkway passengers disposed in open areas. Most of them do not collect the waste that is kept in individual's premises for the fee they are receiving.

The uniform service charge for high, medium and low income households and the rate that does not consider the amount and type of wastes generated by the residents with the poor waste collection service has discouraged and made the residents to become more reluctant to pay the existing US\$1.09 service fee per month. Literatures indicate that the service charge for waste collection can be priced using *flat fees, local tax collection and incentive schemes*. Flat fees and

⁸ Kebele is the lowest administrative unit (equivalent to county in Western countries) in the governance structure of Ethiopia.

local tax collection provide little incentive to reduce waste as producers are not required to incur extra costs in producing more wastes. It does not consider the quantity of wastes generated per capita. Residents are simply required to pay the flat rate and local tax. Incentive schemes or subsidies can be set to encourage for reduced waste generation, combustion, composting, recycling and disposal.

Waste collection fees can be also raised from different sources. In Addis Ababa, for example, waste collectors require a service charge of 20% of the tap water consumed by the residents (Mohammed & Eysu, 2017), US\$ 0.004 per bottle of distilled Eden water and US\$ 0.36/m² limestone from customers for waste service. In Bogundie, Tanzania, households pay US \$1 for waste collection and \$0.50/day for showing how to clean, sort and store wastes at home.

Waste Management System in Legetafo

Wastes are handled in a variety of ways with the primary purpose of reducing its adverse impacts on health, aesthetics, environment, resources and economic concerns with the improper disposal of wastes. The effectiveness of waste management system then can better addressed by considering the stakeholders involved in the process, the facilities and technologies needed and the management approach and organization structure to be adopted.

1. Stakeholders in Waste Management

It is necessary to consider new parameters involved in waste management and develop a model from Ethiopian perspective associated with poor performance of the formal sector. In many countries waste pickers also known as micro enterprises, municipalities and households are almost always stakeholders in waste management. But public representatives, environmental protection, local government and regulatory agencies, businesses investors, CBOs and the society as a whole are often the major responsible bodies with different roles and interests in waste management (Melaré, González, KattiFaceli, & VitorCasadei, 2017; Raines, 2017). The Ministry of Health is also playing a significant role in issues related to public health and sanitation (Ahsan, et al., 2014; Ejaz, Akhtar, Nisar, & Naeem, 2010; Mohammed & Eysu, 2017). Thus, waste management is a team work that requires the persistent and fluent cooperation of all stakeholders and establishing a well-functioning system to obtain the commitment of all citizens (Ismail, 2015). The challenge, however, is how to integrate them for a common purpose and weak governance among stakeholders with regard to waste management (Wee, Abas, Mohamed, Chen, & Zainal, 2017).

In Legetafo, the stakeholders participating, their duties and responsibilities can be better addressed by assessing the waste management process from waste generation till waste disposal.

Step 1: Waste Collection, Segregation and Storage: This is the stage of identifying materials that are no longer useful, accumulating in locations where micro-enterprises emptied, sorting using modern machines and transporting to the nearby primary collection sites. The residents put their wastes in non standardized plastic bags and keep inside their premises. Then, micro-enterprises collect. But sorting of wastes is highly neglected by the city dwellers and where door-to door collection systems are not available, some people dispose wastes to the nearby open spaces and ditches. This is because many residents do not recognize the value of sorting wastes and simply assume that all wastes are garbage that should be thrown and no more useable or recyclable. Others do not have extra bags of whatever type and size and micro-

enterprises do not even return the residents' non-standardized bags. The municipality has failed to place containers at sites where large amount of wastes are produced.

Micro-enterprises are organized to collect wastes from households on door-to-door bases. They used to dump wastes in open areas until some residents reported that this practice has health related problems to the local authorities. After this is reported to officials, residents are advised to put their wastes in sacks/plastic bags alongside the gate so that waste collectors can pick it easily. However, waste collectors have shortage of trucks/tailors to provide the door-to-door waste collection service and transport it to the ultimate disposal areas.

In Windhoek, the Waste Management Division collects waste from households; private companies and the municipality from businesses; and private contractors from industries and supply plastic bags. The society is also familiar with waste separation (Ejaz, Akhtar, Nisar, & Naeem, 2010). But the role of CBOs and the health bureau is very little in Legetafo and it seems that there is no responsible body for wastes that are disposed in open areas, sewerage systems and the hinterlands.

Step 2: Transferring and Transporting wastes: Once collected, wastes must move to the temporary storage sites and then to final disposal area using transport trucks or trailers. But, in Legetafo the effectiveness of waste collection and disposal systems do not keep pace with the growing population and increasing generation of wastes. Previously, waste collectors transport wastes using carts and horse driven trailers. Currently, the municipality has only one tractor that collects wastes in the town. The tractor also fails frequently due to mechanical problems. As a result, the residents are complaining the irregularity of waste collection service and the municipality failure to subcontract waste disposal service.

Step 3: Waste Processing: The best waste management practice is strictly implementing the concept of the 3Rs: *Reduce* at the source, *reuse* to minimize waste and *recycle* through composting, gasification, energy recovery, autoclaving, fluffing, melting, incineration, etc. technologies (Saleem, Zulfiqar, Tahir, Asi, & Ghazala, 2016). However, it is found out that there is no planned waste minimization program to date in the town of Legetafo except some attempts by individuals collecting plastic materials and pigs of iron at the source by Quaralios. Sometimes resident's burn the dry wastes when the wastes are piled up and the municipality fails to collect.

Processing of wastes can help to generate electricity and converting it into valuable organic fertilizers that has significant contribution to improve agricultural productivity. But due to limited knowledge and financial capacity, wastes in Legetafo are either disposed in landfill sites or found scattered in the surrounding areas. In Windhoek, however, private companies introduced a method of waste separation though awarding prizes to liter picker's collecting the most recyclables at the landfills and these individuals are working under safe working conditions provided with protective wear. Then, before semi processed materials are sent to recycling, the ruminants are compacted (Ejaz, Akhtar, Nisar, & Naeem, 2010).

Step 4: Waste Disposal: This is the common, old method and systematic withdrawal and combustion of waste disposal using open dumping, burning and incineration. The process of land filling through open dumpling, however, has a potential threat to the quality of the environment due to wind-blown litters and dust, emissions from gas and leachate that

contaminates water via direct contact, inhalation of contaminated food and drinking water (Danthurebandara, Passel, Nelen, Tielemans, & Acker, 2012). It leads to water and air pollution in the form of land litter, particulates and toxic gases. Methane gas and solid residues are also produced from burning process (Saleem, Zulfiqar, Tahir, Asi, & Ghazala, 2016). The construction and management of landfills also have substantial effects on the ecology such as loss of habitats and a source of several socio-economic impacts like public health issues derived from surface water contamination.

Sendafa landfill (located 9 Kms from the town of Legetafo and 27 kms from Addis Ababa) in Chebe Woregenu Kebele is not properly selected and prepared for waste disposal. This is mainly because;

First, although the total area protected by fence is 123 hectares and the leach collection system is well lined, the residents stated that the actual landfill area is narrow (about 8 hectares width and only 5 meters depth) as compared to the existing landfill area in Addis Ababa, i.e. Reppi-Koshe which is 25 hectares wide and currently receiving over 750 tons of waste per day (Berhanie, 2016; Mohammed & Eysu, 2017).

A resident in Chebe Woregenu stated that the selected landfill was planned to serve for the next 20-30 years. But it was half full within a year with wastes transported from Addis Ababa, the garbage was not properly compacted and has no compartments specialized to treat hazardous wastes separately. The site was not properly operated and closely monitored by the responsible bodies.

Second, regardless of whatever amount the residents are compensated (about US\$ 0.66/m² or 10 year's yield of agricultural land), it cannot be a substitute for the invaluable life of farmers, their health and economic costs associated with garbage disposed and considered as a criminal act that threatened not only their survival but also violates the basic principle of sustainable environment, i.e. "*the polluter pays principle*") (Figure 2).



Figure 2. Households living close to landfill area and Litchate smelling, Nibretu K@2018

Third, in principle a landfill is supposed to be a valley used for excavation, processing, treatment and/or recycling deposited materials. It is a method of solving lack of space, pollution concerns and cover bare land. However, in Legetafo the landfill is a plain and fertile agricultural land used to grow wheat, peas and other cereals (Figure 3 and Figure 4). In this regard, a native resident stated that:

"The landfill site that was initially studied and selected was different from what is lastly put in place. It was far from the present location and seems a proper area where the residents also gave their consent. But later the authorities and contractors changed the original site without any reason and told the residents as if they are constructing access road to the new airport that will be constructed in the future. Above all, the new landfill area is located in a plain land that affects the lives of farmers. As a result, the contractors who changed the original location are sent to jail after the controversy is aroused by the residents and still they are in prison."



Figure 3. Plain agricultural land before 2016, Nibretu K@2018



Figure 4. Landfill protected by fence, Nibretu K@2018

Fourth, the leachate kept in an open space has a bad smell. Especially during the rainy season, this liquid over floods the container and displaces the people in the surrounding areas as shown in the Fig. 5 and Fig.6. As one resident mentioned, sometimes the municipality discharges this liquid when it starts to overflow and adversely affects the lives of the people around the area.



Figure 5. Leachate discharged into the storage area that spillover when mixed with rain water, Nibretu K@2018



Figure 6: The landfill over flooded during the rainy season, Nibretu K@2018

2. Facilities and Technologies

Efficient waste management is not labor intensive that absorbs many waste pickers. There are situations where economies of scale and scope favors mechanized operations. There are also times where greater sums of money are needed to fulfill new waste management technologies. Though the choice of new technologies depends up on economic condition, priorities, and types of waste generated in an area, the current practice requires the application of updated technologies to tackle the waste management challenge. Developed countries have introduced modern ways of waste collection and storage, methods of incineration, gasification, digestion, deep slurry injections, advance treatment and disposing technologies (Saleem, Zulfiqar, Tahir, Asi, & Ghazala, 2016).

In Legetafo, however, there are only limited facilities available for solid waste collection and disposal. An employee of micro enterprise engaged in waste collection activity said that:

"there were two tractors that transport all wastes to landfill area from the town of Legetafo. Now, one tractor is not working due to technical problems and there is no substitute for it. That is why we do not give regular waste collection service to the residents."

A thirty-eight year old woman in Legetafo also told the interviewer that:

"the municipality is unable to service the existing tractor on time, buy or rent additional waste collection trucks and place containers in the nearby areas. The waste collectors do not provide substitute plastic bags and return our sacks. Because of this, we cannot participate in segregation of wastes at the source and sometimes forced to transfer solid wastes to the containers found in the skips of the city of Addis Ababa. Some of us resort to burn wastes during dry seasons since converting them into ashes is relatively simple, easy to load and transport. But there is nothing as best as disposing wastes in landfill areas provided that adequate waste collection trucks are assigned and closely monitored by the municipality. The municipality Legetafo and other stakeholders are not able to provide simple facilities that may not require too much cost. Except a tractor, there are no primary waste containers like plastic materials and sacks, protective wears to waste pickers, dust bins, secondary containers and closed trucks that are commonly found in many developing countries."

Thus, it may not be wise to talk about effective waste management without investing in waste management facilities and appropriate selection and implementation of emerging technologies. In addition to applying prevention methods to minimize wastes from the source, the municipality in collaboration with other partners should try to fulfill high quality and adequate tractors with trolleys, normal and open trucks, bulldozers and dump trucks, forklifts and dislodging vacuum tankers, crushing machines, waste treatment plants, etc. that are the order of the day and necessary for waste collection, sorting, loading, smashing, recycling, composting, treatment, combustion, and disposal as commonly found in the city of Windhoek and Bangladesh (Ahsan, et al., 2014; Kumar & Samadder, 2017).

3. Approaches and Organization for Waste Management

Obviously, good waste management approach bridges the gap at all levels of stakeholders and the practice is more crucial to implement waste management policies in a comprehensive and holistic manner. In fact, stakeholders' participation is one of the most important requirements in policy transparency, successful policy implementation and indicators of good governance in waste management.

But equally important to setting waste management policies and identifying participating stakeholders is building a system and organization which is holistic, cost-effective, socially acceptable and sustainable, integrating them based on hierarchy with the emphasis of waste reduction, building the capacity of stakeholders and developing their commitment are critical elements in ensuring successful waste management.

In Legetafo, the conventional and still ineffective waste management system that flows from top to down is widely applied. It does not involve CBOs, the communities and the informal sectors. Since the approach primarily focuses on minimizing cost, it ignores equity, accessibility and meeting the current and anticipated changes in waste management. As a result, it is less realistic compared to the mixed or hybrid approach that combines top-dawn, bottom-up and horizontal relationships (the matrix approach).

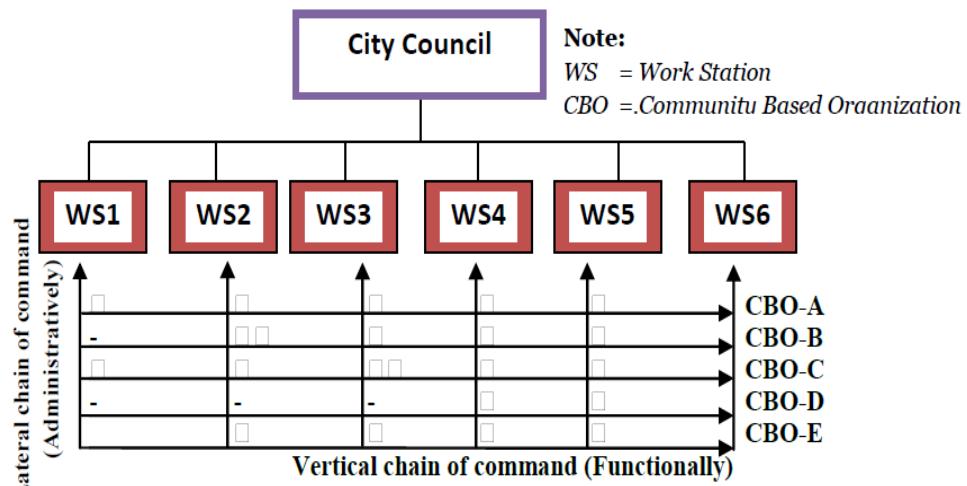
Many people believe that waste management is the sole responsibility of the government. The researchers also noticed that the capacity of the municipality has limited financial and human resources in discharging the social responsibility while the activity of waste management requires an interactive decision and the application of joint effort in a systemic framework. Studies indicated that the simultaneous action of different groups such as residents, CBOs, Kebele officials, micro enterprises and other stakeholders functioning in a harmonious and integrated manner produces better result than the sum of the separate efforts of individuals in every area of operation.

The respondents described that an effective waste management service cannot be ensured simply by applying the customary hierarchical (top-down) management approach or formulating sound waste management policies. Rather, it is the result of failure to closely follow the status of wastes and absence of consistent control and supervision of the day-to-day waste management operations in the town.

It is also observed that when local authorities effectively monitor waste collection activities and involve in fee collection campaigns with micro enterprises in Legetafo, the amount and frequency of waste collection increases at least temporary and the residents become more responsive to pay the required service fee.

Therefore, involving the representatives of the society or CBOs, residents themselves and micro-enterprises in waste management process using a matrix organization structure is very essential (Fig. 7). Every stakeholder becomes dually accountable and establishes well-functioning relationships based on trust and commitment in waste monitoring. Though a lot of resources are needed, matrix organization shares duties and responsibilities, creates awareness and develops check and balance among the stakeholders in waste management.

CBOs such as A, B, C. etc. (Fig.7) and household members can involve in developing waste management system and follow the day to day operation of waste collection through lateral chain of command in the hierarchy. They can specify waste handling methods, controls and follow up the day-to-day operations with work stations (such as WS1, WS2, etc.) under the city council (Generowicz, Kowalsk, & Kulczycka, 2011). On the other hand, the city council and Kebele officials through work stations in collaboration with CBOs play a key role in setting waste management system, coordinate the activities of waste collectors and residents, fulfilling the necessary facilities and enforcing the rules and regulations through vertical chain of command. Such a structure also allows to give proper orientation and public education about why and how to sort wastes accompanied by incentives to those conforming waste management regulations and imposing penalties on others violating the rule.



Source: Developed by the authors based on literatures

Fig. 7: A Hypothetical Matrix Organization for Waste Management for Legetafo

CONCLUSION

The main generators of waste in the town of Legetafo are households, commercial activities and industries. Residents expressed that many of the households are permanent and others are temporary or informal settlers. They produce every category of wastes that can be classified based on the place where it came from and material content. The majority of wastes constitute residuals of food production and consumption, plastic materials, scraps of construction materials and byproducts of animal processing.

The study also indicated that the volume of waste generated has increased from time to time associated with population growth, level of urbanization and economic growth while micro-enterprises that provide waste collection service and the facilities remained almost the same for many years. These processes coupled with lack of planning for wastes, public awareness and participation problems, lenient supervision and weak enforcement by the local governments has led to dumping of a large amount of wastes in uncontrolled areas or open spaces, streets, and sewerage systems of the town that affected the residents' health, socio-economic activity and the environment.

It further showed that, in addition to poor waste service provided by the municipality, only one tractor is assigned to collect all sorts of wastes throughout the town. On the other hand, the residents have shown willingness to pay higher than the existing fee provided that they are given a scheduled waste collection service and the fee considers the amount and type of solid waste generated by individual households.

To this end, the study assessed the need for properly estimating wastes produced in the town, fulfilling the facilities by considering the size of resident population and effectively implementing appropriate technologies. Above all, establishing an organization structure that involves different stakeholders including representatives of the society, CBOs and households at various stages of waste management process and enforcing the existing waste management laws are the *hallmarks of sustainable waste management*.

ACKNOWLEDGMENTS

The authors are grateful to acknowledge Mr. Abebe Dechasa and Ms. Tigist Tamirat for their time and invaluable support during data collection. Micro enterprises and survey households are also duly recognized for providing the required data and expressing the views of the society on their behalf.

REFERENCES

- Ahsan, A., Alamgir, M., El-Sergany, M. M., Shams, S., Rowshon, M. K., & Daud, N. N. (2014). Assessment of Municipal Solid Waste Management System in a Developing Country. *Chinese Journal of Engineering, Hindawi Publishing Corporation*, <http://dx.doi.org/10.1155/2014/561935>.
- Berhanie, D. (2016). Sendafa Landfill controversy: The farmers' version of the story. HornAffairs.com: Addis Ababa.
- Cheever, M. (2011). *Environmental Policy Review 2011: Waste Management in Ethiopia*. The Environmental Policy Group in the Environmental Studies Program, P. 1-33: Colby College, Waterville, Maine.
- Cheru, M. (2016). Solid Waste Management in Addis Ababa: A new approach to improving the waste management system. Helsinki Metropolia University of Applied Sciences: Helsinki.
- Danthurebandara, M., Passel, S. N., Nelen, D., Tielemans, Y., & Acker, K. V. (2012). Environmental and Socio-Economic Impacts of Landfills. *Linnaeus ECO-TECH, Belgium*.
- Dick, M. P. (2014). Sustainable Solid Waste Collection in Addis Ababa: The Users' Perspective. *International Journal of Water Resources*, <https://www.omicsonline.org/>. Retrieved from <https://www.omicsonline.org/>
- Ducharme, C. (2010). Technical and economic analysis of Plasma-assisted Waste-to-Energy processes. Earth Engineering Center : Columbia University.
- Ejaz, N., Akhtar, N., Nisar, H., & Naeem, U. A. (2010). Environmental impacts of improper solid waste management in developing countries: A case study of Rawalpindi City. *Ecology and the Environment, DOI 10.2495/SW100351*, 142, 379-387.
- Forum for Environment. (2010). *Assessment of the Solid Waste Management System of Bahir Dar Town and the Gaps Identified for the development of an ISWM Plan*. Ethiopian Environment Review, Bahir Dar.
- Generowicz, A., Kowalsk, Z., & Kulczycka, J. (2011). Planning of Waste Management Systems in Urban Area Using Multi-criteria Analysis. *Journal of Environmental Protection*, doi:10.4236/jep.2011.26085, <http://www.SciRP.org/journal/jep>, Vol. 2(--), 736-743. Retrieved from <http://www.SciRP.org/journal/jep>
- Guerrero, L. A., Maas, G., & Hogland, W. (2013). Solid Waste Management challenges for cities in developing countries. *Waste Management*, 33(1), 220-232.
- Ismail, T. M. (2015). Solid Waste Management in Developing Countries. *Innovative Energy & Research, Suez Canal University, Egypt*, 1.
- Kumar, A., & Samadder, S. R. (2017). A review on technological options of waste to energy for effective management of Manucipal Solid Waste. *Waste Resources, Solid Waste Management*, <https://doi.org/10.1016/j.wasman.2017.08.046>. Retrieved from <https://doi.org/10.1016/j.wasman.2017.08.046>
- Mahiteme, Y. (2005). Landfill Management, its Impacts on the local Environment and Urban Sustainability: The Case of Repi Landfill Site, Working papers on population and land use change in central Ethiopia. Addis Ababa University: Addis Ababa.
- Marello, M., & Helwege, A. (2014). *Solid Waste Management and Social Inclusion of Waste Pickers: Opportunities and Challenges, GEGI Working Paper*. Boston University: Research from the Global Economic Governance Initiative.
- Marshall, R. E., & Farahbakhsh, K. (2013). Systems approaches to integrated Solid Wase Management in developing countries. *Waste Management*, 33(4), 988-1003. Retrieved from <https://doi.org/10.1016/j.wasman.2012.12.023>
- Melaré, A. V., González, S. M., KattiFaceli, & VitorCasadei. (2017). Technologies and decision support systems to aid Solid Wse Mnagement: A systematic review. *Journal of Environmental Management*, <https://doi.org/10.1016/j.wasman.2016.10.045>. Retrieved from <https://doi.org/10.1016/j.wasman.2016.10.045>

Middlesex County. (2012). *Solid Waste Management Plan*. Middlesex: Department of Public Safety, Division of Solid Waste Management.

Mohammed, A., & Eyasu, E. (2017). Domestic waste management and its environmental impacts in Addis Ababa City, ISSN 2375-1266,. *African Journal of Environmental and Waste Management*, 4(3), 206-216.

Morrissey, A., & Browne, J. (2017). Waste management models and their application to sustainable waste management. *Waste Management*, <https://doi.org/10.1016/j.wasman.2003.09.005>. Retrieved from https://doi.org/10.1016/j.wasman.2003.09.005

Negarit Gazeta. (2007). Solid Waste Management Proclamation No. 513/2007, Ethiopia. Berhanena Selam Printing Press: Addis Ababa.

OWWDSE. (2011). *Integrated Land Use Planning Study Project Final Report, Regional Planning*. The National Regional State of Oromia Land and Environmental Protection Bureau: Addis Ababa.

Raines, C. (2017). *Environmental and socio-economic impacts of landfills: A List of Stakeholders in the Waste Business*, <https://www.researchgate.net/publication/278738702>.

Rushton, L. (2003). Health hazards and waste management. *British Medical Bulletin*, <https://doi.org/10.1093/bmb/ldg034>, 68, pp. 183-197. Retrieved from https://doi.org/10.1093/bmb/ldg034

Saleem, W., Zulfiqar, A., Tahir, M., Asi, F., & G. Y. (2016). Latest technologies of municipal solid waste management in developed and developing countries: A review. *International Journal of Advanced Science and Research*, Volume 1 (10), PP. 22-29.

UN. (2018). *World Population Prospects: The 2017 Revision, Population Division, Department of Economic and Social Affairs*, www.worldometers.info.

Wee, S. T., Abas, M. A., Mohamed, S., Chen, G. K., & Zainal, R. (2017). Good Governance in National Solid Waste Management Policy (NSWMP) Implementation: A Case Study of Malaysia, The 2nd International Conference on Applied Science and Technology. Malaysia: AIP Publishing.

Zenebe, W. (2008). Ethiopia: New Special Zone to Smooth Oromia-Addis Relations. Addis Fortune: Addis Ababa.

ABOUT THE AUTHORS

Nibretu Kebede is a Lecturer in St. Mary's University and PhD candidate, College of Development Studies (Center for Environment and Development), Addis Ababa University, Ethiopia.

Degefa Tolossa (PhD) is an Associate professor of Geography and College of Development Studies (Center for Rural Development), Addis Ababa University, Ethiopia.