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A survey of solid waste management services in Woldya Town (Ethiopia): Challenges and opportunities for improvement

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Abstract. In different cities and towns of Ethiopia, solid waste is a major environmental problem. Woldya town also face the challenges of solid waste management. Effective and efficient solid waste management in a town is a mandatory to ensure human and animal health and also to ensure clean and sound able environment in urban development. The aim of this study is to assess challenges and opportunities for improvement of solid waste management services in Woldya town. Interviews, questionnaires and observation were the major tools used for data gathering. The data were analyzed using tables, percentages, pie chart followed by explanation. In Woldya town the residents use illegal methods of solid waste disposal; this includes burning, open dump and ditch. The key challenges of solid waste management services in the town are lack of Awareness, lack of manpower, lack of facilities and financial constraints. The communities recommended that solid waste management can be improved through community participation, increasing funding, create awareness and encourage waste minimization. This study recommends environmental education related to solid waste management plays a great role to promote attitudinal change of the community and strong community participation, improve institutional capacity, strengthen financial capacity, promote private sector participation and preparing disposal site for solid waste

Keywords. Solid waste management, waste, Challenges, Oppurtunities, Environmental Safety, public policy, Clean environment, Hygiene and drainage system

Introduction

1.1 Background to the Study

In developing countries solid waste management has become a serious challenge. High urbanization rates and challenges in the life styles and steady rise in living standards have resulted in the increase of solid waste both in types and volume. Inefficient and improper methods of disposal of solid waste and its management result in scenic blights, create serious hazards to public health, including pollution of air and water resources, accident hazards, and increase in rodent and insect vectors of disease, have an adverse effect on land values, create public nuisances, otherwise interfere with community life and development. The failure or in ability to salvage and reuse such materials economically results in unnecessary waste and

depletion of natural resources (Technobanalogous, 1993).

Until the late 1980s, solid waste management policies and programs in most African counties were formulated and implemented by government agencies with out significant public participation. There were many challenges in the management schemes for solid waste management. The most often encountered problems were financial constraints and low capacity of local authority. However, political and social changes across the continent in the 1990s, including the coming of Non- Governmental Organizations, has fostered increased awareness of environment issues to the general public. Urban populations have been involved in the issues surrounding solid waste management.

Ecological phenomena such as water and air pollution have also been mostly a result of improper management of solid waste. Due to diminutive concern for environmental degradation, environmental related problems have become extensively of inferior quality in the globe. Unfortunately, the seriousness of the problematic state of affairs augmented in developing countries in recent years persists (IUCN, 1990: cited by Bantiun, 2003).

In Ethiopia particularly in Woldya town urban population has been growing at a faster rate. The increasing population in Woldya town needs better and adequate services especially solid waste management but municipalities are unable to meet their demand because of inadequate revenue, poor coordination of expertise and weak technical capacity.

1.2 Statement of the Problem

As urban areas expand, in particular when urban development is unplanned, unregulated and urban areas expand haphazardly, urban living conditions usually worsen. The surrounding environment suffer from solid waste problem, sanitation problem and land degradation the insufficiency of services results in a deterioration of the urban environment and that poses risks to human health and the environment.

There is improper method of solid waste disposal in Woldya town, this result in different types of diseases , air and water pollution. The rationality for the selection of the topic was because of the area have in adequate solid waste service coverage, land fill disposal, lack of awareness and in adequate management of solid waste.

There is also operational inefficiency of services and limited use of informal sector, affects health problems are faced by human and animal and the waste blocks drainage system.

1.3 Objectives

1.3.1 General Objectives

The general objective of the study was to identify the challenges and opportunities for improvement of solid waste management in Woldya town

1.3.2 Specific Objectives

- a. To identify the different sources and methods of solid waste management used in Woldya town.
- b. To identify the solid waste management facilities used in Woldya town.
- c. To identify the challenges of solid waste management in the study area.
- d. To find out the role of stakeholders on solid waste in the study area.
- e. To make recommendations that help to improve solid waste management services in Woldya town.

1. What are the different sources and the methods of solid waste management in Woldya town?
2. What are the solid waste management facilities used in Woldya town?
3. What are the challenges of solid waste management in the study area?
4. What are the roles of stakeholders on solid waste management in the study area?
5. What are the possible solution to minimize the problem of solid waste management in the study area?

1.4. Significance of the Study

The study gives an overview of current knowledge of solid waste management challenge and how solid waste management can be improved.

The study also provides guidelines on solid waste management for local government, Non Governmental Organization and others who involves in solid waste management.

Policy makers also benefit from the policy recommendations of the research for efficient and effective management of solid waste services. Finally, the finding of the study also help researchers and academicians interested in related topics as a basis of further research in the future.

1.5 Scope of the Study

The study covers Woldya town and focus on the challenges and opportunities for the improvement of solid waste management services. In this study the researcher is interested in collecting data on sources of solid waste, methods, facilities and challenges of solid waste management

1.6. Description of the Study Area

Woldya town is one of the 12 city administration found in Amhara region which is located on the northern part of Ethiopia. Woldya is the main town of north Wollo zone which was established around 1780 E.C by Ras Ali and has since been the administrative and urban centers. It is a nodal town connecting four main roads from opposite directions (Addis Ababa, Mekelle, Bahir dar and Afar- Djibouti).

The town of Woldya is found 521 km north of Addis Ababa. According to CSA (2007) of census result, the populations of the town were 46,126. 8% of people are engaged in agriculture, others are involved in non- agricultural activities such as petty trading, hand crafts, small scale industries and civil servants. It is found at 11⁰50' north latitude and 39⁰ 46' east longitudes and it has an elevation of 2000 meters above sea level. It has

350 mm average annual rain fall and 22⁰c average daily temperature. Woldya town has hill topography and surrounded by mountains.

Woldia (also spelled Weldya), the current chief town of North-Wollo administrative Zone, lies at 11° 49' North and 39° 36' East (National Atlas of Ethiopia, 1984:78). It is situated on the major north-south highway that links the national capital Addis Ababa with Mekele in Tigray Region. The town is located at a distance of about 360 kms from the regional capital, Bahir Dar; 700 kms from Djibouti; and about 180 Kms from the tourist attraction site, of Lalibela. Woldia is the nodal town connected by three radial roads with other towns of the country. Accordingly, the town served as junction with Bahir Dar in the west, Mekele in the North and

Djibouti in the East with the same road, and Addis Ababa-Dessie in the south. This is also a major access route to the religious center of Lalibela. The town is bounded by Mount Gubarja in the East, mount Gebrael in the North which are the major physical barriers that limit further expansion, to the East and North respectively. To the west of Woldia lies the flat plain of Mechare which is the alternative area for further expansion until it is encountered by two perennial rivers, Tikur Wuha and Melka Demo. To the south of Woldia lies part of the flat plain of Mechare and small escarpment of Gubalafto for further expansion until it is also limited by the small mountain which is locally called Guba terara -literally means Mount Guba.

Figure 1. 1: Map of Ethiopia, Amhara Region, North Wollo Zone and Woldia town

Source: GIS team of the ANRS, BOFED and north Wollo Finance and Economic Development (2009)

Although the small escarpment of Gubalafto is a limiting physical factor for the expansion of the town towards the south, the main factor governing for the expansion of the town in to this direction is 12 kms highway that runs from Jeneto ber to Woldia through Gubalafto.

Apart from this highway, the opening of Woldia University situated at Jeneto also contributes for further expansion towards this direction. In addition to the advantages of levelness /flat nature / of Mechare, the opening of Woldia University, the construction of the highway from Jeneto to Woldia, the Woldia-Gondar-Bahirdar highway also facilitates for further expansion of the town. The area under study is, geographically, situated in the northwestern highlands and associated lowlands, and in the sub division of the north central massifs having an average altitude of 2000 meters above sea level.

Currently, the town is divided in to three town districts (kebeles) namely, Yeju Genet, Defergie kibikalu and Debie Gelila and four rural kebeles namely, Adengur-Gebreil, Jeneto, Mehal Mechare and Golamechare as shown in map 1. The town is also bordered by Gebriel Adengur in the north, Mehalmechare in the south and west, Jeneto ber in the south and Gubarja in the east.

1.7 Limitations of the Study

The limitations of the study were time constraints: to gather sufficient data, to analyze the collected data, scarcity in secondary data in the town. Even if there were time and financial constraints, all possible efforts by the researcher have been made to accomplish this study.

Literature Review

2.1 Introduction

This chapter describes the conceptual definition of solid waste and the general overview of solid waste management which includes the methods, facilities and challenges in solid waste management and how solid waste management can be improved.

2.2 Definitions and concepts of Solid Waste

Solid waste comprises all the waste arising from human and animal activities that are normally solid and that are discarded as useless or unwanted. The term solid waste means garbage, refuse, and other solid materials, including solid waste materials resulting from residential, commercial, industrial, agricultural and community activities (UNCHS, 1985).

Solid wastes are the organic and inorganic waste materials such as product packaging, grass, clippings, furniture clothing, bottles, kitchen, refuse paper, appliances, paint cans, batteries, etc. produced in a society which do not generally carry any value to the first users, solid wastes, thus encompass both a heterogeneous mass of wastes from the urban community as well as a more homogeneous accumulation of agricultural, industrial and mineral wastes (Ramachandra, 2006).

2.3 Solid Waste Management

Solid waste management may be defined as the discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accordance with the best principles of public health, economics conservation, aesthetics and other environmental considerations, and that is also responsive to public attitudes. In its scope, solid wastes management includes all administrative problems of solid wastes.

The solution may be involve complex inter disciplinary relationships among such fields as political science, city and regional planning, geography, economics, public health, sociology, demography, communication and conservation as well as engineering and material sciences (Techobanoglous, 1993).

Human activities create waste and the way these wastes are handled, stored, collected and disposed of can pose risks to the environment and public health. In urban areas especially in the rapid urbanizing cities of developing world problems and issue of municipal solid waste management are of immediate importance. And this has been acknowledged by the most governments population growth over whelms the most basic services (Zurbrugg, 2000).

2.3.1 The Solid Waste Management Hierarchy

Within integrated solid waste management, the waste management hierarchy has been taken as a key element in waste management policy. The hierarch is based on environmental principles, and implies that waste, depending on its characteristics, should be handled by different methods: a certain amount should be prevented by either reducing the content of the waste or by reusing the waste, another share of the waste stream needs to be converted into secondary raw materials, may be land filled. Especially in- developing countries, reality does not adhere to this sequence. In fact a large quantity of waste is dumped in an uncontrolled manner, or worse, burned in the open air.

Obviously the below figure this options do not belong to the waste management hierarchy because of their unacceptable high levels of environmental damage. (Hogland et. al, 2000)

Figure 2. 2: Solid waste management hierarchy

Source: Hogland et al (2000)

Although this ranking of waste management options does provide policy makers with an effective basis. It should be realized that integrated solid waste management goes beyond the waste hierarchy. It is generally known that the hierarchy has to be applied in a flexible way and it is only meant as a guideline to achieve the best environmental solution for the long term.

2.4 Sources of Solid Wastes

Knowledge of the sources and types of solid wastes, along with data on the composition and rates of generation, is basic to design and operation of the functional elements associated with the management of solid wastes. Sources of wastes in a community are, in general, related to land use and zoning. Although any number of sources classifications can be developed, the following categories to exist: residential, commercial, institutional, construction and demolition, municipal services, treatment plant sites, industrial, and agricultural (Techobanoglous, 1993).

According to him residential refers to wastes from dwellings, apartments and consists of leftover food, vegetable peels, plastic, clothes ashes. Commercial sources of solid waste includes wastes consisting of leftover food, glasses, metals, ashes generated from stores, restaurants, markets, hotels, motels, auto-repair shops, medical facilities. Institutional sources of solid waste consists of paper plastic, glasses, generated from educational administrative and public building such as schools, colleges, offices, prisons.

2.5 Solid Waste Management Methods

Solid waste management in urban areas is a complex activity that involves the collection, transfer, treatment, recycling, resource recovery, and disposal and solid waste generated in a city. The complexity and the service and the requirement of high level of organizational, technical and managerial capacity make it difficult to be handled by local governments single handed. Therefore effective service delivery requires cooperation between numerous stakeholders in both the private and public sectors. For successful operation, it is advisable to integrate stakeholders from the very beginning of the planning a solid waste management system (Bernstein, 2004 and UNDP, 1999).

The activities associated with the management of solid wastes from the point of generation to final disposal have been grouped in to six(6) functional elements: these are waste generation, waste handling and separation, storage, processing at the sources, collection, separation and processing and transformation of solid wastes, transfer and transport and finally disposal (Techobanoglous, 1993).

These functional elements that constitute the system are:

2.5.1 Waste Generation

Wastes are generated at the start on any process, and there after, at every consumption. The source of waste generation, determines quantity, composition and waste water characteristics. For example, wastes are generated from households, commercial areas, industries, institutions, street cleaning and other municipal services. The most important aspect of this part of the solid waste system is the identification of waste.

This includes gathering of waste and housing them to the location, where the collection vehicle is emptied, which may be a transfer station (i.e. intermediate station where wastes from smaller vehicles are transferred to larger site). Collection depends on the number of containers, frequency of collection is provided under various managements, ranging from municipal services to franchised services, and under various forms of contracts.

2.5.3 Waste Storage

Storage is a key functional element because collection of wastes never takes place at the source or at the time of their generation. The heterogeneous wastes generated in residential areas must be removed within eight days due to shortage of storage space and presence of biodegradable material. On site storage is of primary importance due to aesthetic consideration, public health and economics involved. Some of the options for storage are plastic containers, conventional dustbins (of households) used oil drums, large storage bins (for institutional and commercial areas or servicing depots) etc. Obviously, these vary greatly in size, form and material.

2.5.4 Transfer and Transport

This functional element involves the transfer of wastes from smaller collection problem; where necessary to overcome the problems of narrow access lanes, to large ones at transfer stations the subsequent transport the wastes, usually over long distance, to disposal sites. The factors that contribute to designing of transfer station include the type of transfer operation, capacity, equipment, accessories and environmental requirements. If the disposal site is far from the collection area, it is justifiable to have a transfer station serve as a transfer station, where small. Collection vehicles transfer their loads to larger vehicles, which then haul the waste long distance. In some instances the transfer station serves as a processing point (EPA, 1989).

2.5.5 Recovery and Recycling

This includes various techniques, equipment and facilities used to improve both the efficiency of disposal system and recovery of usable material and energy. Recovery involves the separation of valuable resources from the mixed solid wastes, delivered at transfer stations or processing plants. It also involves size reduction and density separation by air classifier, agnatic device for iron and I cheers for glass. The selection, of any recovery process is a function of economies, i.e. cost of separation. Versus the recovered material products. Certain recovered materials like glass, plastics, paper etc. can be recycled as they have economic value.

2.5.6 Waste Disposal

Disposal is the ultimate fate of all solid wastes be they residential wastes, semi- solid wastes from municipal and industrial treatment plants, incinerator residues, composts or other substances. Land use planning becomes a primary determinant in the selection, design and operation of land fill. A modern sanitary land fill is a method of disposing solid waste without creating a nuisance and hazard to public health as well as environmental degradation. One of the most important functional to the final use of the reclaimed land.

Source: Ramachandra (2006)

2.6 Solid Waste Management Facilities

Solid waste collection is handled in the following ways: door to door, block and communal collection using vehicles, side load trucks, closed compacting type trucks and container lift trucks (EHDA, 1997).

Effectiveness of solid waste management service is depending on sustainability of the management of the services. Sustainability in its turn depends, among other on the way the management of the service providers and supporting organizations, the choice and use of technology, the private sector involvement and community participation. Provision of effective and sustainable solid waste management services requires going even further to formulation of specific objectives and implementation of appropriate measures regarding political, institutional, social financial, economical and technical aspects of the service (World Bank, 2000, and Schubeler et. al, 1996)

Duties and responsibilities of solid waste management service are often discharged by municipalities, while tasks such as formulating legal and policy framework, setting standards and establishing the control and monitoring indicators are carried out at the national level. Frequently sighted challenges of decentralization such as conflicts of interests and duplication of tasks and waste of resources could be mitigated through clear definition ditions. This does not only serve to improve solid waste management but also significantly enhances the enforcement capacity of the local governments and maximizes the satisfaction of service receivers (World Bank, 2006).

2.7 Challenges of Solid Waste Management

Many challenges influencing the decision making process in the implementation of a solid waste management system are the following according to Ramachandra (2006).

2.7.1 Financial and Foreign Exchange Constraints:

Solid waste management accounts for size able proportions of the budgets of municipal corporations. This is allocated for capital resources, which go towards the purchase of equipments, vehicles, fuels and labor costs. The unfavorable financial situation of some countries hinders purchase of equipment, and this situation is further worsened by the a cute shortage of foreign exchange. This means that the balance between the degree of mechanization and the size of the forces becomes a critical issue in arriving at the most cost- effective solution.

2.7.2 Management and Technical Resources

Solid waste management, to be successful, requires a wide spectrum of workforce in keeping with the demands of the system. The best system for a region is one which makes full use of indigenous crafts and professional skills and or ensures that training programmers are in place to provide a self- sustaining supply of trained worked force.

2.7.3 Physical Characteristics of an Urban Area

In urban area (i.e, towns and cities) where the lay out of streets in such that access by vehicles possible, door to door collection of solid wastes in the accepted norm either by large compaction vehicles or smaller vehicles. The picture is however, quite different in the inner and older city areas where narrow lanes make service by vehicles difficult and often impossible. The problem of urban sprawl in the out skirts (of the cities) where population is growing at an alarming rate. Access ways are narrow, unpaved and tortuous and therefore, not accessible to collection vehicles. Problems of solid waste storage and collection are most acute in such area.

Most developing countries have little or no expertise in environmental/ sanitary engineering and municipal waste management moreover the solid waste service in most developing country cities lacks planning, human resource development, and financial Management as well as budget control functions., thus, efforts to improve municipal solid waste management should include appropriate levels of technical assistance, and training in the operational, financial, and. to support the development of solid waste planer, technical assistance can be provided for: planning collection; waste: assessing available or proposed equipment; setting up maintenance shops and construction of strategic deposal facilities resource recovery, and disposal facilities needed (Bartone et al 1990)

From this it can be seen that inadequate attention to institutional issues in the design of solid waste management results poor performance. In addition, deficient institutional organization and capacity is also the principal impediment of effective municipal solid waste management execution According to Zurburrg and Schertenlieb, (2002) , there are four major problems faced in developing countries on municipal solid waste management such as

2.7.4 Inadequate Service Coverage

Zurburrg and Schertenilieb, (2002) implies that solid waste collection service of cities in developing countries generally serve only limited part of the urban population which is found at the heart of the city and high income people. These who are remained without waste collection services are usually low income living at the periphery. They also argued that the main reason is lack of financial capacity to address the increasing amount of solid waste production associated with inadequate charging methods and insufficient funding from central government.

2.7.5 Operational Inefficiency of Services and Limited Use of Informal Sector

According to Zurburgg and Schertenlieb. (2001), municipal authorities in developing countries usually spent around 20 to 50 percent of the total municipal expenditure. However, even at such expenditure the level of service is low. Only 40 to 50 percent of the solid waste is collected and serving less than 50 percent of the population. Once collected is disposed off in uncontrolled open dump.

2.7.6 Inadequate management of special wastes or Hazardous Waste

Zurburgg and Schertenlieb put as the third challenge on their argument. They argued that waste produced from Hospital and Clinic can be regarded as special waste (non-industrial waste) approximately 70 percent of the total waste generated by hospital and clinics assumed to be non hazardous waste. Where as 20 percent of the total waste regarded as hazardous and infectious waste while the remaining 10 percent considered as non infectious but hazardous wastes. Therefore, it is essential that the generated waste be separated the non hazardous from hazardous and can be treated like any domestic wastes Hazardous and infections wastes are sharp needles, scalpels, pharmaceutical and chemical residues and other hazardous wastes .

2.7.7 Inadequate Land fills Disposal

In most developing countries solid waste are disposed off on uncontrolled open dumping sites. These unsafe open dumps lay on large plot which is uneconomical. Further it exposed to scavengers, informal waste pickers, animal entry and ingesting of waste, breeding insects and usually produced unpleasant odor. Many authors suggested that the main reason to the inadequate landfill disposal is that poor financial and institutional arrangement, especially where local governments are under financed and low level of institutional capacity and rapid continuous of population growth. Further (Zurburgg and Schertenlieb, 2002) indicated that inadequate land fill disposal have occurred in areas where inappropriate guidelines for siting, lacks design and operation of new landfill as well as missing recommendations for possible upgrading options of existing open landfill disposal sites.

2.8 The Role of Stakeholders in Solid Waste Management

The discussion on solid waste management begins, from regulatory officials, persons from neighboring communities, local waste management experts, environmental and business groups and others should be encouraged to participate and involve in solid waste management. Bringing representative of interest groups together and providing a forum for communication is a valuable activity. Cultural diversity is another consideration when seeing input, from the broadest possible spectrum of the community (Ramachandra, 2006)

Basically, solid waste management involves not only local governments but also wide range of actors; different public institute which and indirectly involved in service delivery partner NGOs governmental organizations, Civil Societies and direct service user such as households and different business organizations. Smooth functioning of the service requires the cooperation and coordination among all actors, partners and service users.

No single solution completely answers the question of what to do with out solid waste. Every community or region has its own unique profile of solid waste. The composition of the waste varies, depending on such diverse variables as urbanization, commercial enterprises, manufacturing, and service sector activities. Similarly, the attitudes of people in different states

and regions of the country vary regarding waste management practices. Community diversity and waste diversity and two reasons why no single approach to waste management has been accepted as the best method (Gwimbi et. al 2008).

2.8.1 Role of local government and municipalities

Local government responsibilities and roles in solid waste management have historically been based on the premise that solid waste management is an appropriate exercise of general local government police power to provide for the safety of the public (William Hogland, et. al (2001). According to him local governments, exercising their state or provincial police powers, have taken steps to choose to either be involved or not involved in solid waste management, regulate the collection of solid waste with in their Jurisdiction, dispose of solid wastes with in their Jurisdiction license private companies to provide solid waste management services with their Jurisdiction, define the types of solid waste storage containers to be used, fund solid waste management systems through tax- based revenues and/ or user fees, contract with private service providers to provide services within their jurisdiction and establish authorities to make choices about services with in their jurisdiction by the passage of ordinances.

Consequently, local governments to assume other roles and responsibilities to: develop integrated solid waste management plans, provide a means for private service providers to compete for business to ensure a competitive environment and to ensure that solid waste facility capacity is available.

Municipal solid waste authorities commit some form of managerial and financial resources to a solid waste management system, even if private sector organizations have a role in the waste management sector. Sound practices virtually required a fiscal commitment from some level of government to design, finance, create and maintain the solid waste management system.

2.8.2 Role of the Community

Community participation is also essential even if there is a municipality waste collection services. This is because the effort made by the people at households is important to solve solid waste problems at source with a minimum resource.

Community usually, participates at different levels committee. Of management system by establishing their own When sufficiently organized, community groups have considerable potential for managing and financing local collection services and operating waste recovery and composting activities through mobilizing societies. In addition, they are more effective if they work in collaboration with government entities, NGO's and private sectors (UNCHS and world bank 1996 cited by Dawite 2008).

2.8.3 Role of Private Service Provider

According to Hickman (1999), private service providers play a major or role in providing solid waste management services. The private sector provides the majority of services for commercial, institutional and industrial solid wastes: provides residential solid waste collection services to large percentage of the population; private sector are major owners of land fills and partners with local governments in the ownership and operation of waste to energy, composting and materials recovery facilities and also they competes openly with local governments owned municipal solid Waste management services for business. The knowledge of the private sector about solid waste management equipment, technologies and systems represent a major asset when

2.9 Solid Waste Management in Some African Cities

Some African cities of solid waste management such as Lusaka (Zambia), Nairobi(Kenya), Pretoria (south Africa), Gaborone (Botswana) by (William Hogland et. al, 2000).

2.9.1 Lusaka, Zambia

Once very rich in copper resources, the capital of Zambia has its solid waste management system in dire straits. The streets are heavily littered with domestic refuse, drains are choked and there is no form of pest control in place. The causes of poor waste management in Lusaka are due to shortage of proper refuse removal vehicles, financial constraints and lack of technology. The country's economy has become weak due to the mismanagement of the mineral resources.

2.9.2 Nairobi, Kenya

Solid waste management which had improved over the years has been badly affected by natural events due to the lack of prepared ness and to political crises. The rich tourist resources have been compromised by the lack of environmental protection. Whilst technical staff has been trained in waste management, the political arm has made it very difficult for the relevant authorities to forge a head with a protracted waste management system.

2.9.3 Pretoria, South Africa

Because of the sound economy of the country, the city of Pretoria has put in place a solid waste management system which caters well for all its residents. The environmental protection plan has been put in place and solid waste management has greatly improved. Guidelines refuse disposal are being monitored to protect the environment.

2.9.4 Gaborone, Botswana

The diamond rich city has started to create to environmental protection; part of the diamond profits has been earmarked for the city's development and environmental protection. Very expensive refuse removal vehicles have been acquired but with very little technical expertise to handle or service them. This fast growing city has done very well to recycle its resources for environmental protection. The African countries must put their heads together to improve their resources and protect the environment Just as the European countries have done. Ideas or technology should be assessed before being imposed in local situation and more practical strategies should be put in practice to safeguard the environment.

2.10 Environmental policy of Ethiopia

In order to handle growing volumes of waste, the proper polices need to be enacted and implemented. Solid waste management should aim to be socially desirable economically viable and environmentally sound. And it gives opportunities to waste prevention, reuse, recycling, composting, incineration and sanitary land filling (Medina1997). The federal Democratic Republic of Ethiopia (FDRE) had prepared environmental policies related to solid waste, liquid waste and sanitation. Among others, sanitation and solid waste policies are stated as the following (Gwimbi et. al, (2008).

To promote the construction by individual families of their own houses and create conducive

conditions for communities and individual families to make improvements to their immediate habitats as well as to provide human and domestic waste disposal facilities; to the extent possible to recycle liquid and solid wastes from homestead and establishments for the production of energy, fertilizer and for other uses; To ensure that improved environmental sanitation be placed highest on the federal and regional agendas for achieving sustainable urban development; To create conducive conditions for families, housing groups and communities to construct latrines and for private entrepreneurs to undertake latrine emptying as well as waste collection and disposal services;

To give priority to waste collection services and to its safe disposal; To undertake studies which identify suitable sanitary land fill sites in the major cities and towns of Ethiopia; To promote waste minimization processes, including the efficient recycling of materials wherever possible. Devising system by which the role of the urban administration, investors and the public will be specified and integrated in the disposal of solid and liquid waste and guiding implementation of the same.

Methodology

3.1 Research Design

The research design is the master plan specifying the methods and procedures for collecting, processing and analyzing the required data of the study. In order to achieve the objectives of the study, a descriptive research design used to describe the characteristics of sample population the extent relationship between variables in order to specific prediction and then examines and evaluate the existing solid waste management activities in order to identify the challenges and formulate solutions.

3.2 Sources of Data /Type of Data

The data was obtained from primary and secondary sources. The primary data was gathered directly from the respondents of the study area to use for the first time by the researcher. The secondary data which is collected in the previous researches and document used by the researcher.

3.3 Sample Size and Sampling Technique

3.3.1 Sample Size

Since it is difficult to cover the whole population it is necessary to take a sample from the study area. The total population in each kebele was revealed in the table below by using cluster sampling

3.1.1.1 Population size and households of the kebele in Woldya town

	K Population size	Households
Debre Gelia	144666	2769
Yeju genet	16475	3400
Deferge	14985	2833
Total	46126	9002

Source: Woldya town finance and economic office (2009)

From the total kebele the researcher took Yeju genet kebele by using simple random sampling because the residents are homogeneous and there is similar problems of solid waste management in each kebele, the selected kebele was that Yeju genet kebele which has the population size of 16475 and the sample frame is that 3400.

According to Wallace (2004) for statistical analysis a minimum sample size of 30 is usually thought to be desirable. This is to ensure that there are sufficient elements for research analysis. In fact one can face, with financial, administrative and time constraints to deal with the whole population. Due to these constraints the study considers a sample size of 170 respondents. The household respondent for the study is 5% of the total households from the selected kebele with the exclusion of different officials.

3.3.2 Sampling Technique

The sampling techniques to employee for selecting representative were a combination of purposive sampling and simple random sampling. Purposive sampling was used for selecting 6 respondents from professionals and officials who do have in depth know how about the study issue. Simple random sampling was used to select 170 respondents who were heads of households from the sample frame of 3400 households by using lottery system.

3.4 Data Collection Methods

The following data collection methods employed to collect the data. These include observation, interviews questionnaire, photography and secondary data.

3.4.1 Interviews

The researcher used interviews because it helps to gain an understanding the underlying reasons and motivations for people's attitudes, preferences or behavior. Face to face interview used to get accurate information, good response rate and to obtain more information about the study.

3.4.2 Questionnaires

The researcher used questionnaires because it is an effective mechanism for efficient collection of certain kinds of information. Data collection by questionnaires are relatively cheap and it cover a large number of people in the study area. The researcher used both closed-ended questions to obtain factual information and open ended questions to allow the respondents to answer in any way they wish.

3.4.3 Observation

The researcher used observation because it is a purposeful, systemic and selective way of watching and listening to collect data.

3.4.4 Photography

The researcher used photography to show different types of solid waste, the disposal site and solid waste management activities of the area because a picture or photographs can tell a thousand words.

3.4.5 Secondary Data

The researcher collected data from government publication, earlier researches, census and other record on state of solid waste management in Ethiopia and Woldya in particular.

3.5 Data Analysis

Depending on the nature of the data, the information or data analyzed by quantitative and qualitative tools. For quantitative percentages, tables' pie charts were used while for qualitative data, interpreting and summarizing of response are employed.

Data presentation and analysis

4.1 Introduction

This chapter discusses the sources, characteristics of solid waste and the facilities used in solid waste management in Woldya town. Moreover, emphasis is given to where solid wastes are stored, collected, disposed and the role of local government, private sector, informal service provider and public participations in solid waste management processes. In addition to these institutional capacity, manpower, equipment and the financial capacity applied in solid waste management is discussed. Finally it discusses the key challenges and opportunities for improvement of solid waste management services. The findings presented in to two categories which include finding from households and finding from interview officials.

4.2 Findings from Households

4.2.1 Characteristics of Respondents

4.2.1.1 Age and Sex Distribution of the Respondents

The researcher collected information on the age education and income of the respondent.

Table 4.1: Age of respondents

Age of respondent	Number of respondent	Percentage
18-24	44	26
25-29	65	38
30-34	19	11
35-39	11	7
40 and above	31	18
Total	170	100

Sources: Field survey (2009)

From table 4.1, the results of sample survey confirmed that the highest that is 38 and 26 percent of respondents are grouped under economically active age that is 25- 29 and 18-24 respectively. In addition to this the lowest that is 7 percent were between 35 and 39.

The age structure showed that the population of the selected respondents is characterized by high population of young people. This indicates that there is a strong potential man power for solid waste management in waste management meeting and in awareness creation in the community. Sex of respondents showed that 72 respondents are female that is 42 percent and 98 respondents are male that is 58 percent. The sex distribution shows that both male and female can contribute for solid waste management.

4.2.1.2 Education level of respondents

Education is a basic factor for economic development of any society. To be employment or hired either in private or public sector, education plays an important role in improvement of human life as well as to make life simple. Household heads with low educational level have less contribution for solid waste management.

Table 4.2: Education level of respondents

Education status	Number of respondents	Percentage
Elementary	38	22
Secondary	56	33
Certificate	15	9
Diploma	34	20
Degree and above	19	11
Others explain	8	5
Total	170	100

Source: Field survey (2009)

From table 4.2, the highest that is 33 percent of the respondents attained secondary school and 22 percent of the respondents attained elementary school level. The lowest that is 5 percent are others, these are illiterate. The above table indicates that more than 85 percent of the respondent can read and write. This indicates that it is a good opportunity to create awareness regarding solid waste management in the study area.

4.2.1.3 Monthly income of the households

Monthly income of the households has direct or indirect relationship with solid waste management system.

Table 4.3: Monthly income of the respondents

Monthly income	Number of respondents	Percentage
Below 200 birr	46	27
201- 400 birr	32	19
401- 600 birr	68	40

601-800 birr	10	6
801 and above	14	8
Total	170	100

Source: Field survey (2009)

From table 4.3, the highest that is the monthly income of 40 percent of the respondents earned an income between 401-600 birr. The lowest monthly income is 6 percent respondents earned between 601- 800 birr. Where as 27 percent of the respondents earn below 200 birr per month. The above figure indicates that more that 50 percent of the respondents have a capacity to contribute for solid waste collection and disposal system.

4.2.2 Sources of Solid Waste in Woldya Town

In Woldya town, the major sources of solid waste are residential, commercial and institutional but there is no industrial solid waste in the town. The respondents have given detain explanation for residential sources of solid waste.

4.2.2.1 Residential Solid Waste in Woldya Town

Waste that are the consequences of household activities in Woldya town which includes organic and some part of non-organic wastes.

From table 4.4, plastic constitute the highest quantity that is 43.5 percent household waste, the lowest is that others (12%).

Table 4.4: Categories of solid waste

Categories of solid waste	Number of respondents	Percentage
Food left over	33	19
Old clothes	42	25
Plastics	74	44
Others	21	12
Total	170	100

Sources: Field survey (2009)

The other solid waste constitutes the lowest percentage that is 12 which includes paper, onion peels, vegetable, bones, chat trimmings and metal. The highest percentage constitutes plastic that is 44 percent because the respondents use plastic for day to day life when they buy goods and different materials from the market area or from commercial area. Plate 1 and 2 shows solid waste near residents' houses and plastic waste disposed off in a ditch respectively.

Source Field survey (2009)

Plate 4.2: Plastic waste disposed off in a ditch

Source: Field survey (2009)

4.2.3 Types of Materials Used For Solid Waste Storage by Household

The following table shows solid waste storage containers used by the respondents, the highest (48%) and the lowest (8%) are sack and community containers respectively

Table 4.5: Solid waste storage containers

Solid waste storage containers	Number of respondents	Percentage
Sack	81	48
Basket	56	33
Community containers	14	8
Others explain	19	11
Total	170	100

Source: Field survey (2009)

From table 4.5, the highest that is 48 percent respondents use sacks and the lowest percentage uses community container that is 8 percent since there is lack of community containers, most of the household used sack. The others include carton, dust bins and bucket which account 11 percent.

4.2.4 Types of disposal method used by household of Woldya town.

From table 4.6, the highest (46%) respondents dispose their solid waste at open dump. The lowest respondent that is 3 respondents use their solid waste for composting.

Table 4.6: Type of disposal method used

Disposal method	Number of respondents	Percentage
Open dump	78	45.88
Community containers	12	7.05
Composting	6	3.53
Ditch	54	31.76
Others explain	20	11.76
Total	170	100

Source: Field survey (2009)

The other 12 percent of the household dispose their residential solid waste illegally to the river, drainage channels and by burning their solid waste in the study area. This informal means of disposing solid waste on open dump, drainage channels and rivers are creating health and environmental problems in the study area. Plate 3 and 4 shows disposal of solid waste at an open dump and illegal burning at an open dump respectively

Source: Field survey (2009)

Plate 4. 4: Illegal burning at an open dump

Source: Field survey (2009)

2.5 The Condition of Disposal Facilities

From figure 4.4, the highest that is 56 percent of the respondents responded that there are no good disposal facilities in the study area. The lowest that is 44 percent responded that there are good disposal facilities.

Figure 4.4, the condition of disposal facilities

Source: Field survey (2009)

The highest (56%) respondents answered that there is no good deposal facilities in the study area because there is expensive facilities, small facilities, the facilities are easily exposed on contaminated with germs and there is poor management of owners of households for their facilities.

4.2.6 Solid Waste Service Providers

From table 4.7, the highest (38 %) of provider for household with solid waste management is informal service provider. The lowest that is 15 percent of provider for household with solid waste management is city administration,

Table 4.7: Provider of solid waste management services

Service Provider	Number of Respondent	Percentage
City administration	26	15.29
Private service provider	48	28.23
Informal service provider	64	37.65
No service Provider	32	18.82
Total	170	100

Source: Field survey (2009)

Now there is better work by business processing re-engineering (BPR) and the city administration provides services such as tracks, containers and wheel barrow 28 percent and 19 percent of respondents are answered that there is private service provider and no service provider respectively.

4.2.7 Facilities Used by service provider

As it is show in table 4.8, the highest service provider uses other (41%) which includes daily laborers, forks and shovels. The lowest service provider use donkey that is (10%) respondents.

Table 4.8: Facilities used by service provider

SERVICE PROVIDER	Number of Respondent	Percentage
Truck	37	22
Donkey	18	10
Wheel barrow	46	27
Others	69	41
Total	170	100

Source: Field survey (2009)

One of the main facilities of solid waste management is equipment (material) which is used for collection transportation and disposal but in the study area most of the facilities were not in good condition because they were very old, the facilities do not repair and the facilities do not have speed to work for a short period of time. Most of the household were not satisfied by the services provider because there is irregular collection, funding limitation for public services, lack of modern technology and the emerging limitation in both energy and raw material and there is expensive service in the study area.

4.2.8 The key challenges of solid waste management in Woldya town.

From table 4.9, the highest (28%) of the respondents answered that the key challenges of solid waste management is lack of awareness, and the lowest is that others which accounts (4%).

Table 4.9: key challenges of solid waste management

Key challenges	Number of respondents	Percentage
Service expensive	22	13
Lack of manpower	36	21
Lack of equipment	21	12
Lack of awareness	47	28
Financial constraints	38	22
Other explain	6	4
Total	170	100

Source: Field survey (2009)

The lowest is that others which include lack of modern technology, inadequate service coverage and inadequate land fill disposal, all these key challenges have their own impact on solid waste management. In the study area the highest (28%) respondents responded that the key challenge is lack of awareness because there is no environmental education related to solid waste, How solid waste is collected, transported and disposed, the residents do not no clearly the use of solid waste.

4.2.9 Involvement of the Community in Solid Waste Management in the Study Area

As it is shown in figure 4.5, the highest that is 72 percent respondents answered that there is no involvement of the community in solid waste management such as in collecting fees, in waste management meeting and in deciding location of containers. The lowest (28%) of the respondents responded that there is community involvement in deciding location of containers and in waste management meeting but their involvement is very low.

4.2.10 Community Role in Solid Waste Management

Community has a greater role in solid waste management such as by deciding disposal site, creating fund and cleaning the waste of their neighborhood environment.

Source: Field survey (2009)

From figure 4.6, the highest (81%) of the respondent think that there should be community role in solid waste management such as in awareness creation, there should be education for the community about solid waste because solid waste have uses for human being by using recycling or reuse but the community think that solid waste do not have uses, this is the problem of awareness or lack of education about solid waste. The others are that the community should involve in waste management meeting and in providing service in poor communities.

The lowest (28%) respondents think that government involvement in solid waste management should be high and the local authority should know the advantages and disadvantage of solid waste management.

4.2.1.1 Ways through which solid waste management can be improved

Form table 4.10 the highest (33%) respondents responded that there should be creating awareness and the lowest are others (7%).

Table 4.10, ways through which solid waste management can be improved

Solid waste management can be improved	Number of respondent	Percentage
Community participation	43	25
Increate funding	38	22
Create awareness	56	33
Encourage waste minimization	22	13
Others explain	11	7
Total	170	100

Source: Field survey (2009)

As it is shown in table 4.10, the highest that is 33 percent of the respondents answered that solid waste management can be improved by creating awareness for the community and for all people in the town because they have not awareness about solid waste management.

The lowest (23%) respondents answered that there should be waste minimization in the town. The others (7%) answered that clear rules and regulation on solid waste management should be formulated and the methods to improve the efficiency of management system for the delivery of service, the local governments should invite and create association with different stakeholders and non- governmental organizations.

4.3 Data Presentation and Analysis from Interview (officials)

4.3.1 Sources of Solid Waste in Woldya Town

According to Woldya town municipality environmental cleaning and beautification experts, the main sources of solid waste in Wolday town are residential, commercial and institutional solid waste. But here is no industrial waste in the town.

Residential solid waste are the consequence of household activities in Woldya town which constitutes garbage, plastic, ash, vegetable peels chat trimmings, food left over, old clothes and metals. From the study plastic and food left over constitute large part in amount of solid waste generated in the study area.

The other source of solid waste is that commercial solid waste comes from hotels, bars and grocery, restaurants, shops, markets, cafeterias, these sources includes glasses, bottles, bones, food remains, paper and vegetable peels. Most of these commercial wastes are found along the main road, in Pisa, Adago and Mugad in the study area where commercial activities are concentrated. There are a number of institutions in Wodya town; this includes schools, government offices, hospitals and religious buildings. The dominant quantities of waste from this institution are paper.

4.3.2 Existing Situation of Methods and Facilities for Solid Waste Management in Woldya Town

According to Woldya town environmental protection experts and Yeju genet kebele environmental department experts, one of the main facilities of solid waste management is equipment or material which is used for collection, transportation and disposal. In Wolday town there is lack of facilities such as track and wheelbarrow, most of the residents used daily laborers as a facility to dispose their waste by carrying with sack from their house to their

disposal area (open dump and ditch).

In Woldya town most of the collection system is performed by the household and by daily laborers. Some of the problems in the process of collection are: inadequate transport equipment, lack of manpower to facilitate the community and private sector for the collection of solid waste, poor internal road network but now it is constructing. The main street and bridges are cleaned by municipality and kebele sanitation and beatification team.

The most widely used storage facilities in the study area are sack and basket but there is lack of community containers in the town. According to municipality expert, the most widely used transport means for solid wastes in the town is by daily laborers but there is lack of track and wheelbarrow to transport solid waste. The residents of the town dispose their waste indiscriminately everywhere around their living quarter such as at open dump and ditch some of the residents burn their solid waste around their houses but there is no official disposal site.

4.3.3 Challenges and Opportunities of Solid Waste Management.

According to Woldya town municipality environmental cleaning and beautification experts and other officials the key challenges of solid waste management in the town are: lack of man power, lack of awareness, financial constraints, lack of equipment, lack of community containers, there is no disposal site, low involvement of the community, private sector and NGO participation, lack of technology and skill for recycling and composting the wastes, weak implementation capacity, lack of clear rule and regulation in the study area about solid waste, awareness of impact assessment, lack of organized data base about profile of waste and performance of the sector in the town and lack of comprehensive solid waste management plan. Moreover, lack of mechanisms that allows professionals and institutions to share experience, transfer innovation for upgrading the service and planning of the services within the town as well as from other town. In the town there was no budget only for solid waste management rather the budget for sanitation, liquid waste and solid waste were performed by one budget not separately. The man power for sanitation, liquid waste and solid waste were not separate rather they worked together.

The opportunities for improvement solid waste management services in Woldya town includes the existence of environmental policy in the country, the provision of the federal democratic republic of Ethiopia (FDRE) constitution right to clean and healthy environment. The existence of law and regulation that provides for decentralization and privatization of the services, the willingness of the community to pay for solid waste management services, to create employment opportunity for waste collectors, the existence of law, regulation and policy for involving the community in to the services. Moreover, the local farmers can use the waste near the town for fertilizing land, because it sustains a naturally healthy soil.

4.3.4 Roles of Stakeholders on Solid Waste Management

According to municipality and health experts effectiveness and capacity of stakeholders are essential to develop an integrated solid waste management in the study area. In the town there is poor quality of service, low service coverage and inefficient, the problem of solid waste management can be solved by community participation, private sector involvement, NGO's involvement and local governments but these stakeholders have low involvement in the town.

4.3.4.1 The Community

Sustainable solid waste management needs active community involvement through specific area of participation. According to the officials the community some times participates in cleaning their surrounding. In general the current status of community participation in the town

is not that much satisfactory. Therefore, it needs a great effort to enable the community fully participate in solid waste management activities and regular neighborhood cleaning programs should be prepared and implemented.

4.3.4.2 Private Sector

According to the officials, there are only some private sectors who participate in solid waste management. For example there were nine (9) contractors for solid waste management but the local government did not support for their work. This indicates that there is low participation of private sector and low cooperation between private sector and local authority. Therefore, the private sector should provide their service effectively and efficiently and they should support the poor households in obtaining their services by cooperating with the local authority of the town.

4.3.4.3 The Municipality and Local Authority

According to the officials, the local authority are not in a position to penalize residents for throwing the garbage in ditches and other open space because there is no clear rules and regulation in the town. The municipality of Woldya town is the most responsible actor to solid waste management of the study area. In the municipality the main problem is that lack of man power, financial constraints and lack of equipment.

Therefore, the activities and the work of solid waste management by the municipality were very low. The local authority and the municipality was the most responsible actors to integrate the community, private sector and NGO's to work on solid waste management but their activities are very low. Therefore, there should be strong man power and mobilization of different actors to generate fund.

4.3.5 Rules and Regulation for Solid Waste in the Town

According to environmental protection experts and local Authority, Wolday town does not formulate such rules and regulation about solid waste because solid waste does not acquire emphasis like that of other major urban problems. Informally, there are some rules, for example the residents should clean from their house up to 20 meter distance. There are environmental policies in Ethiopia which have relevance in waste management. Therefore, there is a need to have a detailed action plan to have clear quid lines and regulations in place for proper management of solid waste in the town.

4.3.6 Possible Solution to Minimize the Problem of Solid Waste Management According to the officials, to improve the waste management significantly the behavior and participation of individuals and groups of society have to change. The methods to improve the efficiency of management system for the delivery of service, the local governments should invite and create association with different stockholders and non- governmental organization. The community should support management of solid waste by contributing finance, equipment, and knowledge and by other necessary materials. The provision of solid waste management at present in the study area is the responsibility of municipality and kebele cleaning and beautification department. The efforts by the community and private sector are very low. Therefore it is better to accommodate, manage and integrate partnership and cooperation all the actors. There should be man power, strong financial capacity, equipment and attitudinal change in the society about solid waste management to be clean and sound able environment of the town. Formulate rules, regulations, legal framework and enforcing mechanism regarding to solid waste in the town.

Conclusions and recommendations

This chapter concludes the major findings of the study and it also forwards recommendations that help to improve solid waste management services in Woldya town.

Conclusions

In Ethiopian cities and towns solid wastes is a major environmental problem. In Woldya town , a worsening solid waste situation such as lack of awareness , lack of manpower , lack of equipment, financial constraints , lack of community containers, no disposal site, low involvement of the community , private sector and non-governmental organization participation being a great challenge for the town.

Involvement of the stakeholder in solid waste management is a mandatory for ensuring improved solid waste management service delivery and hence urban cleanness but in the town their involvement is very low. In the study area, there is improper methods of solid waste management, for example the residents dispose of solid waste in to open dump, ditch and drainage channels, blocking them and finally make to fail functioning properly resulting in water contamination and over flow of effluent and flood of the streets which results a sources of air, land and water pollution and poses risks to human health and the environment.

The opportunities for improvement solid waste management services in the study area are the existence of environmental policy in the country, the willingness of the community to pay for solid waste management services, to create employment opportunity for waste collectors and the local farmers can use the waste near the town for fertilizing land.

Recommendations

In order to improve the solid waste management services in the town, the researcher makes the following recommendations:

➤ **Promote attitude change of the community**

The community should develop proper attitudes and perception towards solid waste handling such as about collection at sources, storage, transportation and disposal by using environmental education about solid waste management.

➤ **Increasing man power**

In the municipality of the town, there is shortage of man power which is a serious problem. So additional man power should be appointed and added and also to improve their skills in different activities like workshops, seminars, other environmental related issues should be given to strengthen their knowledge and there should be sharing of best experience from other town in the country.

➤ **Strengthen financial capacity**

The financial capacity should be strengthening by mobilizing the community, private sector and non-governmental organization to contribute fund for municipality or local authority for the purpose of solid waste management to fulfill necessary materials (equipment) for solid waste management, to add another man power, to environmental education related to solid waste, there is a need of fund to ensure smooth implementation of solid waste management.

➤ **Promote private sector participation**

The private sector should encourage because they are additional means towards waste management such as for collection, storage, transportation and disposal activities in the town.

➤ **Promote education and awareness creation**

Environmental education should aim at improving the quality of life by empowering people with the tools they need to solve and prevent environmental problems. Environmental education

can recognizes values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter relatedness among man, his culture and his biophysical surroundings. There should be education and communication channels between sectors about solid waste management, especially government and the residents of the town.

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