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DEVELOPMENT OF SOLID WASTE MANAGEMENT STRATEGY FOR HOSSANA TOWN

MSc thesis in Environmental Planning and Landscape Design

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Declaration

I, the undersigned, declare that this thesis is my own and original work and has not been presented for a degree in any other university, and that all sources of material used for the thesis have been duly acknowledged, following the scientific guidelines of the Institute.

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Confirmation

The thesis can be submitted for examination with my approval as an Institute`s advisor.

Advisor`s Name: Hailu Worku (PhD)

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Table of Contents

List of tables, figures and plates

List of tables

List of figures

List of plates

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ACRONYMS

asl	Above sea level
CBOs	Community based organizations
CSA	Central Statistics Agency
EPA	Environmental Protection Authority
EPM	Environmental Protection Management
FDRE PCC	Federal Democratic Republic of Ethiopia Population Census Commission
FGD	Focus Group Discussion
g	gram
GDP	Gross Domestic Product
GIS	Geographic Information System
GNP	Gross National Product
HHs	Households
HHSW	Household Solid Waste
HHSWM	Household Solid Waste Management
HIHH	High Income Household
HSWMS	Hossana Solid Waste Management Strategy
ISWM	Integrated Solid Waste Management
kg	Kilo gram
km	Kilo meter
L	Litre
LFA	Logical Framework Analysis
LIHH	Low Income Household
m^3	Cubic meter
MIHH	Middle Income Household
MRF	Material Recovery Facility
MSEs	Micro and Small scale Enterprises
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NGOs	Non-Governmental Organizations
NR	No Response

NUPI	National Urban Planning Institute
PPP	Public-Private Partnership
SCP	Sustainable Cities Pogramme
SJKMC	SriJayawardenapuraKotte Municipal Council
SNNPRG	Southern Nations, Nationalities and Peoples Regional Government
SW	Solid Waste
SWM	Solid Waste Management
UN	United Nations
UNEP	United Nations Environment Programme
US EPA	United State Environmental Protection Authority
V	Volume
W	Weight
WUDD	Works and Urban Development Department

ABSTRACT

Solid waste, which is a result of day-to-day activities of human kind, needs to be managed in a proper manner. Hossana town, like other towns in Ethiopia, faces serious problems associated with poorly solid waste management system.

This study is conducted with the objectiveto develop the solid waste management strategy in Hossana town.

Different sampling methods were employed to select the study units like clustered sampling, systematic random sampling, and purposive sampling. Even thoughmost of the collected data from the interviewed households were qualitative in nature, it was also supported by quantitative information collected through survey and secondary sources.

The study identified that the existing solid waste management problems are highly pronounced due to: no system is introduced for sorting wastes, no community bins (shared containers) for collecting household wastes, piles of solid wastes are often found everywhere (along roadsides, underneath bridges, in drainage channels and in other open spaces), weak implementation of government policy, laws, regulations and legislations, the general public has not been motivated to participate actively in solid waste management system, there are no formal and informal as well as private sectors involved in the operation, insufficient financial resources or inappropriate allocation of available resources, and poor institutional arrangements.

The solid waste management strategies developed for the Hossana town have a number of importance for minimizing the problems that faced the current municipality's proper solid waste management system.Finally, the study forwarded some important recommendations towards implementing the developed strategies to mitigate the existing solid waste management problems.

Key words: Waste, Solid Waste, Solid waste management, solid waste management strategies.

CHAPTER ONE: INTRODUCTION

1.1. Background to the study

The level of population growth and the corresponding increasing levels of consumption pattern in urban areas have contributed a lot to the high amount of wastes generated and their relative negative impacts on the urban environment. Furthermore, the rapid and unregulated expansions of urban areas haveaggravated urban environmental problems including waste management. Hence, the problem of urban environmental degradation is becoming a common issue in all countries(R.C.Kirkwood and A.J.Longley (1995)).

Urban environmental problems are common phenomena in both developed and developing countries. One of the causes for the prevalence of urban environmental problems in urban areas is poor solid waste management practice of urban centers (David,Satterthwaite (1999)).

Higher standards of living and increasing population rate have resulted in an increase in the quantity and variety of waste generated. It has been obvious that if waste generation and its uncontrolled disposal continue in the recent pattern then it would very soon be beyond the capacity of municipalities to control the adverse impacts in a short period (Anubahakaushik, 2007 cited in Ermias, 2009).

Solid waste is one component of environmental degradation, resulting in the contribution ofair, water, and soil pollution by materials interfering to human health, the quality oflife and nature.

Hence, there has to be appropriate planning for proper waste management by means of analysis of the waste situation of the area. Solid waste management can be bifurcated into mainly two phases. One is the waste management in the area where it is generated and second is the management of waste at dumping grounds. This includes the issues related to the waste generation, their storage, collection and removal from the collection points. There are many drawbacks in the existing solid waste management system. For

example, allocation of waste bins at improper location, multiple and manual handling of the waste, no separate bins for recyclable waste, pollution of natural water streams due to waste bin proximity(Kum, V., Harnpornchail, N. and Sharp, A. (2005)).

Management of solid waste, therefore, has been an inevitably the day to day mandate of every urban dweller to minimize the adverse effects of solid wastes on the biosphere (Anubahakaushik, 2007 cited on Ermias, 2009).

Improper solid waste management leads to substantial negative environmental impacts: pollution of air, water and generation of greenhouse gases frominappropriately managed landfills. Furthermore, these problems allow the infestation of insects which spread disease thus affecting the health of human beings (David,Satterthwaite (1999)).

Municipal authorities charged with responsibility of providing municipal solid waste management services have found it increasingly difficult to play their role. The difficulty has been aggravated by lack of effective legislation, inadequate funds and services and inability of municipal authorities to provide the services cost-efficiently(Raea, T (2002)).

As urbanization continues, the management of solid waste is becoming a major public health and environmental concern in urban areas of many developing countries (Zurbrrugc, 2003).

Hossanatown is one of the rapidly growing towns in Ethiopia; it is the second largest town in the SNNPRG (Southern Nations Nationalities and People Regional Government).The solidwaste management problem is steadily increasing from time to timein the town since there are no well-developed mechanisms/instruments to control this problem.

1.2. Statement of the Problem

The disposal of garbage in the world is a problem that continues to grow with the development of industrialized nations and the growth of population. Rapid urbanization, poor financing capacity of local authorities, low technical capacity for planning and management of solid waste, weak enforcement of environmental regulations which allow

local authorities to flout environmental regulations without any sanctions have all contributed to compound the problem (WELL Fact Sheet-Nov 2005: Solid Waste Disposal in Ghana).

The quantity of solid waste generated, as well as its ever changing characteristics is alarmingly increasing. The type of waste varies with respect to the consumption pattern of its generators: residential, commercial, industrial, etc. The household waste contains biodegradable waste (such as vegetables, leftover foods), non-biodegradable materials (such as plastics), and hazardous material (like used batteries); thereby indicating it to be a complicated environmental issues which need proper planning and management practice (UNEP,Developing integrated solid waste management plan; Volume4.)

On the other hand, the problem on solid waste management has been aggravated by the non-timely collection of generated wastes by municipalities coupled with their poor law enforcement mechanisms. The inappropriate location of containers, poorly sited truck route lines, limited personnel are the major problems that significantly affect the solid waste management strategies in a city.

According to Hossana Municipality estimation (2009), every day about 2385.95kg of solid waste are generated from residential, commercial, and industrial activities in the town. From the per capita per day of the total waste generated in the town, the municipality collects and dumps is less than 50% and the rest are discarded into streets, drains, ditches, canals and open spaces; slums and squatter settlers of the town population mostly lacks any form of solid waste collection services; and disposed of their wastes into roadsides, drains or local drains.

The poor municipal solid waste infrastructure system of HossanaTown results in a serious impact on the environment, health and aesthetic condition of the community. The responsible public institution, i.e. Municipality andSanitation and BeautificationCore Processunder the town Service Office does not have sufficient resources to completely and efficiently carryout municipal solid waste management (MSWM).

Therefore, the main causes for the prevalence of poor solid waste management practice in Hossana can generally be pinpointed as: poor institutional arrangement, weak implementation of policies and regulations, lack of adequate budget, few number of containers, low level of economic development, absence of due attention to the informal sectors,lack of awareness of the community,low level of public participation, absence of the involvement of NGOs (Non-Governmental Organizations) and private sectors in solid waste management program.

Hence, the consolidated problem statement of this research paper calls forthe development of solid waste management strategy for Hossana town to curb the situation.

1.3. Objectives

1.3.1. General objective

The general objective of this study is to develop solid waste management strategy for Hossana Town.

1.3.2. Specific objectives

The general objective can be broken down into the following specific objectives:

- To identify the current status of solid waste management in Hossana town.
- To examinethe existing institutional arrangements, policies, laws and regulations pertaining to the management of solid waste in theHossana town.
- To develop solid waste management strategies for theHossana town.

1.4. Research/Guiding Questions

The major guiding questions that the study supposes to answer:-

- What are the social and economic as well as physical impacts of solid wastes on the town environment?

- What are the existing institutional arrangements, policies, laws and regulations pertaining to the management of solid waste in the town?
- What are the current strategies for solid waste management of Hossana town?

1.5. Significance of the study

This paper is deemed to provide reliable information to community based associations, NGOs, governmental and private institutions working in solid waste management in SNNPRSG in general and Hossana Town in particular. Furthermore, it can be considered as a guideline to acquaint students with the basic components of solid waste management strategies in an urban context. Moreover, it gives some direction for the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant environmental issues prior to major decisions that have direct relation with the environment being taken. In addition to this,it provides baseline information for decision makers about the proper solid waste management strategy at all levels.

1.6. Scope and Limitation of the Research

The thematic scope of the study was limited on the assessment of existing solid waste management system that include solid waste handling, collection, transportation, and disposal system and finally developing the solid waste management strategy. In doing so, spatially it is confounded within the boundary of the town by taking three sample kebeles. Further, the thematic scope includes the discussion about households and their characteristics with the solid waste management strategy. Other land use categories are left out from the scope of this paper due to time and resource limitations.

This research is conducted with the following limitations: difficulty of gathering data from different offices, urban dwellers and individuals.

1.7. Research Methodology

1.7.1. Method of Data Collection and Analysis

Hosanna town is sub divided in to three sub-towns(*Addisketema, sechduna and Gofermeda*) and eightkebeles: each sub-town has two, three and threekebeles respectively. These kebeles are considered to be clusters for surveying. For the purpose of this study, three kebeles were randomly selected i.e. one kebele from each sub-town to represent the cluster.

For the public survey, a sample size (n) of households who participate in the study was determined using the sampling technique (formula), which was developed by Cochran (1977) with the desired degree of precision for general population. In this case population variable (p) is house unit variable, and is given as:

$$n = \frac{NZ^2 pQ}{d^2 (N-1) + Z^2 pQ}$$

Where n = Sample size of housing units

P = housing unit variable (residential houses)

Q = Non- residential houses (offices, schools, etc.) = 1 – p

N = Total number of housing units

Z = standard normal variable and its value that corresponds to 95% confidence intervalequals 1.96

d= Allowable error (0.05)

The total population of Hosanna is 74,390 (CSA, 2010) with average 5.3 urban household members (CSA, 2010). The estimated household size (N) for the town is therefore 14,035. Out of these, more than 90% (p) are residential and the rest 10% (Q) is non-residential: commercial, offices and institutions.

Hence, $$n = \frac{NZ^2 pQ}{d^2 (N-1) + Z^2 pQ}$$

$$n = \frac{14{,}035*(1.96)^2*0.9*0.1}{(0.05)^2*(14{,}035-1) + (1.96)^2*0.9*0.1}$$

$$= \frac{4{,}852.51704}{35.340744}$$

$$= 136.957 \approx \underline{137}$$

n= 137 is the minimum sample size of housing units for reliable results.

Each Kebele in Hosanna has a minimum of 1,754 households (14,035 total household of the town divided by 8 kebeles out of which 3 kebeles were selected for data collection i.e. 14035/8 =1,754). On the other hand, if 137households were taken from the clustered region, a method of taking a household at the interval of 45 households (1,754/45 =39 interval) which is demarcated on the kebele maps were used to access a household for questionnaire distribution. Two households were left from the total households if 45 households were equally distributed to each randomly selected kebeles. Therefore, the author was purposelyselected 45, 46 and 46 households from each kebele and by using systematic random sampling technique the selected households were interviewed. Similarly by purposive sampling method, decision makers and experts were accessed at their respective offices at working hours.

Data are collected from primary and secondary sources. Primary data sources include site visit,town residents, decision makers of the town, technical experts who are working in Hossana municipality and Hadiya zone Works and Urban Development Department. Secondary sources of data are collected from published and unpublished materials, website, reports, magazines, and guidelines to gather existing information related to the study area.

1.7.2. Data collection instruments

Data collection instruments for primary data are unstructured interviews, observations and FGD (focus group discussions) whereas for secondary data sources reading books, reports, and referring previously conducted projects are used.

1.7.3. Data analysis

Data analysis tools like GIS, SPSS, MS-Excel and EPI-INFO 2008 version 3.5 are used to analyze the surveyed data and the results are presented in the form of maps, tables, and report.

To have a complete picture of the study, the author made some relationshipsamong research objectives, research questions, methodology and result as shown in Table 1.1

Table1.1 Matrix showing the relationship among research objectives, questions, methodology and result

Ser.No.	Specific objectives	Research questions	Methodology	Results
1.	To identify the current status of solid waste management of the town.	What are the social and economic as well as physical impacts of solid wastes on the town environment?	Data collection -Interview -Observation -FGD Data analysis -Qualitative and quantitative	-Table -Map -Report
2.	To examine the existing institutional arrangements, policies, laws and regulations pertaining to the management of solid waste in the Hossana town	What are the existing institutional arrangements, policies, laws and regulations pertaining to the management of solid waste in the town?	Data collection -Data taken from different documents Data analysis - Qualitative	-Report

3.	To develop solid waste management strategies of the town.	What are the current strategies for solid waste management of Hossana town?	Data collection -Interview -FGD -Data taken from different documents Data analysis -Qualitative	-Report -Table

Source: computed by the author, 2012

1.8. Organization of the Paper

The paper is organized into six chapters. The chapters in the thesis are organized in such a way that they create a smooth flow of the main idea. Chapter one is all about the introduction of the thesis. Chapter two is a room for literature review work discussing the major concepts for the research work. Chapter three gives general description of the study area and the components that describe the existing situation of the town. Chapter four discusses the results and analysis of the results of the survey. Chapter five is the major part of this thesis i.e. the strategies developed for the solid waste management of the Hossana town. Chapter six is a part for conclusions and recommendations where different issues and analysis get concluded and possible recommendations are forwarded.

CHAPTER TWO: LITERATURE REVIEW

2.1. Definition and concepts

Waste: - materials discarded by their generators as having no value. They fall into two broad categories, solid and liquid wastes (Conrad P. Straub (ed.) (1989))..

Solid waste (SW):-solid waste means garbage, refuse, and other solid materials, including solid waste materials resulting from industrial, commercial, institutional, and agricultural operations, and from a wide range of community activities. 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 accord with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental considerations, and that is also responsive to public attitudes" (T. George, et al, 1993).

Household/domestic waste: - Waste materials originating from residential householdsand institutions such as schools and hotels.

Waste recycling: - a process whereby waste materials are reused to make the same types of product.

Waste reuse: – involves the use of a waste for the original or another purpose without pre-treatment or processing.

Waste recovery: - the extraction of useful materials for the purpose of reusing.

Municipal Solid Waste (MSW):- MSW is a waste type that includes predominantly household waste (domestic waste) with sometimes the addition of commercial wastes collected by a municipality within a given area. (*UNEP (United Nations Environment Programme*), *Developing integratedsolid wastemanagement plan; Volume4)*

Waste management (WM):- Waste management is the collection, transport, processing or disposal, managing and monitoring of waste materials. The term usually relates to

materials produced by human activity, and is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management is a distinct practice from resource recovery which focuses on delaying the rate of consumption of natural resources. The management of wastes treats all materials as a single class, whether solid, liquid, gaseous or radioactive substances, and tries to reduce the harmful environmental impacts of each through different methods. *(From Wikipedia, the free encyclopedia)*

Integrated Solid Waste Management (ISWM):- ISWM refers to a strategic initiative for the sustained management of solid waste through the use of a comprehensive integrated format generated through sustained preventive and consultative approach to the complementary use of a variety of practices to handle solid waste in a safe and effective manner (*UNEP*, *Developing integratedsolid wastemanagement plan; Volume4).*

2.2. Solid Waste Generation

In order to prepare a well-planned waste management system, it is essential to know the quantity of waste generated as well as different categories of the waste. Solid waste generation differs from place to place to a great extent; its production and composition are influenced by consumption pattern, climate, season, cultural practice, etc. (Conrad P. Straub (ed.) (1989)).

Solid waste generation rates estimate the amount of waste created by residences or businesses over a certain amount of time: day, year, etc.

Solid waste generation, as one would expect, varies between countries, cities, and parts ofcities in Africa. The solid waste generation rates for the continent's major cities are estimated to range from 0.3-1.4 kg per capita per day (See table below). This gives an average of 0.78kg per capita compared to an average of 1.22 kg per capita for developed countries (Beukering et al. 1999:9). Extreme cases may exist in both situations.

Table2.1. Solid waste generation rates of some African cities

Country	City Name	*Per capita SW Generation kg/day	+Households with garbage collection (%)	Population > 0.5 million
Benin	Porto Novo	0.5	25	0.6
Burkina Faso	Ouagadougou	0.7	40	1.6
Burundi	Bujumbura	1.4	41	-
Cameroon	Douala	0.7	60	1.1
Cameroon	Yaounde	0.8	44	1.0
Congo. DR	Kinshasa	1.2	0	6.3
Congo Rep.	Brazzaville	0.6	72	0.9
Cote d' Ivoire	Abidjan	1.0	70	3.4
Egypt	Cairo	0.5	65	14.5
Gambia	Banjul	0.3	35	0.5
Ghana	Accra	0.4	60	1.7
Guinea	Conakry	0.7	50	1.3
Mauritania	Nouakchott	0.9	15	0.6
Morocco	Rabat	0.6	90	1.6

Namibia	Windhoek	0.7	93	-
Niger	Niamey	1.0	25	0.5
Nigeria	Ibadan	1.1	40	2.0
Nigeria	Lagos	0.3	8	8.0
Senegal	Dakar	0.7	36	2.3
Tanzania	Dares Salaam	1.0	25	2.3
Togo	Lome	1.9	27	0.8
Tunisia	Tunis	0.5	61	1.8
Uganda	Kampala	0.6	20	0.8
Zimbabwe	Harare	0.7	100	1.5

**Solid waste generated per person, in kilograms per day.*

+Percentage of households enjoying regular waste collection.

=Actually based on city levels of 1993 by UNCHS (Habitat, Nairobi 1997)

*Sources: * + World Resources 1998-99 p.278, Data Table 9.3 Urban Data. The provisioning of African Cities.http://www.aiid.org/publ_dietz1.htm & World Wide Cities Product Sample Data. http:www.meridianworlddata.com/product-overview*

2.3. Categories of municipal solid waste

There are many categories of MSW such as food waste, rubbish, commercial waste, institutional waste, street sweeping waste, industrial waste, construction and demolition waste and sanitation waste. MSW contains recyclables (paper, plastic, glass, metals,

etc), toxic substance (paints, pesticides, used batteries, medicine), compostable organic matter (fruits, and vegetable peels, food waste) and soiled waste (blood stained cotton, sanitary napkins and disposable syringes (Jha*et al.,* 2003; Reddy and Galab, 1998; Khan, 1992).

2.4. Solid waste characteristics and composition

Not only wealth, but also consumer patterns significantly influences waste composition. The high content of biodegradable matter and inert material, results in high waste density (weight to volume ratio) and high moisture content. These physical characteristics significantly influence the feasibility of certain treatment options. Vehicles and systems operating well with low-density wastes such as in industrialized countries will not be suitable or reliable under such conditions. Additionally to the extra weight, abrasiveness of the inert material such as sand and stones, and the corrosiveness caused by the high water content, may cause rapid deterioration of equipment(C. Zurbrugg, February 2003, USWM-Asia).

The physical and chemical characteristics of MSW change with population density. The differences in the MSW characteristics indicate the effect of urbanization and development. In urban areas, the major fraction of MSW is compostable materials (40-60%) and inert (30-50%). The relative percentage of organic waste in MSW is generally increasing with the decreasing socio-economic status; so rural households generate more organic waste than urban households (Sharholy*et al*., 2008).

Information on the composition of solid wastes is important in evaluating alternative equipment needs, systems and management programs and plans. For example if the solid waste generated at the commercial facility consists of only paper products, the use of special processing equipment such as shredders and balers, may be appropriate. Evaluation of the feasibility of incineration depends on the chemical composition of solid wastes (Tchobanoglous*et al*., 1977). The composition of solid waste varies with cities and countries depending on the standard of living, life style, social and religious traditions and eating habit of people.

2.4.1. Physical Composition

Information and data on the physical composition of solid wastes are important in the selection and operation of equipment and facilities, in assessing the feasibility of resources and energy recovery and in the analysis and design of disposal to facilities(Sharholy et al., 2008).

2.4.2. Chemical Composition

Information on the chemical composition of solid wastes is important in evaluating alternative processing and recovery options. For example consider the incineration process. Typically wastes can be thought of as combination of semi moist, combustible and noncombustible materials(Sharholy et al., 2008).

2.5. Solid waste management

MSWM encompasses the functions of collection, transfer, resource recovery, recycling and treatment. The primary target of MSWM is to protect the health of the population, promote environmental quality, develop sustainability and provide support to economic productivity. To meet these goals, sustainable solid waste management systems must be embraced fully by local authorities in collaboration with both the public and private sectors. Although in developing countries the quantity of solid waste generated in urban areas is low compared to industrialized countries, the MSWM still remains inadequate (Henry *et al*., 2006).

The best approach to solving a community's solid waste problem is integrated solid waste management- using a combination of techniques and programs to manage the municipal waste stream (US EPA, 1994). An integrated system is designed to address specific set of local solid waste management problems and its operations are based on local resources, economics and environmental impacts. The idea behind integrated solid waste management (ISWM) is that a combination of approaches can be used to handle targeted proportions of waste stream. Local officials should consider a series of activities, each of which is designed to complement the others. For example, a recycling program can have positive impacts on the development of a waste-to-energy facility,

source reduction, recycling, combustion and land filling can have positive impacts on the local municipal waste management problem. To reduce waste management problems at the national level most effectively, states, municipalities and the waste management industry should first consider source reduction- reducing the amount and the toxicity of solid waste generated. Recycling of useful waste materials is the next most desirable approach. Finally composting, incineration and land filling complete the solid waste hierarchy.

The implementation of the integrated solid waste management (ISWM) systems depends on several important factors such as the country statutes, environmental requirements, the strategies in environmental management, energy policy, economic and technological feasibility, and the education and environmental awareness of the people (Hui*et al.*, 2006). Some advanced industrial countries, such as Germany, Sweden, Japan and the United States have achieved remarkable results in resource comprehensive utilization and solid waste management.

2.5.1. Onsite handling, storage and processing

2.5.1.1. On site handling

On site handling refers to the activities associated with the handling of solid wastes until they are placed in the containers used for their storage before collection. Depending on the type of collection service, handling may also be required to move the loaded containers to the collection point and to return the empty containers to the point where they are stored between collections (Wilson, D.C. (2007)).

The residents or tenants of low-rise dwellings are responsible for placing solid wastes that are generated and accumulated at various locations in and around their dwelling in the storage containers and in many locations hand carts are used to transport loaded containers to the pickup point (Tchobanoglous*et al.*, 1977).

Handling methods in most medium rise apartment building are similar to those used for low rise dwellings and high rise apartments, or various combinations of the two. The methods vary depending on the age and location of the buildings. In some of the older medium- rise apartment buildings, it is still common practice for the tenants to place containers outside their doors and to have the waste collector pickup wastes from each floor(Tchobanoglous*et al*., 1977).

2.5.1.2. Onsite storage

According to Tchobanoglous*et al*.1977, factors that must be considered in the onsite storageof solid wastes include: types of container to be used, the container location, public health andaesthetics, and collection method to be used. To large extent, the types and capacities of thecontainers used depend on the characteristics of the solid waste to be collected, the collectionfrequency, and the space available for the placement of containers. Because solid wastes arecollected manually from most residential low-rise detached dwellings, the containers should belight enough to be handled easily by one collector when full. Temporary and disposablecontainers are commonly used when curb service is provided and the home owner is responsiblefor placing accumulated wastes on the curb for collection, paper bags, cardboard boxes, plasticcontainers and bags, and wooden boxes are routinely used as temporary and disposablecontainers. Under normal circumstances, temporary containers are removed along with wastes.

2.5.1.3. Onsite Processing of solid wastes

Grinding, sorting, compaction, shredding and composting are all onsite processing methods used to reduce the volume, alter the physical form, or recover usable materials from solid wastes(Tchobanoglous*et al*., 1977).

2.5.2. Collection and transport

Collection systems comprise household and neighborhood (primary) waste containers, primary and secondary collections vehicles and equipment, and the organization and equipping of collection workers, including the provision of protective clothing. Selection of collection equipment should be based on area-specific data on waste composition

and volumes, local waste handling patterns and local costs for equipment procurement and operation and maintenance: labour, fuel, lubricants, tires, etc(Andrews, Lord, O.Toole and Requena (1993)).

Waste collection systems are characterized by inconsistent and unreliable services caused by shortage of appropriate collection equipment, poor management, shortage of trained personnel, and limited availability of supporting infrastructure and equipment such as transfer stations and public bins(R*aea, T andRarotonga (2002)).*

The collection of waste includes not only the gathering of solid waste and recyclable materials but also the transport of these materials after collection to the location where the collection vehicle is emptied. This location may be a materials processing facility, a transfer station or landfill disposal site(Andrews, Lord, O.Toole and Requena (1993)).

Source-separated collection means that the MSW is first classified as several different parts such as composting materials (food waste), combustible materials (fiber and paper) and recyclable materials (metals and glass). Once classified, these different waste types are then collected and forwarded to the appropriate users (Huiet al., 2006).

2.5.3. Transfer system

Transfer systems include temporary waste storage and transfer points,vehicles and equipment for waste transfer, and the procedures for operating and maintaining these facilities and equipment. Design and expansion of transfer facilities and equipment must match the characteristicsof local collection systems and the available capacity of environmentally safe disposal facilities(Sharholy et al., 2008).

The size, number and distribution of transfer stations must be carefully designed to facilitate local collection while achieving efficient transfer operations and minimum transport distances and costs. Detailed cost analysis is required to determine the optimal solution(Sharholy et al., 2008).

The technical characteristics and design of transfer points and vehicles must consider the characteristics of local collection systems (hand cart dumping requirements, etc.). Careful attention must be given to the objectives of reducing local pollution and limiting, as far as possible, the access of rats and insects. Transfer points are often a choice location for scavengers. Activityand arrangements should be explored for accommodating scavenging without accentuating local pollution problems(Philip Rushbrook and Michael Pugh (February 1999)).

The selection of vehicles must be based on careful cost-analysis which considers `transfer ease, haul volume, operation costs and maintenance requirements. Practical techniques are available for the specification of vehicle requirements (Andrews, Lord, O.Toole and Requena (1993)).

Collected solid wastes are delivered either to a transfer station or directly to disposal facilities. Transfer stations are centralized facilities where waste is unloaded from several small collection vehicles and loaded in to large vehicles, the large vehicles then transports waste to the disposal facility. In addition, operations of a transfer station can be integrated with other waste management options such as recycling programs. By sharing a regional transfer station, communities that use the same disposal facility can substantially reduce their individual costs (US EPA, 1994).

2.5.4. Treatment

Treatment refers to the practice of processing the material to recover resources (usable materials), to improve the efficiency of solid waste management systems, and to recover conversion products and energy. The processing techniques used are (1) mechanical volume reduction (compaction), (2) chemical volume reduction (incineration), (3) mechanical size reduction (shredding) (4) component separation (manual and mechanical) and (5) drying and dewatering (moisture content reduction). Of these, the first two have been used for the processing of solid waste since the turn of the century (Tchobanoglous*et al.*, 1977).

2.5.4.1. Source reduction and reuse

Source reduction is an approach that changes the way products are manufactured, purchased, and used so that less solid waste is generated. Source reduction of MSW involves measures such as: (a) product design and packaging to make them easy to reuse; (b) use of existing packaging materials as opposed to producing new ones; (c) lengthening usage life of products to minimize the frequency of replacement, (d) developing alternatives to disposal such as composting of grass and food wastes and other compostable solid wastes from farms or markets; (e) eliminating unnecessary packaging and (f) avoiding disposable products if reusable items are available (such as razors and batteries). Reuse has worked well with packaging of drinks where reusable glass bottles and cans instead of non-reusable plastic or paper packaging are being used for bottling. This strategy, however, may need change in industrial technology and in consumer choice and preferences as well as taste(US EPA, 1994 and Henry *et al*., 2006).

2.5.4.2. Recycling

On the local or regional level, waste reduction can be accomplished through the increased use of source separation and subsequent material recovery and recycling. Separating waste materials at the household level occurs to some extent almost universally, and prevents the most valuable and reusable materials from being discarded. Following in-home retention of valuable material, waste-pickers currently remove most valuable materials either before garbage enters the waste stream especially in the lower and middle income areas of many municipalities. In these instances, there is little need for additional encouragement of recycling. Even in the more affluent areas of developing cities, often there are found itinerant “buyers” of waste materials such as cardboard and glass. These buyers will help to divert many materials out of the waste stream, and illustrate a key point. If recycling materials is an economically viable undertaking, small enterprises have been and will continue to spring up whenever there is an opportunity; in fact the theft of source-separated recyclable materials has been documented in many pilot schemes in both developed and developing nations (UNEP 1996).

2.5.4.3. Composting

A somewhat more low-technology approach to waste reduction is composting. The waste of many developing nations would theoretically be ideal for reduction through composting, having a much higher composition of organic material than industrialized countries. In developing countries, the average city's municipal waste stream is over 50% organic material (Hoornweg, et al 1999); studies in Bandung, Indonesia and Colombo, Sri Lanka have found residential waste composed of 78% and 81% compostable material, and market waste 89% and 90% compostable, respectively (Cointreau 1982). Still, composting has not been overwhelmingly successful and widespread in practice throughout the developing world. Although well documented in China and other areas of eastern Asia, composting projects have had a spotty record throughout Africa, Latin America and elsewhere, and have had the largest number of failed facilities worldwide (UNEP 1996).

2.5.5. Solid waste disposal

2.5.5.1. Incineration

Another option for waste reduction and disposal is incineration. Incineration should not be considered a 'disposal' option, since following incineration there is still some quantity of ash to be disposed of (probably in a landfill), as well as the dispersal of some ash and constituent chemicals into the atmosphere. It should instead be considered more in terms of its waste-reduction potential, which can be 80-95% in terms of waste volume (Kofoworola, O.F. and Rand (2007)). This appears to be an extremely attractive option, however, with occasional exceptions; incineration is an inappropriate technology for most low-income countries.

Incineration is the process of control and complete combustion for burning solid wastes. It leads to energy recovery and destruction of toxic wastes, for example, waste from hospitals. The temperature in the incinerators varies between 980^0C and 2000^0C. In some newer incinerators designed to operate at temperatures high enough to produce a

molten material, it may be possible to reduce the volume to about 5% or even less (Sharholy*et al.*, 2008).

2.5.5.2. Land filling

Sanitary land filling is an acceptable and recommended method for ultimate disposal of MSW. It is a necessary component of MSWM, since all other options produce some residue that must be disposed of through land filling. It involves placing of wastes in a large specially designed cavity, then covering them with soil (or approved alternative materials) each day. The daily cover prevents attraction of animals and insects(Philip Rushbrook and Michael Pugh (February 1999)).

2.6. Stakeholder Participation and Public Education and Awareness

Solid waste management is basically a welfare and development matter and it is commonly accepted that public participation is essential for its success. Stakeholder participation entails the involvement of all categories of people on the identification of their felt needs, mobilization of resources, and deciding on the direction and execution of programs and projects. It should take place at all levels of planning and management, including training, problem identification, implementation, monitoring and evaluation. Awareness, on the other hand, is the process of awakening and raising people's sensitivity to concerns, in this case the solid waste management problems. Awareness can be created through formal and non-formal education with the assistance of both the print and electronic media (Schertenleib and Triche (1989)).

Environmental education with respect to solid waste management, both formal and non-formal, is vital to changing people's attitudes to appreciating a clean and safe environment, and leads to their empowerment in enabling them to manage their wastes sustainably. It also creates responsibility among the different communities, increases environmental accountability and governance and encourages the rational use of environmental resources(Schertenleib and Triche (1989)).

2.7. Countries experience in the Development of Solid Waste Management Strategy

2.7.1. Swaziland

The project to develop a National Solid Waste Management Strategy was initiated on 1 April 2000. Financial support was provided by DANCED (now DANIDA) and the technical support provided by the Danish consulting company RAMBØLL (www.ramboll.dk). The development of the strategy was carried out in close co-operation with the Government of Swaziland and was anchored in Swaziland Environment Authority.

The project implementation was divided into four phases, namely the Inception Phase (April 2000 – June 2000), the Design Phase (June 2000 – May 2001), the Pilot Project Phase (February 2001 – June 2002) and the Fine-tuning Phase (July2002 – September 2002).

The process that was followed to develop the National Solid Waste Management's Strategy for Swaziland, was structured to make provision for active and continuous participation of the various stakeholders in Swaziland. These stakeholders represented a wide range of constituencies, including commerce and industry, government, non-governmental organizations (NGOs), civil society, and education. It was intended that the strategy would be developed within a Swaziland context, taking into account issues such as land tenure and the available institutional and resource base. The process also made provision for structured interaction with the various stakeholders through internal management review of documents, forums, meetings and workshops. This was achieved mainly through following a Logical Framework Analysis (LFA) Approach.

The development of a National Solid Waste Management Strategy is a dynamic process. The Strategy is therefore a living document and will need revision at least every four years. The strategy represents a solid background for future initiatives concerning waste management in Swaziland.

2.7.2. Sri Lanka

The perception of the people has always been that it is a responsibility of the localauthority. Local authorities are constitutionally bound to keep their territories clean. Forsome time now, many local authorities have been experimenting with several innovative and participatory methods of Reduce, Reuse and Recycle. Over the past four years, SriJayawardenapuraKotte Municipal Council (SJKMC) too has been engaged inexperimenting with new technical options and administrative processes to find innovativemethods to address solid waste management more effectively. Under UN-Habitatsponsored Sustainable Cities Programme, it has tried out various innovations, particularlyby promoting household level composting and bio-gas generation.

Invited by SJKMC, MaRGG undertook a survey to assess the impact and gaps ofthe aforesaid compost barrel project. The survey covered a sample of 252 housesrepresenting 12.6% of the bin recipients during October – November, 2004. A pre-testedquestionnaire was administered for the purpose. In addition, MaRGG conducted a seriesof mini consultations to obtain the views and suggestions of a representative sample ofthe main stakeholders in solid waste management. The findings and ideas that emergedfrom these two exercises, the observations of several visits to the bio-gas plant the VajiraHome and the municipal waste recycling centre in Baddegana and an extensive review ofexisting literature on the subject have helped produce the Report.

CHAPTER THREE: GENERAL DESCRIPTION OF THE STUDY AREA

3.1. Administrative set up and population

Hosanna is the capital town of Hadiya zone which is one of the nine zones of the SNNPRG. The town has got its new structure since 2004 as a town administration and consisting of three sub-towns and eight kebeles.The total population of Hosanna is 74,390 and 14,035 households (CSA projection, 2010) having 50.7: 49.3 sex ratio.

3.2. Geographical Location and Economic Situations

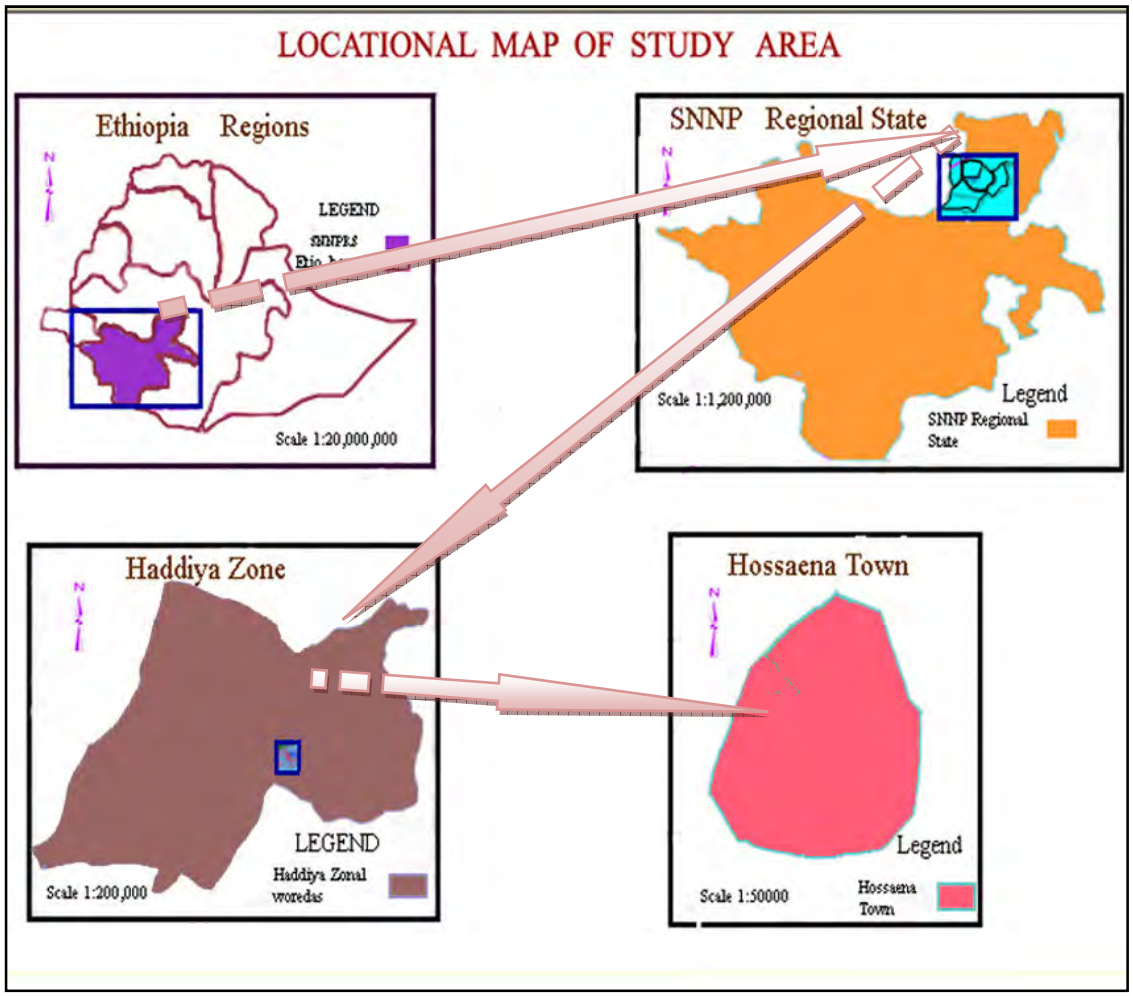

Figure3.1. Location map of the study area

Source: computed by the author, 2012

Astronomically, Hosanna is situated at $7^0 15' 00''$ North latitudes and $37^0 50' 30''$ East longitude. Hosanna is found at 230km away from Addis Ababa via *AlemGena_ Butajira*; 305km via *Ziway-Butajira* and 280 km via *Wolkitie* (NUPI,1998, cited in NUPI,2000). The town is also bounded by peasant associations namely, *Ambicho* and *Kalisha* in the North; *Lareba, Jewie* and *Haysie*in the south; *Ambicho* in the east; and G*ora, Bobicho* and *Allela* in the west (NUPI, 2000). These are the suppliers of cereals mainly wheat.

3.3. Physical Characteristics, Infrastructures and Municipal services

The Physical Characteristics

Physically, Hosanna covers about 40.7km^2 of land with alternatively changing horizontal vertical landscape orientation. It includes several ups and downs, hills and plains which can commonly be said that the town is inclined dominantly from west to east, so that the drainage pattern of the town is from west to east direction covering 25% of the land to be within the slope classification range of 4–7%. According to Tamirat (2005), the present day landscape of Hosanna owes its actual surface from the past volcano tectonic activities with the slight modification by local thick soil formation, soil erosion and to some extent by gulley formation. Hosanna is found at the south eastern edge of the western plateau physiographic region which is very close to the left margin. Its location on a topographically higher area makes the town to serve as a divide for the Gibe-Omo and Rift-Valley lakes drainage basins (Mulugeta, 2000). Its elevation within the town ranges from 2400m asl around *Balewold Church* where the Hadiya (currently Queen Elleni Hospital) Hospital is situated to 2200m.asl around *TekleHaymanot*Church.

According to NUPI (2000), the slope characterizes the town, which gradually descends from the north to south elongated and highly elevated land mass to the east and west. Generally, about 75% of the town is with slope less than 15% and most built up areas are within the slope between 5–10%. According to the same source, the soil of the town is predominantly the litosol which is suitable for construction purpose.

3.4. Brief Description on Infrastructures and Services

According to NUPI (2000), Hosanna town has got electric power service since 1979E.C. with the hydroelectric power. Hosanna sub-station receives electric power from K*oka*and *MelkaWakena* main stations. The sub-station in Hosanna has a capacity of 5Megawatt of which 2.7Megawatt is consumed in Hosanna and the surrounding woredas' towns like *Durame, Gimbichu, Doyogena, Angacha*and *Jajura*. The power is transformed with the aid of 45 transformers with the capacity of 50–315 kilo watt. But some large settlements in the town have not yet accessed to the power services especially to the peripheral parts.

Hosanna town telephone service has started in 1957 E.C with the radio communication. The long line carrier was connected from Addis Ababa and later in 1981E.C. the Micro wavecommunication started through S*hashemene* branch at the end of 1990E.C. (Tamirat, 2005). The system had growth to semi-automatic level with the capacity of serving 2000 clients at that time. The telephone service nowadays is no more serious problem for the town because the use of mobile cell telephone is being prevailed.

The Hosanna town post office has been giving services since 1942E.C with one post office and one collection box. Observation has shown that the post office and the collection box are found very close to one another and located at the center of the town without any branch office at the town. Services like mailing letters and parcels, selling postage stamps and money orders such as remittance and renting boxes have been given in Hosanna and other peripheral towns like *Fonko, Morsuto, Doyogena, Gimbichu*and *Jajura.* Recent observations also show that there is no change of services in size (no branch office and no additional collection boxes)(Tamirat, 2005).

Hosanna as a zone capital has a good road connections with other towns found in Hadiya Zone and elsewhere. All weather gravel roads with the total length of 12–15km in the town radiate from the center of the town to five out lets like *Addis Ababa*, *Wolkite, Gombora, Gimibichu*and *Sodo.* The town also has sufficient amount of collector, local and minor roads with the total length of more than 300km maintaining the good network connection. Recently, 15.4 km roads are asphalted while 94km is paved with the cobble stones (Shobiso, 2010).

Intra–urban passenger transport in Hosanna involves the use of bicycle, horse drawn carts, minibuses, motor cycles, and Bajaj. The uses of minibus, motor cycle and Bajaj have been started since 2007 after the pavements have improved. The remaining transportations means are use of on foot transportation in the town. Hosanna town has one modern hospital that gives services to the town and the adjoin “woredas”. In addition, there are four private clinics, ten drug vendors, one government health center and three health posts (nonfunctional) (Shobiso, 2010).

With respect to education facilities, there are 9 kindergartens, 6 government and 5 private primary schools, 2 high schools and 1 preparatory school in the town. The schools also serve the surrounding rural areas. The existing kindergartens are not sufficient enough to serve the demand of the population. This implies that the educational (KG) and health facilities that were proposed for the last 10 years have not been implemented (Shobiso, 2010).

The solid waste management is not practiced in the town in an organized way. There are different types of solid wastes generated from the town residents, institutions and organizations disposed of here and there in the town. These solid wastes pollute the environment which in turn has a negative impact on social, physical, economic, health and aesthetic of the people. The major solid waste management problems in Hosanna town are:-

- Solid waste infrastructures /equipment and transport vehicles are not enough to give sufficient service.
- Solid wastes generated from various sources are dumped in different parts of the town.
- The provision of solid waste management infrastructuresby the responsible organ /municipality isvery weak.
- People dump solid waste in their vicinity like open spaces, drainage way, along the roads, near the fences, etc.
- No system is introduced for sorting waste in containers at the source of household waste generation;

- There is no community bins for collecting household wastes provided by the municipality at any place in the town

Currently there are no solid waste management strategies to solve solid waste management problems of town.

CHAPTER FOUR: DISCUSSION AND ANALYSIS OF RESULTS

4.1. Existing solid waste management practice in Hossana

Ethiopia has experienced rapid urbanization and increasing urban population in the last few years due to more rural-urban migration and rising per capita incomes (FDRE PCC (Federal Democratic Republic of Ethiopia Population Census Commission), 2008). Presumably, increased demand for infrastructure and public services accompanies this growth, but this has not been the case. Many towns in Ethiopia lack the financial resources and institutional capacity to provide the most basic municipal infrastructures and services, including solid waste management.

The management of solid waste in Hossana town is ahistory of institutional trials and abandonment,with most issues remaining unsolved. The newestablished core processin the town Municipality,Cleaning and Beautification Core Processwas assigned the responsibilityfor the management in 2009. Unfortunately, thiscore process is struggling with tight budgets, lackof qualified manpower, and experience in wastemanagement.In this chapter the existing solid waste management practices are briefly discussed and analyzed in detail based on the surveyed data.

4.1.1. Socio economic conditions of residents in Hossana

Economic studies on solid waste management in Ethiopia, especially those involving contingent valuation, are extremely scanty or non-existent.

The income level of the households who were surveyed in this study is indicated in Table 4.1.These households were categorized into three groups depending on their family income to come up with their economic status. Therefore, households who earn less than or equal to 212.30 birr per month i.e.76HHs (55.5%) werecategorized under low income, those who earn 212.30-390.59birr per month i.e. 37HHs (27.0%) were

categorized under middle income and those households that earn greater than or equal to390.59birr per month i.e.24HHs (17.5%) were categorized under high income groups.

According to Central Statistics Authority of Ethiopia 2004/05, domestic expenditure of households isindirect indicator of households' income level. When monthly income of household is distributedto its respective family members, majority of households come under low income level. This ismay be due to most households supporting large family sizes with low income source. Asindicated in Table4.1, 76households surveyed (55.5%) in Hossana town werecategorized under low income group, whereas middle and high income groups accounted for 27.0% and 17.5% respectively.

Table4.1. Income levels of Households in Hossana town

Income level	Monthly income in birr	Households	Percent
Low income	≤ 212.30 birr	76	55.5
Middle income	212.31- 390.59birr	37	27.0
High income	>390.60birr	24	17.5
Total		137	100.0

Source: CSA the Household Income, Consumption, and Expenditure Surveys 2004/05

Economic status of households is one of the major factors which have direct impact on domestic solid waste generation rate. The Gross National Product (GNP) is strongly associated with the increasing volume of solid waste, but population is weakly associated with generation of solid waste (Heidenstam, O. von. 1977).

4.1.2. Household solid waste generation

The waste generated by a population is primarily a function of the people's consumption patterns and, thus, of their socio-economic characteristics. At the same time, waste generation is conditioned to an important degree by people's attitudes towards waste: their patterns of material use and waste handling, their interest in waste reduction and minimisation, the degree to which they separate wastes and the extent to which they refrain from indiscriminate dumping and littering (Peter Schübeler, KarlWehrle and Jürg Christen, August/1996).

According to Hossana town municipality, every day an average of 0.07-0.37kg/capita/dayof solid wastes are generated from individual households in the town.

Table4.2. Summary of SW generated of all types from HHs *in Hossana*

Waste generator	Daily total generation (kg)		Per capita generation per day
	Range	Average	
Low income	24.35-33.28	28.82	0.07
Middle income	31.21-47.69	39.45	0.18
High income	44.64-59.87	52.26	0.37
Overall	85.54-115.63	100.59	0.20

Source: Hossana Town municipality, 2012

Table4.2.depicts the per capita waste generation of HHs with different income level. Hence, the amount of waste generated varies along with the income level of households.

The results of the study indicate that 55.5% of the low income householdsgenerate0.07 kg of solid waste per capita per day and 27.0% and 17.5% of medium and high income households generate 0.18kg and 0.37kg of solid waste per capita per day respectively and the overall average per capita generation is 0.20kg/day. This indicates that the daily household solid wastes generation per person increases with increased economic status of households and standard of living.

Households in the study area were categorized into three groups depending on their monthly per capita income.Households that have better life standard use more consumption materials than low income households do, through which they generate greater amounts of wastes. As indicated in Table 4.3, a household generates 0.41kg/day for low income families, whereas middle and high income households generate 1.68kg/day and 3.79kg/day respectively. Similarly, per capita generation rate

of a person is 0.07kg/day, 0.18kg/day and 0.37kg/day for low, middle and high income groups respectively.

Table4.3. HHs SW generation rate of Hossana town

Descriptions	Low income	Middle income	High income
Monthly income	≤ 212.30 birr	212.30-390.60 birr	>390.60birr
Number of HHs	76 (55.5%)	37 (27.0%)	24 (17.5%)
Average family size	5.7	5.1	4.6
kg/HH/day	0.41	1.68	3.79
L/HH/day	2.88	4.0	3.97
kg/capita/day	0.07	0.18	0.37
L/cap/day	0.40	0.75	0.86
Density (kg/m3)	175	240	430.23

Source: Own survey, 2012

Based on the above table it can be concluded that the volume of the waste generated by low-income familiesgenerates2.88L/day, whereas middle and high-income households generate 4.0L/day and 3.97L/day respectively. This indicates that solid waste generation rate has direct relationship with income level.

Total generation rate

Total generation rate of household solid wastes can be calculated from the average per capita per day generation rate (0.20kg/cap/day) of the studied household, average family size of Hossana town (5.3) and total number of housing units (14,035).

Calculating total generation rate of the household solid waste enables us to estimate the total solid waste that can be generated in a day, month, or in a year, which in turn help to plan accordingly for better solid waste management of the town.

With regard to solid waste generation rate, even though the solid waste trend is expected to increase in general, recent and up to date data were not available. The

amount of the solid waste generation rate in Hossana town per day, month and year has been estimated based on the CSA population projection 2010 (Table 4.4).

Table4.4. The solid waste generation rate in Hossana town per day, month and year

Town	Population CSA projection 2010	Solid waste generation kg/capita/day	Solid waste generation kg/day	Solid waste generation kg/month	Total Solid waste generation kg/year
Hossana	74,390	0.20	14,878	$4.5x10^5$	$5.4x10^6$

Source: Computed by the author, 2012

4.1.3. Comparison of solid waste generation rate of Hossana town with other Ethiopian towns

Comparing the SW generation rate of Hossana town with other Ethiopian towns that have similar socio-economic situation enables us to estimate the magnitude of the solid waste problems of the town.Hence, the comparison has been made with Addis Ababa city,Mekele,Adama andHawassaTown. Thus, in Addis Ababa 200,000tonsof domestic waste is being generated in a year(Overview of Addis Ababa citysolid waste management system, 2010).On the other hand, Mekelecity's annual solid waste generation is over 4,800tons(DagnewHagos, AlemuMekonnen, and ZenebeGebreegziabher, 2012), Adama town generates 12,856 tons of HHSW in a year (LemaAsfaw, 2007) while Hawassa generates 14,490.5 tons of HHSW in a year (DerejeDiriba, 2009). The generation of Hossana being 4,615.79 tons of HHSW in a year indicates thatthe figure is the lowest of all compared towns and Addis Ababa city.

The comparison on the daily generation rate reveals the same truth. The daily generation rate of HHSW in Hossana town varies from 0.07 to 0.37 kg/cap/day. Whereas the rate inAdama varies from 0.11 to 0.57kg/cap/day (LemaAsfaw, 2007); in Addis Ababa cityvaries from 0.252to 0.40kg/cap/day (Overview of Addis Ababa citysolid waste management system, 2010) and in Hawassait varies from 0.1 to 0.95 kg/cap/day (DerejeDiriba June, 2009).

The minimum generation rate in all cases is relatively equal while the maximum range shows significant variation. The reason for this is that the distribution and number of high income dwellers residing and generating waste in the compared towns and city is very much higher than that of Hossana while the number, distribution and generation rate of low income dwellers is very much in closer ranges.

4.1.4. Solid Waste Composition

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

As it was observed in this study, majority of the waste was of plant origin while the animal and the industrial origin was almost none in most of the households. Of the plant source, vegetable residues take the greatest portion.

Overall composition includes paper, vegetable peelings, onion seed coats, broken plastic and festal, soil and dust, animal dung, grasses, pieces of cloth, small bottles, soot, etc. The waste aggregate more frequent in the whole mass of household waste was house sweeping, which is composed of soil and dust followed by pieces of paper and vegetable peelings. Ash swept out from kitchens is more in quantity than other waste. However, it is not removed every day. Households having regular chattchewing members are found to have a lot of waste in the form of chattsticks and leaves.

When considering the solid organic waste production across different origin/nature (plant, animal and industrial), the plant origin was found to be higher (98%) while percentage composition for animal origin is 1.75% and 0.25% accounts for industrial origin.

4.1.5. Waste Storage Systems

A key aspect of effective waste management is proper waste storage on the premises where the waste is generated (Kum, V., Harnpornchail, N. and Sharp, A. (2005)). Generally no system for sorting waste in containers at the source of household waste generation has yet been introduced in Hossana town. Hence, the paper studied the storage practice in Hossana Town as indicated on the table below.

Table4.5. Types of SWs handling for onsite storage in Hossana

Waste handling	Households	Percent
Closed Container	14	10.2
Open Container	40	29.2
Plastic Bags	50	36.5
Pile in the yard	17	12.4
Other	16	11.7
Total	137	100.0

Source: Own survey, 2012

The table above reveals that 10.2% of households use close containers to dispose the waste that they generate while 29.2% open containers and 36.5% are dependent on plastic bags to store the waste they produced. About 12.4% pile the waste simply on the back yard or open fields. The rest 11.7% of households use either of the storage mechanisms based on convenience and suitability.

The town municipality has not placed public dust bins along some of the major roads for temporary storage of waste to be used by the public to put small amount of waste such as paper, piles of fruits or wrappings, in order to avoid littering, and to improve the cleanliness and appearance of the town. There are places where different types of wastes disposed at different areas of the town. This shows that the public awareness about storage of solid wastes is still very low.

Plate1: Solid waste ofchatt sticks and leavesPlate2: Solid waste broken plastic and festal

Source: Field photograph by the author, 2012

The above plates depicts that there is no waste management strategy placed in the study area thus improper disposal is the major characteristics on the municipality.

4.1.6. Solid Waste Collection and Transportation

The solid waste management policies issued by the Hossana town council in 2003 E.C. prescribes that the collection, transport, storage, minimizing and dumping of waste in the town is the responsibility of the Hossana town municipality. However, there are no waste bins (shared containers) for collecting household wastes provided by the municipality at any place in the town. But there is only one waste collection vehicle with a capacity of $5m^{3.}$ The vehiclecollects waste from different places: hotels, restaurants, streets, open spaces, etc. and transports and disposes of it in the disposal site. The vehicle makes 2-3 daily trips to the dumping site which found about 5km away from the center of the town. Thus, the vehicle does not reach each part of the city with this daily performance.

Table4.6. Access for house-to-house collection and disposal service in Hossana,

Access for collection	Households	Percent
Have	6	4.38
Have not	131	95.62
Total	137	100.00

Source: Own survey, 2012

The table above depicts that out of 137 households selected for this study, only 6 HHs (4.38%) have access for house-to-house collection and disposal service whereas the rest i.e. 131 HHs (95.62%) do not have direct access. Even the frequency of transporting and collection of household and other solid wastes to the container and disposal site by the municipality are extremely low.

Furthermore, house-to-house collection and disposal service is done by the municipality and there is no formal or informal sectors involved in this activities yet. This shows that the collection and transportation and disposal service needs an improvement in order to address the problems of solid waste management of the town.

The following plates show that the collection and transportation of solid wastes by the municipality from hotels and restaurants.

Plate 3: Solid waste collected and transported to disposal site by municipal vehicle

Source: Field photograph by the author,2012

However, there is good practice to be implemented on this regard. According to the information that obtained from the municipality, the municipality made an agreement with informal sector solid waste collectors to collect waste in a house-to house collection mannerby the use of animal pull carts or other mechanism suitable to the site. The collectors are expected to separate reusable/recyclable materials and collect the unwanted degradable waste to the centrally located transfer stations and then transported and disposed of it to the disposal site.

4.1.7. Resource recovery and recycling

In low-income countries, recovery of recyclable materials-mainly paper, glass, metals and plastics- is normally undertaken by informal private sector workers. This economically useful activity should be facilitated by the appropriate provision of equipment and facilities at each stage of the collection and disposal process*(*Philip Rushbrook and Michael Pugh (February, 1999)).

Recycling is viewed as a resource conservation activity and it may also offer agreater return for many products in energy saving.

Reuse is an important factor to reduce the amount of waste to be dumped at the final disposal site.

As far as waste reuse/recycle is concerned, there are some people called “Korallew” who move through the town to buy recyclable items such as glass, plastic, tin cans, metals, shoes etc. from different houses, hotels, restaurants, and repairs services.There are also people involved in similar types of job called “Liwach” who go around the town and exchange used clothes and shoes with new household utensils.These people, who arenot recognized by the town Municipality, involved in the collection of reusable/recyclable wastesand transported it to Addis Ababa for further reusing and recycling.

Plate 4.Different types of solid wastes collected by “Korallew” and “Liwach”.

Source: Field photograph by the author, 2012.

The above plate4 shows that the task of “Korallew” and “Liwach” is inevitable and exemplary. There is a practice of segregating recyclable wastes as per their category and flexibility for further reuse and enhance recycling efforts very well.

4.1.8. Waste disposal Practice

Waste disposal is one of the most important management activities which need to be carefully planned. With regard to waste disposal, the study identified that almost all solid waste generated in households is disposed together i.e. there is no sorting habit of organic wastes from others at the household level. Therefore,disposing of household wastes into a river system, drainage system and any open place is a common practice and the result is threatening both surface water and ground water and causing flooding which provides a breeding ground for disease carrying pests and create problems to human health and the surrounding environment due to mismanagement.

Table4.7. HHs get rid of food wastes from their house in Hossana

Disposal means	Households	Percent
Burn	18	13.1
Bury	16	11.7
Dump in River/Gully	20	14.6
Dump in Yard	18	13.1
Dump on road	8	5.8
Dump at disposal pit	36	26.3
Garbage Bin	21	15.3
Total	137	100.00

Source: Own survey, 2012

The above table testifies that 26.3% of the inhabitants dispose their wastes in to disposal pits while 15.3% dump the wastes in to garbage bins. The rest of the households dump in river/gully, dump in yard, dump on road, burn, bury and other means.

Concerning the disposal of paper/cardboard and yard trimmings, majority of the households like 80.3%, 7.3%, 2.9% and 2.9% use burning,dump in yard,dump in river anddump at disposal pit respectively. The rest of the households usegarbage bin, dump on road, bury and other means as shown in Table 4.8below.

Table4.8. HHs get rid of paper/cardboard and yard trimmings in Hossana

Disposal means	Households	Percent
Burn	110	80.3
Bury	3	2.2
Dump in River/Gully	4	2.9
Dump in Yard	10	7.3
Dump on road	2	1.5
Dump at disposal pit	4	2.9
Garbage Bin	3	2.2
Recycle	1	0.7
Total	137	100.00

Source: Own survey, 2012

Here are some of the plates that show the solid wastes which are disposed of in different places of the town.

Plate5: SW disposed of near fence *Plate6: SW disposed of near to residence*

Plate7: SW disposed of near to building *Plate8: SW disposed of in market place*

Source: Field photograph by the author, 2012

Currently there is one open dumpsite which serves as final disposal sitelocated 5kms away from the city center in the south-west part of the town. It was established two yearsago and has a surface area of 1.5hectares. It is in close proximity to the river and pollutes the water.

4.1.9. Waste burning/incineration practice

The selected respondents were interviewed whether they have practiced burning or incineration or not, and if there is incineration, is it practiced at secured places or not, as shown in Table 4.9.

The surveyed result that was conducted on 137 households of the town shown that 95 HHs (69.3%) burn their house hold wastes in their gardens or by road side,38HHs (27.7%) do not burn and the rest of the households i.e.4HHs (3.0%) do not know about the importance of burning the wastes. Out of those who burn their household wastes, 4 HHs (4.2%), 51 HHs (53.7%) and 40 HHs (42.1%) burn their household wastes daily, once in two or three days and weekly respectively. Table 4.9 and Table 4.10 below show the number of households who burn their households' wastes and the frequency of burning respectively.

Table4.9. SW burning practice in Hossana town

Burn or not burn	Households	Percent
Yes	95	69.3
No	38	27.7
Do not Know	4	3.0
Total	137	100.00

Source: Own survey, 2012

Table4.10. Frequency of burning of SWs in Hossana town

Frequency of burning	Households	Percent
Daily	4	4
Once in two or three day's	51	54
Weekly	40	42
Total	95	100.00

Source: Own survey, 2012

Waste burning by households mainly includes paper, plastics and yard wastes. The use of plastics and papers as igniting agent for fire wood in kitchen is common practice in Hossana town.

4.1.10. Composting Practice

According to Gardner (2001), as cited in Bezaye (2008), composting is an ancient practice where more cities in the world nowadays are reclaiming the benefits of reusing solid organic waste material. It is a natural way to prepare the waste for use (NigatuRegassa, Rajan D. Sundaraa and BizuneshBogaleSeboka, 2011).

With regard to composting, the households practicing composting are very few i.e. only 21households (15.3%). 111households (81.1%) do not practice compostand the rest 5households (3.6%) do not know about composting as shown in Table4.11.

Table4.11. SW composting practice in Hossana town

composting practice	Households	Percent
Yes	21	15
No	111	81
Do not know	5	4
Total	137	100.00

Source: Own survey, 2012

As can be seen from the Table4.11, 81% of household wastes are not composted. This shows that composting practice needs to be improved since composting of solid waste is one of the sustainable ways of managing it if a large fraction ofthe waste is organic in nature.

4.2. Existing institutional arrangements, policies, laws and regulation in SWM

Solid waste management activities are supported by practical, effective, enforceable and culturally-sensitive legislation.

Institutional aspects of MSWM concern the institutional structures and arrangements for solid waste management as well as organizational procedures and the capacity of responsible institutions.

The current institutional arrangement of the solid waste management of the town has no integration or coordination with other sectors.

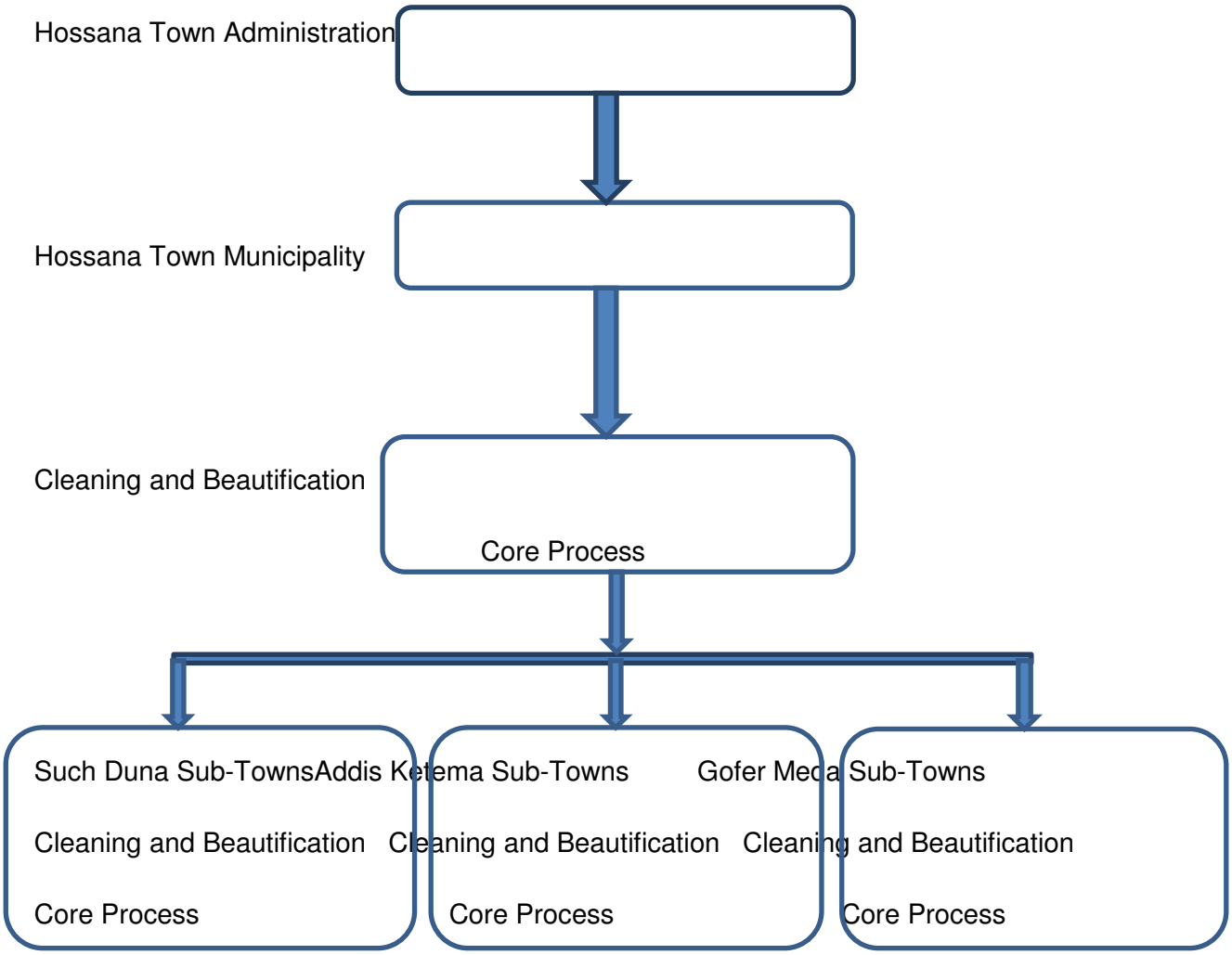

Figure4.1. Institutional arrangement of the SWM of Hossana Town

Source: Hossan Town Municipality, 2012

As can be seen from the above figure4.1, there is no other sectors involved in the waste management system. Even the kebeles are not actively involved in this operation.

According to the town municipality, the annual budget (2004 E.C) allocated for the implementation of solid waste management of the town is 112,000.00 (one hundred twelve thousands birr) and the human resources assigned in the Cleaning and BeautificationCore Process both in the town municipality and sub-towns to carry out the

cleanliness of the town is only 23. With this amount of budget and human resources, it is difficult to give sufficient services to the town residents.

The town has proclaimed laws or acts onsolid waste management by the Hossana town Council in 3/5/2003 E.C. The regulation discussed about the storage, collection, transport and disposal of solid waste as well as penalty on those who violate the provisions. Even if there are policies, laws and regulations, their implementations and enforcement are very weak.

4.3. Community Participation, awareness and attitude towards solid waste management

Experience is availablewhich demonstrates the effectiveness of community- based solid waste management and environmental development. Information concerning this experience and practice may be provided, along with practical guidance and tools, to enable governments to establish active partnerships with community organizations in the interest of more extensive, low-cost waste collection service (Nicholaisen, Plog, Spreen and Thapa (1988)).

Solid waste management is basically a welfare and development matter and it is commonly accepted that public participation is essential for its success. Stakeholder participation entails the involvement of all categories of people on the identification of their felt needs, mobilization of resources, and deciding on the direction and execution of programs and projects(Schertenleib and Triche (1989)).

Public awareness and attitude towards waste can affect all stages in solid waste management process.This has an impact on household waste storage, waste segregation, recycling, collectionfrequency, littering and willingness to pay for waste management services (Imam *et al*., 2008).

In Hossana town it is common to see people throw litter from cars or motor vehicles into streetswhile traveling and to see people in the parks leave litter on park benches even thoughsome basketbins are available within the parks.

The following tables show the public awareness and attitude towards: illegal dumping of SWs polluting water bodies; improper storage and disposal methods of SWs are the causes for diseases transmission in their community; SWsthat are blocking drainage cause flooding problems; and willingness to pay to have clean environment.

Table4.12. HHs' attitude towards illegal dumping of SWs in Hossana

Illegal dumping of SWs polluting water bodies	Households	Percent
Yes	108	78.8
No	27	19.7
Do not know	2	1.5
Total	137	100.00

Source: Own survey, 2012

Table4.13. HHs' attitude towards improper storage and disposal of SWs in Hossana

Improper storage and disposal methods of SWs causes for diseases transmission in their community	Households	Percent
Yes	113	82.5
No	21	15.3
Do not know	3	2.2
Total	137	100.00

Source: Own survey, 2012

Table4.14. HHs' attitude towards blocking drainage by SWs in Hossana

SWs that are blocking drainage cause flooding problems	Households	Percent
Yes	109	79.6
No	24	17.5
Do not know	4	2.9
Total	137	100.00

Source: Own survey, 2012

Table4.15. HHs' attitude towards willingness to pay to have clean environmentin Hossana`

Willingness to pay to have clean environment	Households	Percent
Yes	116	84.7
No	15	10.9
I do not know	6	4.4
NR	0	0
Total	137	100.00

Source: Own survey, 2012

Even if the above tables show the public awareness and attitude towards SWs; practically there are solid wastes here and there in the town and therefore, efforts should be made by both local government and private sector to increase public awareness of solid waste management issues.

Plate9: SW dumped in to drainage channel

Source: Field photograph by the author, 2012

4.4. Private Sector Participation in solid waste management

The private sector includes a wide range of enterprise types, varying from informal micro-enterprises to large business establishments. As potential service suppliers, private enterprises are primarily interested in earning a return on their investment by selling waste collection, transfer, treatment, recycling and/or disposal services. Operating in various forms of partnership with the public sector, they may provide capital, management and organizational capacity, labor and/or technical skills(Schertenleib and Triche (1989)).

Currently, in Hossanatown, there is no formal and informal private sector involved in the operation of solid waste management. Even if the municipality has a role and responsibility to clean the town for collection and disposal of MSWs by different mechanisms, the survey result conducted on the households shows that out of 137 HHs, only 6HHs (4.38%) get the municipal service. The rest of the HHs i.e. 131HHs (95.62%) got neither municipal nor other services(see Table4.5). There are some restaurants used the animal pull carts to collect, transport and dispose of their solid wastes to the disposal site as shown in the plate below.

Plate10: SWs from restaurants transported to disposal site

Source: Field photograph by the author, 2012

According to the information obtained from the town municipality, there is a good start to involve the private sectors especially MSEs in the structure of one to five formations in the collection of MSWs from each HHs and other institutions to a common transfer stations and the vehicle of the municipality transported it to the disposal site. Therefore,the local authority of Hossanatown has to provide service through training and hiring of qualified personals to improve themanagement of MSW and disposal.

4.5. Major findings of existing solid waste management problems of the town

From the results which were discussed in this chapter, significant problems/issues related with solid waste management systems of the Hossana town are identified. These are:

1. No system is introduced for sorting waste in containers at the source of household waste generation;

2. There is no community bins (shared containers) for collecting household wastes provided by the municipality at any place in the town;
3. Piles of solid wastes are often found along roadsides, underneath bridges, in drainage channels and in other open spaces;
4. Weak implementation of government policy, laws, regulations and legislations on solid waste management system;
5. The general public has not been motivated to participate actively in solid waste management system;
6. There are no formal and informal as well as private sectors involved in the operation of solid waste management system;
7. Insufficient financial resources or inappropriate allocation of available resources,
8. Poor institutional arrangements.

CHAPTER FIVE: SOLID WASTE MANAGEMENT STRATEGY OF HOSSANA TOWN

5.1. Introduction

In rapidly growing cities in developing countries, solid waste is a major source of concern due to lack of appropriate planning, inadequate governance, resource constraint, and ineffective solid waste management. According to UNEP (2004), the generation of solid waste has become an increasing environmental and public health problem everywhere in the world, particularly in developing countries cities.

Rapid urbanization has made solid waste management a serious problem today.
The perception of the people has always been that it is a responsibility of the localauthority. Local authorities are constitutionally bound to keep their territories clean. Forsome time now, many local authorities have been experimenting with several innovative and participatory methods such asreduce, reuse, recycle, composting, avoiding, incineration, resource recovery, sanitary landfill and remediation.

Town residents and especially households—which are the primary producers of solid waste and suffer the effects of uncollected solid waste more directly—should be able to participate in municipal discussions on improving SWM and structuring effective public-private partnerships to deliver such services. The service provider (whether town municipality or private sectors) needs to better understand households' demands and motivation.

The Hossana Solid Waste Management Strategy (HSWMS) is anchored on the premise thatsolid waste management covers all activities pertaining to the storage, collection, control, transfer, transport, processing and disposal of residual solid waste. The developed strategiesare not a monolithic collection & disposal system. Its scope must include administrative, financial, legal, and institutional functions.

5.2. Identified strategic issues/problems

Urban environmental problems are a common phenomenon in both developed and developing countries. One of the causes for the prevalence of urban environmental problems in urban areas is poor solid waste management generated from households, industries, commercial centers, different institutions, construction and demolishing activities etc.

The author took the major findings that are mentioned in previous chapter as significant problems/issues, which needs alternative strategies to come up with solutions, of the Hossana town identified. These are:

- Piles of solid wastes are often found along roadsides, underneath bridges, in drainage channels and in other open spaces.
- Weak implementation of government policy and legislation on solid waste management system.
- Insufficient financial resources or inappropriate allocation of available resources.
- The general public has not been motivated to participate actively in solid waste management.
- There are no formal and informal sectors as well as private sectors involved in the operation of solid waste management system.
- Poor institutional arrangements.

5.3. Alternativestrategies for the identified issues/problems

The town municipality will emphasize on the use of an affordable mix of appropriate technical and sociological options and thus will cease to depend solely on the conventional collection and disposal method. The strategy is based on the broadly accepted“Hierarchy of waste management” which gives apriority listing or the waste management options available. The hierarchy also gives important general guidelineson relative desirability of different management options.

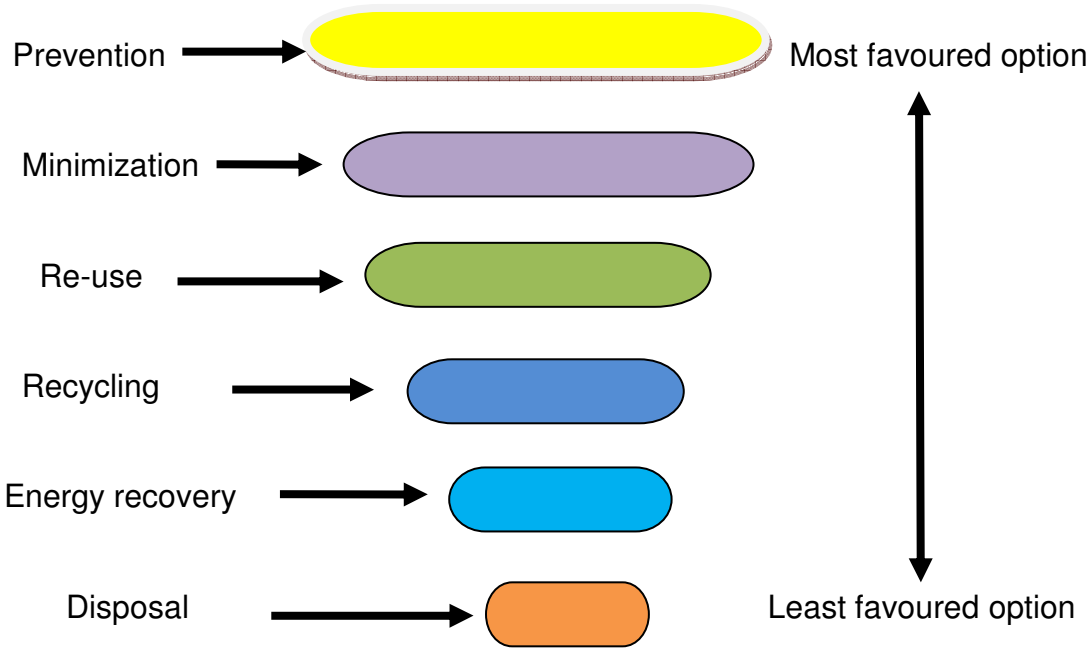

Figure5.1. Hierarchy of integrated solid waste management

The highest and most preferred rank of this integrated management hierarchy is waste prevention or waste minimization at source, which aims at reducing the amount of the waste produced. It is the most effective way to reduce the quantity of disposable waste, the cost associated with its handling and its adverse environmental impacts. Reuse, recycling and energy recovery technologies then come as moderately suitable technologies. Land filling is the last option of the hierarchy that involves controlled interment of the residual waste which has no further use. This is the most common practice in many countries.

Here is the table that shows the generated alternative strategies for each single strategic issues/problems that have already identified.

Table5.1.The generated alternative strategies for each single strategic issues/problems

Ser.No.	Identified strategic issues/problems	The generated alternative strategies
1.	Piles of solid wastes are often found along roadsides, underneath bridges, in drainage channels and in other open spaces.	- An effective punitive action must be applied to those who pollute the environment or; - Public education to enhance awareness or; -Outsourcing SWM to private organizations.
2.	Weak implementation of policy, law and regulation on solid waste management system.	- Implement policy, law and regulation at all levels in a properly manner, and; - Set up "polluters pay" principle; and -Promote Zero Waste Principles and Policies; and -Harmonize services, policies, by-laws.
3.	Insufficient financial resources or inappropriate allocation of available resources.	- Allocate sufficient financial resources or; - Appropriate allocation of available resources and; - Effective utilization of existing resources.
4.	The general public has not been motivated to participate actively in solid waste management.	-public education to enhance awareness, and; -Participating the public in the development of solid waste management strategy.
5.	There are no formal and informal sectors as well as private sectors involved in the operation of solid waste management system.	- Recognize the formal/informal sector as a vital partner and; - Set up a Public-Private Partnership.
6.	Poor institutional arrangements.	- Strengthening institutional SWM capacity or; - Restructuring the present SWM system.

Source:Computed by the author, 2012

The developed alternative strategies shown in Table5.1 above, which are a solution for the identified strategic issues/problems of the existing solid waste management system of the Hossana town, can be divided in to two. These are:

A. The waste management strategy itself.
B. Instruments and mechanisms for implementation of solid waste management strategy.

A. The waste management strategy itself

The integrated solid waste management systems have different management options. The solid waste management strategies based on the hierarchy of waste management provide significant guideline to implement different options. The hierarchies from the first most favoured option to the least favoured option are prevention (remediation), waste minimization (reduction), reuse, recycling, energy recovery and incineration, and disposal.

Based on this hierarchy, the developed alternative strategies are shown below.

- **Prevention (remediation):** Under this hierarchy, no alternative strategies were identified.
- **Waste minimization (reduction):**Under this hierarchy, the identified alternative strategy is public education to enhance awareness.
- **Reuse:** Under this hierarchy, recognize the formal/informal sector as a vital partneris one of the identified alternative strategies.
- **Recycling:** In this hierarchy, set up a Public-Private Partnership and recognize the formal/informal sectors as a vital partner are the identified alternative strategies.
- **Energy recovery and incineration:** In this hierarchy, promote incineration (burning) and resource recovery processes of generated wastes is an identified alternative strategies.
- **Disposal:** In the disposal hierarchy which is the least favoured options, set up a Public-Private Partnership and outsourcing SWM to private organizations are identified alternative strategies.

B. Instruments and mechanisms for implementation of solid waste management strategy

The developed solid waste management strategy for Hossana town has a number of alternative strategies to ensure sustainable solid waste management that must be implemented through different instruments and mechanisms. Legal, administrative, institutional, financial and materials issues are considered for proper implementation of the strategy. In the legal aspect implement policy, law and regulation at all levels in a properly manner, set up “polluters pay” principle, promote Zero Waste principles and policies and harmonize services, policies, by-laws are the instruments and mechanisms. In the administrative view, there are alternative strategies likeset up a public-private partnership; participate the public in the development of solid waste management strategy; restructuring the present SWM system to decentralize the operations and management and outsourcing SWM to private organizations. Allocation of sufficient budget is one of the most and critical mechanism to accomplish the developed solid waste management strategy. The alternative strategies of institutional issues used as mechanisms and instruments include capacity-building for decentralized EPM/SWM; public education to enhance awareness and recognize the informal sector as a vital partner. And finally the materials issue which are important for the implementation of the developed solid waste management strategy encompasses the following alternative strategies: provision of adequate containers at neighborhood level, public places; provision of community bins at the roadsides and selected places and provision of adequate SW collection vehicle (tracks), animal carts, and pushing carts by town municipality.

5.4. Action plan to implement the strategy

Table5.2.Action plan to implement the developed Solid Waste Management Strategy for Hossana town (January 2013-December 2018)

Ser. No.	Strategic issues/problems	Alternative strategies	Implementing body/agency	Source of finance	Time frame	Remark
1.	Piles of solid wastes are often found along roadsides, underneath bridges, in drainage channels and in other open spaces.	- An effective punitive action must be applied to those who pollute the environment or; - Public education to enhance awareness or; -Outsourcing SWM to private organizations.	- Town municipality -Town administration Council - Community	- Government - NGOs - Community	- Every year	
2.	Weak implementation of policy, law and regulation on solid waste management system.	-Implement policy, law and regulation at all levels in a properly manner, and; -Set up “polluters pay” principle; and -Promote Zero Waste Principles; and Policies; and -Harmonize services, policies, by-laws.	- Town administration council - Town municipality	- Government	- Every year	
3.	Insufficient financial resources or inappropriate allocation of available resources. .	- Allocate sufficient financial resources or; -Appropriate allocation of available resources and; - Effective utilization of existing resources.	- Town administration council - Town municipality - Federal and regional government	- Government	-Every year	

4.	The general public has not been motivated to participate actively in solid waste management.	-Public education to enhance awareness, and; -Participating the public in the development of solid waste management strategy.	- Town municipality - Community	- Government - NGOs - Community	Every year	
5.	There are no formal and informal sectors as well as private sectors involved in the operation of solid waste management system.	--Recognize the formal/informal sector as a vital partner and; - Set up a Public-Private Partnership.	- Town municipality -MSEs	- Government - NGOs	-Every year	
6.	Poor institutional arrangements.	-Strengthening institutional SWM capacity or; - Restructuring the present SWM system.	- Town administration council - Town municipality -Federal and regional government	- Government - NGOs	-Every year	

Source:Computed by the author, 2012

CHAPTER SIX: CONCLUSION AND RECOMMENDATION

Human activities create waste, and it is the way these wastes are handled, stored, collected and disposed of, which can pose risks to the environment and to public health. Where intense human activities concentrate, such as in urban centers like Hossana, appropriate and safe solid waste management are of utmost importance to allow healthy living conditions for the population.

Solid waste management problem is complex because it involves a multitude of scientific, technical, economic and social factors. Similarly, it is observed that lack of financial resources, institutional weakness, improper selection of technology, transportation systems and disposal options, social problem associated with apathy towards environmental cleanliness and sanitation have made this service unsatisfactory and inefficient in the study area. So the Hossana town municipality, the town administration and the zonal administration give serious attention for proper municipal solid waste management.

Because of the complexity of the situation in the town, cooperation among different stakeholders like government institutions, private sectors, NGOs, CBOs, MSEs, informal sectors and the general public should be methods of choice to reduce the burden of work of the town municipality and should work as vital partners in order to have an effective way as well as a long-term sustainable system of providing affordable services to the town residents.

The average amount of household solid waste generated in 2004 E.C. is about 0.20kg/capita/day.There was no available data on generation rate to know the percentage contribution of each solid waste source and compositionthat might have changed through time due to the change in demographic and socio-economic conditions of the residences. Therefore, further study should be conducted to have a complete picture of the solid waste composition and generation rate of the town.

The study reveals that almost 98% solid wastes generated from households are biodegradable wastes which have a potential for replacing inorganic fertilizer. So composting is a good method for the treatment and production of soil amendments and also attention should be given to reusable household wastes.

There is a general lack of public awareness regarding the solid waste management and most of the generated wastes are dumped in an uncontrolled manner which affect human and animal health and result in economic, social, environmental and biological losses. Moreover, there is weakness of implementation of existing laws, policies and regulations on solid waste management system. Therefore, public education to enhance awareness should be given and implement solid waste management laws, policies and regulation at all levels in a properly manner to have a clean and safe environment.

There is no source separation/segregation of waste at the point of generation, into re-usable and non-reusable for waste reduction/minimization. Since waste needs proper management, the generated solid wastes should be sorted at the source for further use.

Land filling requires special attention; standard measures should be exercised to control contamination of surface and ground water as well as pollution of air.

The developed solid waste management strategies expect to provide guidelines for proper management of the generated solid wastes. Therefore, the town municipality together with the concerned bodies should implement the developed solid waste management strategies in order to bring significant change in municipal solid waste management practice of the town.

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ANNEXES

ANNEX 1

Part I. Questionnaires for residents

Purpose: - To develop Solid Waste Management Strategy for Hosanna Town.

N.B. the information obtained through this questionnaire will be used only for academic purpose and could not have any effect on the respondents' privacy.

Ser. No.	Questions	Responses	Code
1	Sex	Male	1
		Female	2
2	Age	_____ year	
3	Education Level	Unable to read and write	1
		Read and write	2
		1-8 thgrade	3
		9-12th grade	4
		Higher education	5
		Don't know	6
		NR	7
4	Employment Status	Government worker`	1
		Unemployed	2
		Student	3
		Retired	4
		Not of working age	5
		Don't know	6
		NR	7
5	Income level per month	Low income ≤ 212.30 birr	1
		Middle income 212.31- 390.59 birr	2
		High income >390.60birr	3

6	Please describe how your household stores the solid waste from your house	Closed Container	1
		Open Container	2
		Plastic Bags	3
		Pile in the yard	4
		Other	5
		Don't know	6
		NR	7
7	Please describe how your household gets rid of food waste from your house.	Burn	1
		Bury	2
		Dump in River/Gully	3
		Dump in Yard	4
		Dump on road	5
		Dump at disposal site	6
		Garbage Bin	7
		Recycle	8
		Reuse	9
		Compost	10
		Other	11
		NR	12
8	Please describe how your household gets rid of paper/cardboard and yard trimmings from your household.	Burn	1
		Bury	2
		Dump in River/Gully	3
		Dump in Yard	4
		Dump on road	5
		Dump at disposal site	6
		Garbage Bin	7
		Recycle	8
		Reuse	9
		Compost	10
		Other	11

		NR	12
9	Can you think of any ways of reducing the amount of solid waste that your household must burn, bury, dump, or leave for the garbage bin?	Yes	1
		No	2
		I do not know	3
		NR	4
10	Do you know that illegal dumping of solid wastes polluting rivers, streams, and wells?	Yes	1
		No	2
		I do not know	3
		NR	4
11	Do you know that improper storage and disposal methods of solid waste are the causes for diseases transmission in your community?	Yes	1
		No	2
		I do not know	3
		NR	4
12	Do you know that solid wastes that are blocking drainage causeflooding problems?	Yes	1
		No	2
		I do not know	3
		NR	4
13	Did you make compost at your home (use solid waste as soil fertilizer)?	Yes	1
		No	2
		I do not know	3
		NR	4
14	Have you ever heard about recycling?	Yes	1
		No	2
		I do not know	3
		NR	4
15	Do you have access for shared container (Community bins)?	Yes	1
		No	2
		I do not know	3
		NR	4

16	If Yes for Q.15, frequency of transporting solid waste to the container.	Daily	1
		Once in two or three days	2
		Weakly	3
		NR	4
17	In what way do you transport solid waste to the container?	By member of the household	1
		Paying for micro enterprise	2
		NR	3
18	Do you have access for house-to-house collection and disposal service?	Yes	1
		No	2
		I do not know	3
		NR	4
19	If Yes for Q.18, by whom?	Municipality	1
		Private agency	2
		NR	3
20	Do you burn solid waste?	Yes	1
		No	2
		I do not Know	3
		NR	4
21	If yes for Q.20, the frequency of burning	Daily	1
		Once in two or three day's	2
		Weekly	3
		Monthly	4
		NR	5
22	Do you reuse solid waste?	Yes	1
		No	2
		I do not know	3
		NR	4
23	The collection and disposal services provided by the municipality or private agency	Good	1
		Satisfactory	2
		Poor	3

		NR	4
24	Willingness to pay to have clean environment	Yes	1
		No	2
		I do not know	3
		NR	4

ANNEX 2

Part II. Questionnaires for municipal experts

Notice: All the information obtained through this questionnaire shall be used for the academic purpose only. Anyway, the data collected will be stored, handled and kept confidentially and could not have any effects on the respondents' privacy, To verify this, please do not give your name and any address anywhere in the questionnaire

1. What do you understand by the term "natural environment"?

_____

_____

_____

2. How do you see the situation of solid waste management system of the town?

_____

_____

_____

3. Is there any solid waste management strategy for the town? If yes, what are they?

_____

_____

_____

4. What are the extents of solid waste problem of the town?

_____

_____

_____

5. How much solid wastes are generated in the town per day by type?

_____

_____

_____

6. Where do you disposed of solid wastes that generated in the town?

_____

_____

_____

7. What strategies are used in order to solve the solid waste management problems of the town?

_____

_____

_____

ANNEX 3

Part III. Interview for the decision makers

(Municipal manager, mayor of Hosanna Town and WUDD head of Hadiya zone)

Notice:*All the information obtained through this questionnaire shall be used for the academic purpose only. Anyway, the data collected will be stored, handled and kept confidentially and could not have any effects on the respondents' privacy, and the researcher is fully responsible. To verify this, please do not give your name and any address anywhere in the questionnaire*

1. How do you see the situation of solid waste management system of the town?

_____

_____

_____

2. Is there any solid waste management strategy for the town? If yes, what are they?

_____

_____

_____

3. What are the extents of solid waste problem of the town?

_____

_____

_____

4. How much solid wastes are generated in the town per day by type?

_____

_____

_____

5. Where do you disposed of solid wastes that generated in the town?

_____

_____

_____

6. What strategies are used in order to solve the solid waste management problems of the town?

_____

_____

_____

7. What do you think about for the development of solid waste management strategy for the town?

_____

_____

_____

ANNEX 4

Part VI. Leading Questions for Focus Group Discussions

Notice:*All the information obtained through this questionnaire shall be used for the academic purpose only. Anyway, the data collected will be stored, handled and kept confidentially and could not have any effects on the respondents' privacy, and the researcher is fully responsible. To verify this, please do not give your name and any address anywhere in the questionnaire*

1. How do you see the situation of solid waste management system of the town?

2. Please describe how your household handles, collects, stores, transports and disposed of the solid waste from your house.

3. Can you think of any ways of reducing the amount of solid waste that your household must burn, bury, dump, or leave for the solid waste truck?

4. What strategies are used in order to solve the solid waste management problems of the town?

5. What do you think about for the development of solid waste management strategy for the town?