Addis Ababa University
Ethiopian Institute of Architecture, Building Construction, and City Development (EiABC)

An Investigation of Community Participation in Integrated Municipal Solid Waste Management System in Lagatafo Lagadadhi Town, Oromia Regional State of Ethiopia

By
Mesfin Assefa Kasssaye

June, 2020

Addis Ababa, Ethiopia

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A Dissertation Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirement for the Degree of Doctor of Philosophy (PhD) in Urban and Regional Planning at Ethiopian Institute of Architecture, Building Construction, and City Development (EiABC), Addis Ababa University

Dissertation Supervisor
Birhanu Girma (PhD)

June, 2020

Addis Ababa, Ethiopia

Signed Declaration

I hereby declare that this dissertation is the result of my own original work and has been not submitted at any University/Institutions for any degree or other purpose. All materials used in this study have been fully acknowledged and cited in the text properly.

Name: Mesfin Assefa Kassaye

Signature: _____

Date: _____

Addis Ababa University

School of Graduate Studies

This is to certify that the Dissertation Submitted by Mesfin Assefa Kassaye, the topic entitled **"An Investigation of Community Participation in Integrated Municipal Solid Waste Management System in Lagatafo Lagadadhi town, Oromia Regional State of Ethiopia"** for the in partial fulfillment of the requirements for the Degree of Doctor of Philosophy in Urban and Regional Planning complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the Members of the Board of Examiners

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External Examiner:	_____	_____	_____
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ABSTRACT

The environmental and health impacts as well as economic opportunities presented by waste management in the Lagatafo Lagadadhi town, one of the fastest and the emerging town in the Oromia National Regional Stat of Ethiopia, is not comprehensively and systematically studied. The purpose of this study is to fill this gap in the literature by investigating how solid waste is being managed within the context of community participation in the study area. The study employed a mixed method research using both quantitative and qualitative data. The quantitative portion which is descriptive survey helps to describe the phenomenon under study, and the qualitative data enriched the descriptions generated by and from the quantitative ones to landmark the study. The quantitative data was collected through questionnaire from 384 households; whereas, the qualitative data was gathered using structured interview with 5 key informants, one FGD which has 8 discussants, field observation at different times and various documents. The study reveals that community participation is dismally poor in solid waste management in a town with an average per capita solid waste generation rate of 0.41 kg/cap/day at household level. Although the composition varied due to seasonal conditions, food and biodegradable wastes comprised 76.5% of household wastes. The study shows that most of the solid wastes (49.6%) were burned at the household level and at the dump site. The town's solid waste management budget, accounting about 11% of the municipality's budget (less than half of the average for low-income countries), is woefully inadequate, to cover all operational costs related to Solid Waste Management. The improper management of the solid waste is adversely affecting the residents of the town through water and air contamination, drainage blockages, and the local economy. The study recommends that the improvement of solid waste management through increased coverage and community awareness concerning the segregation of solid waste in order to practice integrated solid waste management through community participation. Finally, the researcher calls on the municipality to implement the Integrated Solid Waste Management plan developed as part of this study.

***Key words**: community participation, composting, composition, dump site, generation rate, integrated solid waste management, per capita.*

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Dedication

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ABBREVIATIONS AND ACRONYMS

CSA:	Central Statistical Agency, Ethiopia
EPA:	Environmental Protection Authority, Ethiopia
EU:	European Union
FDRE:	Federal Democratic Republic of Ethiopia
FMoH:	Federal Ministry of Health, Ethiopia
IGES:	Institute for Global Environmental Strategies
ILO:	International Labor Organization
IPCC:	Intergovernmental Panel on Climate Change, intergovernmental body of the UN
ISWM:	Integrated Solid Waste Management
JICA:	Japan International Cooperation Agency
MDGs:	Millennium Development Goals
MoUDC:	Ministry of Urban Development and Construction, Ethiopia
MoUDHC:	Ministry of Urban Development, Housing and Construction, Ethiopia
MSEs:	Micro and Small-Scale Enterprises
MSWM:	Municipal Solid Waste Management
NAMA:	National Appropriate Mitigation Action
NUSWMS:	National Urban Solid Waste Management Standard
PPE:	Personal Protective Equipment
RURA:	Rwanda Utility Regulatory Authority
SWM:	Solid Waste Management
UNCHS:	United Nations Centre for Human Settlements

UNDP: United Nations Development Program

UNEP: United Nations Environment Program

UNSD: United Nations Statistics Division

USEPA: United States Environmental Protection Agency

WHO: World Health Organization

CHAPTER ONE

1. INTRODUCTION

This chapter provides a comprehensive background of the study, statement of the problem, basic research questions, and objectives of the study. It also discusses the significance and Justification for the Study. Under this the Operational Definition of Terms, the Scope of the Study, and Limitation of the Study were also covered. Finally the Organization of the Dissertation was discussed.

1.1. Background of the Study

Urbanization being one of the defining characteristics of human life in the 21st century, over half of the world`s population is living in towns and cities (Costa et al, 2014). Between 2011 and 2050, the world population is predicted to increase by 2.3 billion, exceeding 7 billion to 9.3 billion. At the same time, the urban population is projected to grow by 2.6 billion, from 3.6 billion in 2011 to 6.3 billion in 2050 (Pisano et al., 2014). Thus, the urban centers across the world will absorb all the population growth in the world during the coming four decades (Keivani, 2010).

Urbanization is also one of the main drivers of economic, social, and physical change in developing countries, including Sub-Saharan Africa (Pieterse, 2008; Rakodi, 1997). The United Nations Centre for Human Settlements (UNCHS), currently UN-Habitat, (2001) indicated that about 25 percent of Africa's population lived in towns and cities were urban in 1975. In the year 2000, Africa's urban population had reached 38 percent of the total population driven largely by growing rural-urban migration and rapid rates of natural population increases. The figure is

expected to increase to 47 percent by 2015 and 50 percent by 2020. At this rate, the Africa's urban population is projected to be doubled by 2050 (Hall & Pfeifer, 2000; UN-Habitat, 2009).

Moreover, urbanization is transforming the social and economic fabric of societies. Towns and cities all around the world are the venues where the bulk of production and consumption takes place. Most crucially, they are becoming engines of economic growth and development (UNCSH, 2001). As a consequence, urban centers happen to be home to three-quarters of global economic activity. As the urban population grows, urban centers would go on drawing more and more of global investments thereby significantly boosting the urban share of the global Gross Domestic Product.

This rosy prospect of urban centers, arenas where a lot of wealth is created, where major global economic functions take place, where greater life opportunities become available, and where dreams are made, is not the full and entire story. Urban centers also pose some serious challenges for sustainable development (Keivani, 2010; UNCHS, 2001). A case in point is the challenges engendered by urban solid waste and its proper management, which have become the single biggest threat facing cities all around the world today.

Because of the rise of the world's urban population, many cities are struggling to provide basic public services. Cities are being pressed to spend a great deal of their scarce resources on solid waste management, which is one of the most pressing issues in global cities. Even though the exact data is lacking, it is clear that the sheer quantity of municipal waste, solid or otherwise, is exponentially increasing. As urban population increases, so does the rate of waste generation. With increased wealth and business activities wastes become increased. Most worryingly, coupled with this increase, the variety and complexity of waste is also increasing (UN Habitat, 2010).

Thanks to this growing complexity and variety, which is directly connected with the urban population growth and the consumption culture, waste management is listed at the top of the priorities of the global environmental agenda. The situation is becoming direr and alarming in rapidly growing economies where urbanization and improving living standards has increased in the quantity, complexity, and capacity of generating waste; posing formidable challenges to most cities (UNDP, 2004).

Even though waste management in general is a growing problem, solid waste management is proving a more critical problem, a challenge experienced by all countries in the world albeit differently and hardly uniformly. Solid waste management is even more problematic in developing countries because towns and cities are generating an ever-increasing volume of solid waste, their solid waste collection and disposal systems have not kept pace (Nigatu, Sundaraa, & Bizunesh, 2011). It is an issue mostly witnessed in urban areas because of the huge surge in population and the phenomenal increase in per capita income coupled with the consumption culture. It is little wonder, therefore, to witness that solid waste is threatening and endangering environmental quality and human health (Javaheri, 2006 cited in Yohanis & Genemo, 2015).

The situation is even more complicated in Africa where less than half of the solid waste produced is collected, and where 95 percent of it is either indiscriminately disposed at various dumping sites on the peripheries of urban centers (slums), or on so-called temporary sites, typically empty lots scattered throughout cities (UNDP, 2004). Regarding disposal of solid waste, the Ethiopian Ministry of Health affirms that in most African cities, households, institutions, and working places routinely and indiscriminately dump their solid waste polluting water sources and the land, causing serious health problems, not to mention creating nuisance in the affected communities (FMoH, 2004). Studies demonstrate that only 43% of generated waste

in Ethiopia are properly collected and disposed into open dumpsites. The remaining is indiscriminately disposed in drainage lines, open spaces, street sides or informally burned (Yohanis & Genemo, 2015; FMoH, 2004).

Currently, Ethiopia's capital, Addis Ababa, generates 2,297m^3 or 851 tons of waste on a daily basis. Of the generated municipal waste, only 65% (1,482m^3) is collected per day (Mohammed & Iyasu, 2017). The remaining 35 percent is disposed informally; haphazardly thrown into open spaces, drainage channels, rivers, valleys, and left to rot on the streets. It is common to observe that the rivers and water bodies have been becoming disposal sites for wastes. These facts fly in the face of Proclamation No.1/1994; a regulation issued by the Addis Ababa City Administration, the Hygiene and Environmental Sanitation Proclamation, and clearly shows that the city is not managing its municipal waste properly (Addis Ababa City, 2003).

If not appropriately managed, solid waste can be hazardous to human health as well as detrimental to the environment affecting quality of life in the form of poor air quality, which is associated to increased risk of morbidity and mortality (e.g., Costa, Ferreira, Silviera, &et al., 2014). Poor management of solid waste has been shown to jeopardize ground water systems and marine ecosystems (ibid). Consequently, rather than a matter left exclusively to municipalities, solid waste management has grown to be a critical problem demanding everyone's participation and active involvement. On the other hand, solid waste can be a resource that provides employment opportunities and contributes to poverty alleviation. However, only a well-informed and a well-educated population, a population that demands being included in the decision-making process, views waste as a resource (Squires, 2006).

Although the Ethiopian government has explicitly declared that it is essential to promote community participation in order to not only prevent the adverse effects but also to enhance the

benefits resulting from solid wastes (FDRE, 2007), the solid waste management action plans designed by and implemented at the lowest units of municipalities come short in ensuring community participation. In fact, public participation in solid waste management in the urban centers is not well planned or coordinated, and at times is in conflict with good environmental management (Ibid). This challenge is common with the towns and cities throughout the country.

In most towns and cities, there is no enough waste disposal bins, compared to population size and the amount of solid waste generated. Even though the number of vehicles for waste collection is far less than what is needed given the size of the population, they, even existing ones tend to be under maintained. It is not unusual to witness the parts of these waste trucks discarded after a long period of use and reuse. Recycling is still far from being integrated into urban life in Ethiopia. Consequently, there is very limited effort to recycle, reuse or recover the waste generated. And waste disposal into open dumpsites has been the major mode of waste management practice in cities (Yohanis & Genemo, 2015). This is especially true even in smaller cities like Lagatafo Lagadadhi town, which are characterized by poor management of solid waste and low community participation in the waste management process. Hence, poor solid waste management is becoming a major threat to the health and wellbeing of town residents (Kebede & Tolossa, 2019).

Being situated next door to the country's sprawling capital, Lagatafo Lagadadhi town is one of the most vulnerable cities with a dismally poor solid waste management system. Besides, the government rarely intervenes and rarely engages concerned stakeholders to mitigate the situation. Worse still, it rarely shows interest to involve the community, and hardly bothers to devise alternative approaches and implement integrated solid waste management practices. Since Lagatafo Lagadadhi town is suffering from serious solid waste management issues, its sheer

proximity to the capital makes it vulnerable to a major spillover effect. Given the rapid pace with which the town of Lagatafo Lagadadhi's growing, an efficient and effective solid waste management system is very important for the Town's growth and prosperity. To make this possible, high community participation in solid waste management is a necessary condition. It is worth investigating whether the municipality makes a concerted effort to actively engage concerned stakeholders to mitigate any problems associated with solid waste management. A comprehensive and in depth look at the state of solid waste management in Lagatafo Lagadadhi town is crucial also due to its proximity to the Ethiopian capital, Addis Ababa, since poor solid waste management could have dire consequences for the lives of the surrounding communities would be adversely affected from the accompanying environmental and health problems, involving the community in the activities of controlling and properly managing wastes becomes mandatory (Ibid).

Even though the law makes community participation mandatory and it is indispensable for an efficient and effective waste management system, little is known particularly about the effect and role of community involvement in Lagatafo Lagadadhi town. Moreover, research studies dealing with this problem are scant. Therefore, there is a need for engaging in a scientific research to investigate the effect and role of community participation in an integrated solid waste management in Lagatafo Lagadadhi town of the Finfinne Special Zone, Oromia National Regional State, Ethiopia.

1.2. Statement of the Problem

Solid waste management in towns and cities is one of the most pressing and critical issues across the globe. The amount of waste is growing in most towns and cities and the growth is

rather rapid. This is caused by the dramatic increase of the urban population, and the concomitant rise in the amount of waste generated, its variety, and complexity following the diversification of sources of wealth and the diversity of business activities (U.N Habitat, 2010).

Nowadays, urban centers are increasingly facing environmental, climate, and social challenges at par with the challenge of economic and physical development. Activities carried out for the welfare of citizens needs to promote sustainable environmental protection, which is an indispensable element for sustainable urbanization (Tracy & Anne, 2008). Combining capacities and local knowledge is essential to identify shared solutions and to achieve well-accepted and sustainable results given the seriousness of the challenges that towns and cities in developing countries are experiencing currently. Identifying effective responses to these challenges will be critical for achieving the smart, sustainable and inclusive society envisaged in the sustainable development goals (EU, 2014) and making urban areas resilient to different man-made and natural shocks (Romero-Lankao, et al., 2016).

Developing countries are facing critical challenges in managing waste given their generally poor management systems. Human existence is dependent on the use of material resources, which eventually become waste. As developing countries achieve greater socioeconomic well-being, they are bound to generate more and more waste per capita, which in turn requires effective and efficient waste management systems (Keivani, 2010). Such systems rely on the active participation of individuals, communities, institutions, and organizations, governmental and non-governmental bodies. Solid waste management is a critical national issue and its effectiveness calls for the involvement of everyone in the society (Squires, 2006).

As is the case in most developing countries, the increase of socio-economic activities in Ethiopian towns and cities parallels the increase in the urban population (MoUDHC, 2014). The

increase in urban population has caused an alarming increase in the production of solid wastes. There are limitations in the solid waste management system in most towns and cities in Ethiopia (FMoH, 2004; Nigatu et al., 2011). The pace of urbanization has been faster than the abilities of municipal governments to maintain the sustainability of the towns and cities by managing these wastes, which means involving the community in the solid waste management system. A study conducted in Jigjiga city showed urban waste management was a challenge for the municipality and its urban government. The shortcomings have been attributed to poor community involvement, poor infrastructure, bureaucratic incompetence, and limited institutional capacity of the municipality (Yohanis & Genemo, 2015). The assessment case studies conducted by MoUDC in 2015 in 12 towns of Ethiopia like Awodai, Bale Robe, Bishoftu, Woliso, Wuqro, Bure, Dilla, and Dire Dawa showed that collection services are woefully insufficient. Besides, lack of equipment and poor capacities tend to be fairly common. The case studies indicated that reliability and trust in the system are not established. Collection coverage ranges from 5–80 percent with 45 percent being the average; and the collection rate is lower ranging between 5 and 60 percent of the total waste generated, with 40 percent being the average. Lack of personal protective equipment for waste workers within both the formal and informal sectors is also a serious concern (MoUDC, 2015).

Most towns and cities in Ethiopia dump wastes in open dumpsites with little to no controls whatsoever. Various studies have revealed that the management of solid waste is generally very weak and suffer from poor community participation (Birhanu & Berisa, 2015; Desta et al., 2014; Erasu et al., 2018; Gedefaw, 2015; Heyi, 2018; Lemma et al., 2019; Tyagi et al, 2014; Woldetsadik, 2017). The municipalities do not comply with the requirements set under the

National Solid Waste Management Standards and most have been facing major challenges with regards to solid waste collection and landfill management (Birhanu & Berisa, 2015).

Although the government has endorsed a strategic framework to involve the community in solid waste management, its translation into practice has encountered obstacles. This is particularly the case in emerging towns and cities where resources are scarce, administrative capacity are weak, made worse by the increasing and high rate of rural-urban migration (EPA, 2012; MoUDC, 2014). In many towns and cities in Ethiopia, the municipal administration is responsible for waste collection and management. Though there is a wide variation in collection performance, it has become a common business practice to collect waste at household and organization levels by individuals who are organized through MSEs and informal associations. The collected waste is then shifted to containers, which are then collected by municipalities. This process has resulted in poor performance. Consequently, the disposal of solid waste has proved to be a major public health issue and a vital factor affecting the quality of the environment (Mulumebet, 2018).

The emerging Town of Lagatafo Lagadadhi of Oromia Region faces a similar situation. Today, the Town faces poor solid waste management that has become one of the most intractable environmental problems. One of the main problems facing the Town is open and indiscriminate dumping of refuse (author's observation). Piles of decaying garbage are found in strategic locations in the heart of the Town. Wastes in such places are a source of air and water pollution, land contamination and environmental degradation. The residents are facing health-related complications due to the poor solid waste management system. One of the factors undermining the existing solid waste management system in the Lagatafo Lagadadhi town is believed to be the absence of active community participation with ominous consequences for the health of

residents who have to deal with growing health complications from the environmental pollution which requires an investigation to look into the problem and come up with conclusions and recommendations.

Even though there are few the emerging Town of Lagatafo Lagadadhi of Oromia Region is among the fastest growing urban areas in Ethiopia. Due to its proximity to Addis Ababa, the Ethiopian capital, it is one of the most favorite destinations for the thousands migrating from rural areas throughout the country in pursuit of better opportunities. Consequently, it is high time to inquire about the state of solid waste management and the level of community participation in solid waste management in Lagatafo Lagadadhi town.

Even though, there are research studies into integrated solid waste management systems in many towns in Ethiopia and beyond, there is no study that investigated the levels of community participation and identified factors affecting the active participation and involvement of residents in the solid waste management system in Lagatafo Lagadadhi town. There is no research that specifically and comprehensively assessed the problem in the town of Lagatafo Lagadadhi the Finfinne Special Zone, the Oromia National Regional State. Hence, a theoretically-grounded and methodologically strong academic inquiry is warranted to fill the gap in the literature. This empirical and in-depth study is set out to assess the effect and role of community participation in solid waste management in the town of Lagatafo Lagadadhi town. Other towns in Ethiopia can also use similar studies of Lagatafo Lagadadhi town. Moreover, since anecdotal information indicated that the town of Lagatafo Lagadadhi lacked an Integrated Solid Waste Management System, this study provides the blueprints for such a system.

1.3. Objective of the Study

1.3.1. General Objective of the Study

The general objective of the study is to investigate the solid waste management system practiced in Lagatafo Lagadadhi town and to devise a practical solution for solid waste management allied challenges through community participation. This is accomplished through a convergent mixed method research design in which quantitative and qualitative data are collected and analyzed to gain a more holistic and comprehensive grasp of the situation on the ground (Creswell & Creswell, 2018) and craft a plan for a more participatory and cost-effective Integrated Waste Management system.

1.3.2. Specific Objectives of the Study

The specific objectives of the study are:

1. To examine the existing solid waste management system in Lagatafo Lagadadhi town;
2. To assess how solid waste is being managed in the Lagatafo Lagadadhi town through community participation;
3. To investigate the effects of Lagatafo Lagadadhi town's solid waste management on the environment, health, and economy;
4. To explore the level and challenges of community participation in the integrated solid waste management system in the Lagatafo Lagadadhi town; and
5. To propose an alternative planning approach to solve the existing municipal solid waste related challenges in the town and develop integrated solid waste management plan for the town

1.4. Basic Research Questions

This study is intended to answer the following research questions:

1. How is municipal solid waste being currently managed in the Lagatafo Lagadadhi town?
2. What are the main effects of the current solid waste management on the environment, health and the economy of the town?
3. What are the levels of community involvement in the town's solid waste management system?
4. How does the existing level of community participation in municipal solid waste management affect the efficiency and effectiveness of solid waste management in the town?
5. What is the best planning approach to solve the municipal solid waste related challenges in the town?

1.5. Justification for the Study

While the need to manage municipal waste properly in the face of huge urban population growth has gained traction in African countries, mitigation efforts are driven largely by donors and tend to be top-down and thus ineffective (Ndum, 2013), hence why bottom-up and participatory approaches, the approached pursued by this study, are badly needed. Moreover, "solid waste management policies and programs in most African cities were formulated and implemented by government agencies without significant public participation" (Ibid p. 15). This is despite the fact that the primary law governing waste management in Ethiopia, the Solid Waste Management Proclamation No. 513/2007, which was issued in 2007 and mandates community Participation as a requirement on municipalities.

Quite a few studies have looked at the problem of solid waste management at different Ethiopian cities/towns (Birhanu & Berisa, 2015; Desta et al., 2014; Erasu et al., 2018; Gedefaw, 2015; Heyi, 2018; Lemma et al., 2019; Tyagi et al., 2014; Woldetsadik, 2017). The most

common thread in these studies is that the management of solid waste is generally very weak and suffers from poor community participation. This, even though better community participation, involving both the private sector and the public at large, is commonly recommended as a way out (Kuma, 2004).

There is a study focusing on assessing specifically on the role and effect of community participation in local development in the town of Bishoftu (Heyi, 2018). While this study sheds important lights on how the town's developmental efforts are being negatively impacted by lack of community participation, or the lack thereof, in these efforts, it did not specifically address solid waste management. Moreover, even though it painted a clear picture of how lack of institutional capacity and an established top-down culture by the municipality has made bottom-up and genuine participation a hollow promise rather than a standard practice, this cannot be generalized to Lagatafo Lagadadhi town.

The other research that looked at waste management in Lagatafo Lagadadhi was a study by (Kebede & Tolossa, 2019). However, this study did not focus specifically on solid waste management nor considered community participation as a key variable. Moreover, this study by was solely only exploratory. Hence, there is a need for a more comprehensive study to investigate solid waste management in Lagatafo Lagadadhi town within the context of community participation and the Integrated Solid Waste Management System. The latter is "participatory" by its nature (Chinaso, 2015, p. 1) because "the effectiveness and efficiency of solid waste management depends on the willingness and active participation of community members" (p. 5). This study is, therefore, justified by the sheer lack of any study that examined community participation within the context of the Integrated Municipal Solid Waste Management System in Lagatafo Lagadadhi town.

Therefore, not only does this study help widen current understanding about Municipal Solid Waste Management in the town but also bridge a critical gap in the literature.

1.6. Significance of the Study

Given the dearth of literature on the topic, the study can provide an invaluable theoretical and empirical body of knowledge to explore what kinds of solid waste management systems are being used by emerging towns and cities of Ethiopia and the role and effect of community participation in this effort. It could thus provide a point of departure to bring together key actors' such as the community, the business community (both public and private), governmental and non-governmental bodies and all other stakeholders with the view towards addressing the solid waste management system to ensure sustainable growth in the town. The study is particularly significant for the Lagatafo Lagadadhi town Administration because it offers them a sketch of an Integrated Solid Management System, which they can adopt as a planning and working document to overcome the growing problems faced by the town and its residents in cost-effectively and sustainably managing solid waste. Although this study was conducted in Lagatafo Lagadadhi town, the findings of this study is however not only relevant to Lagatafo Lagadadhi town but also it may serve other towns of Ethiopia which suffer from similar problems. It is also relevant to the many other towns and cities in the country dealing with the problem of solid waste management, which is bound to take more and more of their attentions as well as resources in the years and decades ahead. It can also serve as a guideline and reference for researchers and practitioners dealing with the problem of solid waste management. Since most of the analysis on the deleterious and multidimensional impacts of poor solid waste management (UNEP, 2005, UN-Habitat, 2009) have been published to address the needs of

industrialized nations, there is a dearth of information on the impacts of improper management of solid waste in developing countries (UNEP, 2005), where the problem is acute. Even though this study is on the Town of Lagatafo Lagadadhi and its intention is not generalizations, its findings can help fill at least a small part of this gap in the literature.

1.7. Operational Definition of Terms

Community Participation means the genuine involvement of local community in the planning, design, implementation, and subsequent maintenance of a development intervention. It means that people are mobilized, manage resources, and make decisions that affect their lives.

Compost is organic matter that has been decomposed in a process called **composting**. This process recycles various organic materials otherwise regarded as waste products and produces a soil conditioner (the **compost***).* **Compost** is rich in nutrients.

Integrated Solid Waste Management (ISWM) is a comprehensive (holistic) waste prevention, recycling, composting, and disposal program. An effective ISWM system considers how to prevent, recycle, and manage solid waste in ways that most effectively protect human health and the environment.

Municipal Solid Waste (MSW) is a waste type that predominantly includes household waste (domestic waste), except industrial and agricultural wastes, with sometimes the addition of commercial wastes collected by a municipality within a given area. The debris and special wastes like hazardous wastes usually not categorized under MSW may also enter the municipal waste stream to an extent. It is sometimes also defined to mean all solid wastes that a city authority accepts responsibility for managing in some way.

Municipal solid waste management (MSWM) refers to the collection, transfer, treatment, recycling, resources recovery, and disposal of solid waste including planning and implementation of systems to handle MSW in urban areas.

Solid Waste can be defined as useless and unwanted products in the solid state derived from the activities of and discarded by society. It is produced either as a byproduct of production processes or arises from the domestic or commercial sector when objects or materials are discarded after use.

Solid Waste Management (SWM) includes the activities and actions required to manage waste from its inception to its final disposal. This includes the collection, transport, treatment, and disposal of waste, together with monitoring and regulation of the waste management process.

The three R's – reduce, reuse and recycle all help to cut down on the amount of waste we throw away. The Three **Rs** help conserve natural resources, save landfill space, and energy.

Waste is everything that no longer has a use or purpose in the eye of the owner or user and does not represent any economic value to its owner.

Waste Transformation is the process in which a waste is converted into a form that is less costly or difficult to dispose.

1.8. Scope of the Study

The geographic scope of this study is limited to the town of Lagatafo Lagadadhi town, Finfinne Special Zone, Oromia National Regional State. Even though managing solid waste requires a holistic and broad initiative and involves the participation of multiple actors and

factors in its formulation, implementation, and evaluation phases, the scope of this study is limited to the effect and role of community participation in this otherwise integrated process.

While making a broader inquiry into the integrated solid waste management is necessary, this is not attempted here due to time constraint and resource limitations. Hence, the scope of the research is limited to examining the state and role of community participation in integrated solid waste management and assessing whether the town of Lagatafo Lagadadhi town is applying the integrated solid waste management system being applied in Lagatafo Lagadadhi town.

1.9. Limitation of the Study

It is clear that research works are not free of limitations. Similarly, this study has its own limitations. Chief among the limitations is the fact that respondents might have exaggerated or underestimated some of the questions presented to them for fear that the answers would affect their livelihoods. The validity of data collected through the survey questionnaire assumed that respondents would answer the questions truthfully (Fraenken & Wallen, 2007). However, this assumption can be problematic because of a couple reasons. First and foremost, the researcher is senior government official and state-community trust is still a work in progress in Ethiopian towns and cities, not to mention the society as a whole. Second, even though their answers will be kept confidential and the anonymity of respondents is assured, some could still be reluctant to express views critical of the municipality and its local government organs. However, this potential problem is mitigated by the mixed method nature of the study and the opportunity to triangulate findings from multiple data sources. There is also another major mitigation factor: the fact that the participants of the study are responsible adults.

Other limitations could have also emanated from the inbuilt and unexpressed attitudes and perceptions of the participants of the study towards some variables. For example, data from some secondary sources, including those from different government organs, could also be colored by the general tendency by government organs and personnel to exaggerate their performance. This could be done not only to look good in the eyes of higher ups but also to escape accountability.

Here again, the researcher attempted to minimize these limitations through triangulation employing different methods such as key informant interviews, focus group discussions, and field observations combining both quantitative and qualitative data. The limitation is also overcome by asking ordinary citizens the same questions enabling the researcher to crosscheck against responses from the officials and experts working for the town administration.

1.10. Organization of the Dissertation

The dissertation comprises eight chapters. The first chapter discusses about background, problem statement, objectives, research questions, scope of the study are covered in chapter one, whereas review of relevant literatures are discussed under chapter two. The third chapter deals with research methodology of the study. The study's findings are discussed from chapters four to chapter seven. Chapter Four presents the volume, composition, and density of solid waste generated by the Town and concludes by exploring the town's existing solid waste system. Chapter Five assesses the state of community participation in Solid Waste Management. Chapter six the study presents the environmental and health impacts of Lagatafo Lagadadhi town's solid waste management. Included in this chapter is also a blueprint of an Integrated Solid Waste Management plan system for the Town. The Conclusions, Recommendations, and Contributions of the study will be discussed in chapter eight.

CHAPTER TWO

2. LITERATURE REVIEW

Chapter two presents the review and the theoretical perspective guiding the study of literature. Key debates in the literature about community participation in integrated solid waste management are presented in detail. Gaps that made this study necessary were also highlighted. It also contains the theoretical perspective guiding the study.

2.1. Concepts of Solid Waste and Solid Waste Management

For the first time in the history of humankind, the world is witnessing an unprecedented phenomenon in the development of places of habitat: the balance of human settlement patterns has shifted from more people inhabiting rural areas to more people living in cities (UNFPA, 2001). Likewise, rapid urbanization has made the management of solid waste very crucial in the areas of public health and environment. As a result, waste management has come to occupy a vital place in the economies of both developed and developing countries (Abagale *et.al,* 2012).

Before defining what is solid waste, a proper definition of what is considered waste is in order here. Waste is defined in the literature based on certain perspectives. For instance, Palmer (2005) defined waste as an object that for which the owner does not want to take responsibility. USEPA (2000) also defines waste as any item that is discarded, proposed for reuse and recycling. Davies (2008) argued that waste for somebody maybe wealth to the other. According to Davies (2008) if someone is responsible for so-called waste material, then it is no longer considered as waste. According to Arnold (2001) waste is an unwanted item for the person who discards it or material that lost value for the primary user. Contrarily, for Arnold (2001) waste is the only resource available to poor people. The various definitions make it clear that waste is

subjective and what is a waste for one person could have value for another person. For the purposes of this study, solid waste is any unwanted and discarded non liquid material that is usually recognized as garbage, refuse, rubbish or trash (WHO, 2009).

Solid waste can also be classified in several ways viewed. For instance, whether the solid waste is biodegradable; Whether or not it is organic and inorganic waste. Based on the nature of disposal and who is doing the disposing, it can also be classified as municipal or non-municipal, residential, commercial, institutional, medical, construction, and demolition waste. Based on the toxicity of materials, sold waste can also be classified as hazardous and non-hazardous (Cointreau-Levine & Coad, 2000; Zurbrugg, 2002).

2.2. The Concept of Municipal Solid Waste

Municipal waste refers to wastes from domestic, commercial, institutional, municipal, and industrial sources, but excluding excreta, except when it is mixed with solid waste (Cointreau-Levine & Coad, 2000). It is, however, necessary to note that in developing countries, many times, it becomes difficult or even impractical to put a line between excreta and solid waste (Cointreau-Levine & Coad, 2000).

As noted with the definitions of waste, some authors substitute the definition of municipal solid waste with a list of what is included in municipal solid waste. For instance, Zurbrugg (2002) in his definition of municipal solid waste provided a list of what is included in municipal solid waste. According to this view, municipal solid waste can be all manner of waste, including product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries all which comes from the industrial, commercial, and institutional establishment (including hospitals), market waste, yard waste, and street sweeping.

Cointreau (1982), on his part, defines municipal solid waste as non-air and sewage emissions imagined within and disposed of by a municipality, including household garbage, commercial refuse, construction and demolition debris, dead animals, and abandoned vehicles. Based on this definition, municipal solid waste is thus generally made up of paper, vegetable matter, plastics, metals, textiles, rubber, and glass.

Schübeler et al., (1999) and Zerbok (2003) in their work added that hazardous waste and hospital waste by definition are not categorized under municipal solid waste but however it is difficult to separate them especially when their portions are small. Also in most cases, they end up in the municipal solid waste system. This definition implies that all the solid wastes not produced in the urban areas are not considered municipal solid waste; also that the form of material can be changed into another form making the same material a resource to another person.

Municipal solid waste management is the collection, transfer, treatment, recycling, resource recovery, and disposal of solid waste in urban areas. According to Skitt (1992), the definition of municipal solid waste management (MSWM) entails the purposeful, systematic control of generation, storage, collection, transport, separation, processing, recycling, recovery, and disposal of solid waste specifically in urban areas.

MSWM is a relevant service since solid waste is inevitable because human beings produce waste at all levels of development both in the economic as well as in the social activities of life. The overall goal of urban municipal solid waste management is to collect, treat and dispose of solid wastes generated by all urban population groups in an environmentally and socially satisfactory manner using the most economical means available (World Bank, 2011). MSWM protects the urban population from the impact of poor waste management such as diseases

caused by poor waste management, which include lung diseases, because of air pollution from the decomposing solid waste and burning pollutants, among other diseases. Most importantly, scholars give an outline of the specific goals of municipal solid waste management, which include promoting environmental conditions by controlling air, water, and land pollution as well as ensuring the sustainability of various ecosystems in urban areas.

The responsibility of the municipality is therefore to support urban economic development by providing demanded waste management services and ensuring the efficient use and conservation of valuable materials and resources (Schübeler et al., 1999). Valorization of recyclables and organic materials is part of this calculus. According to UN-Habitat (2010) waste is a resource and the entire waste system should be designed to maximize the benefits from the discarded materials.

The forgoing discussion makes it clear that waste management is becoming one of the key responsibilities of municipal governments. And that this can be a value-adding effort and not just a process of disposing unwanted things. Having looked at the definitions of waste, municipal waste and municipal waste management, its relevance and goals in the discussion above, the discussion below will focus on Integrated Solid Waste Management in contradistinction to a conventional approach to waste management.

2.3. Integrated Solid Waste Management Vs. Conventional Solid Waste Management

Conventional Solid Waste Management is associated with the control of waste from generation to disposal in the waste management chain. It focuses on the process of collection, transportation, and disposal of waste once generated. In other words, this kind of waste

management system focuses on the management aspect after waste is generated. In contrast to integrated waste management, conventional solid waste management consists of collection, followed by transportation, and disposal of waste (Anschutz, 2001; Squires, 2006). However, both Anschutz (2001) and Squires (2006) observe that this approach to waste management has not been able to cope with the challenges of rapid urbanization and the evolution of waste.

Integrated Solid Waste Management, on the other hand, is a strategic approach of waste management that gives priority for prevention, source reduction, resource recovery, land filling, and landfill site rehabilitation. This type of waste management attempts to include all aspects of waste management and recognizes three dimensions: (1) stakeholders, (2) waste system elements and (3) sustainability aspects. Integrated solid waste management is thus a relatively new approach in the sphere of solid waste management. It revolves around the inclusion of the community in the process of solid waste management shifting attention to resource efficiency and minimization of environmental impacts throughout the life cycle of waste management (Squires, 2006).

2.4. Conventional Solid Waste Management System

According to Asase et al. (2009), solid waste management has four components: recycling, composting, land filling, and waste-to-energy via incineration. Accordingly, the main elements (primary steps) of the solid waste management system are waste generation, waste composition, waste collection and transportation, and waste treatment and disposal (Asase et al., 2009). For Abagale et.al (2012) the four main components of waste management system are 1) onsite handling, collection, and processing; 2) collection, transfer, and transport of solid waste; 3) resource recovery and processing; and 4) disposal of solid waste. The distinction between the

two approaches is that whereas Abagale et.al (2012) side steps the initial step waste generation, for Asase et al. (2009) it is the primary component. For this paper, we consider the following main components of a solid waste management system.

2.5. Waste Generation

Waste generation encompasses activities in which materials are identified as no longer being of value (in their present form) and are either thrown away or gathered together for disposal (Vergas & Techobanoglous, 2002). The World Bank (2018) reports a staggering volume of municipal solid waste generated: 2.01 billion tons, of which 33 percent is not properly managed. The same source adds that the average per capita generation rate stands at 0.74 kilograms, boosting the total solid waste generated by 2050 to 3.40 billion tones.

Rates of waste generation depend on the economic development of a country, the level of industrialization, the consumption habit of the public, and the local climate (Stanford, 2000; World Bank, 2018). In other words the higher the economic development and rate of urbanization, the greater the amount of solid waste production. Waste generation also varies as a function of affluence. However, regional and country variations can be significant, as can generation rates within the same city (Stanford, 2000).

There is generally a positive correlation between waste generation and income level (World Bank, 2018). Daily per capita waste generation in high-income countries is projected to increase by 19 percent by 2050, compared to low- and middle-income countries (Stanford, 2000). Asaase *et al.* (2009) note that, the city of London generates on average a whopping 1.2 kg of solid waste per capita per day. The World Bank (2018) also anticipated that waste generated in low-income countries is likely to increase by more than three times by 2050. Waste generation in sub-

Saharan Africa is approximately 62 million tons per year (Stanford, 2000). The reduction of waste at source is therefore the most important method of limiting the quantity of waste generated (Vergara & Techobanoglous, 2012).

2.6. Waste Handling, Storage, and Processing at the Source

Next to waste generation, the remaining functional elements in a solid waste management system are waste handling, sorting, storage, and processing at the source. Waste handling and sorting involve the activities associated with the management of wastes until they are placed in storage containers for collection (Stanford, 2000). Handling also encompasses the movement of loaded containers to the point of collection. Sorting of waste components is an important step in the handling and storage of solid waste at the source and is recognized as the best place to separate waste materials for reuse and recycling (Steblin & Stanfor, 2008).

The household is the most important stakeholder in separating solid waste at the source of generation (Steblin & Stanfor, 2008). On the source, segregation is onsite labeling of waste at the place where the waste is generated (Labspace, 2013). On the source, handling is the very first step in waste management, involving individual family members, households, and communities, all of whom need to know how to handle waste properly at this level (Steblin & Stanfor, 2008).

Waste handling is an effective management of waste on its physical chain, which entails reducing the volume of waste for final disposal and recovering usable materials (Labspace, 2013). Onsite storage means the temporary collection of waste at the source of generation in appropriate containers that could preferably be made from locally available materials (McDougall *et al*., 2001). According to Labspace (2013) larger containers or dustbins, especially those used for food waste, should be leak-proof, have tight lids, and be long-lasting. The size of

the container should be sufficient to hold at least the amount of solid waste that is generated per day at the household level (Labspace, 2013).

The cost of providing storage for solid wastes at the source is normally borne by the household in the case of individuals, or by the management of commercial and industrial properties. Processing at the source involves activities such as backyard waste composting (McDougall *et al.*, 2001).

2.7. Waste Collection

Collection of waste is part and parcel of waste management and it is broken down into two components: namely, primary and secondary collection. Primary collection is gathering waste from the source of generation while the secondary collection is gathering and transportation of waste from communal bins, transfer stations, and curbside collection points (McDougall & Hruska, 2000). This functional element of collection includes not only the gathering of solid wastes but also the transport of these materials, after collection, to the location where the collection vehicle is emptied (McDougall & Hruska, 2000).

Waste collection is a critical step in managing waste and is a key function of all municipalities (Labspace, 2013). However, municipalities in low-income countries collect only about 48 percent of generated waste (World Bank, 2018). According to the World Bank (2018), the coverage of waste collection in Sub-Saharan Africa is only about 44 percent while developed countries and Central Asia collect about 90 percent.

The composition of the waste, components of the waste stream as a percentage of the total mass generated also varies from economic region to region. For example, developed countries generate relatively more dry waste, including plastic, paper, cardboard, metal, and glass (51% of

waste) and less food and green waste while developing countries generate 53 to 56 percent of food and green waste (World Bank, 2018).

2.8. Sorting, Processing, and Transformation of Waste

The sorting, processing, and transformation of solid waste constitute the fourth of the functional element. The recovery of sorted materials, processing of solid waste and transformation of solid waste that occurs primarily in locations away from the source of waste generation are encompassed by this functional element (Steblin & Stanford, 2008).

According to Steblin and Stanford (2008) sorting of mixed wastes usually occurs at a materials recovery facility, transfer stations, combustion facilities, and disposal sites. These often include the separation of bulky items, separation of waste components by size using screens, manual separation of waste components, and separation of ferrous and non-ferrous metals (Steblin & Stanford, 2008).

Waste processing is undertaken to recover valuable products and energy from waste materials which goes a long way in efficient use of resources, which are always scarce by their nature and need to be available on a sustainable basis. Waste transformation is undertaken to reduce the volume, weight, size, or toxicity of waste without resource recovery. Transformation may be done by a variety of mechanical (e.g. shredding), thermal (e.g. incineration without energy recovery), or chemical (e.g. encapsulation) techniques (Stanford, 2000).

According to Labspace (2013), resource recovery means finding a way to use the waste so it becomes a valuable resource, rather than just a disposal problem. This is a very important part of waste management. Resource recovery includes a range of processes for recycling materials or recovering resources from the waste, including composting and energy recovery.

2.9. Waste Transfer and Disposal

The functional element of transfer and transport involves two further steps: (i) the transfer of wastes from smaller collection vehicles to larger transport equipment and (ii) the subsequent transport of the wastes, usually over long distances, to a processing or disposal site. The transfer usually takes place at a transfer station (Vergara & Techobanoglous, 2012).

Waste disposal is the final functional element in the solid waste management system (McDougall et al., 2001). Today the disposal of wastes by landfill or uncontrolled dumping is the ultimate fate of all solid wastes, whether they are residential wastes collected and transported directly to a landfill site, residual materials from Materials Recovery Facilities, residue from the combustion of solid waste, rejects of composting, or other substances from various solid waste-processing facilities (McDougall et al., 2001). A landfill plant is an engineered facility used for disposing of solid wastes on land or within the earth's mantle without creating a nuisance or hazard to public health or safety, such as breeding of rodents and insects and contamination of groundwater (Vergara & Tchobanoglous, 2012).

According to the World Bank (2018) about 37 percent of waste generated today is disposed of at landfills globally, about 33 percent at open dumping sites, 19 percent recycled and composted, and 11 percent incinerated (World Bank, 2018). The same source indicates a significant variation between developed and developing countries. Whereas developing countries openly dump 93 percent of the wastes they generate, developing countries openly dump only 2 percent of the waste they generate. These differences also hold when it comes to recycling, composting, and incineration of waste.

2.10. Energy Generation from Waste

Generating energy from municipal solid waste (MSW) is becoming common these days. To this effect, several technologies have been developed that make the processing of MSW for energy generation. And these technologies, which include landfill gas capture, combustion, pyrolysis, gasification, and plasma arc gasification, are increasingly becoming cleaner and more economical (Vergara & Techobanoglous, 2012). For example, thanks to new regulations that came into force by the USEPA in 1995 and 2000 under the Clean Air Act, emissions of dioxins from waste-to-energy facilities has been successfully reduced by more than 99 percent below 1990 levels, while mercury emissions have been slashed by over 90 percent. Noting these improvements, the USEPA in 2003 cited waste-to-energy as a power source with less environmental impact than almost any other source of electricity (Takele, 2004).

2.11. Integrated Solid Waste Management

Integrated solid waste management was first developed by a Dutch NGO called WASTE in the mid-1980s.It was further developed in the 1990s by the collaborative working group on solid waste management in low and middle-income countries and has of late become like a norm as far as solid waste management is concerned (Imad, 2011). A key objective of integrated solid waste management is supposedly to give adequate protection to the public and environment from the harmful effects of waste. Population participation is critical for the success of any solid waste management system. The reality is however that the inadequate inclusion of the public in decision-making is adversely affecting the success of different Solid waste management Programs (Squires, 2006).

The inability of conventional solid waste management to cope with the challenges of rapid urbanization and waste evolution calls for an approach that includes innovative techniques to enhance the capability of the system to cope with the challenges of the increasing volume and variety of waste (Anschutz,2001; Squires, 2006). Among these techniques are the passage of regulations to control waste generation, the recovering of materials for recycling, the production of energy, and the reduction of the hazardous effects of waste disposal (Squires, 2006). Solid waste management systems that integrate innovative techniques that enhance the sustainability of solid waste management systems are called integrated solid waste management systems (Anschutz, 2001; Klundert, 1999; Penjor, 2007).

An integrated solid waste management system is a system which uses a range of inter-related collection and treatment options. And as such it has to involve all stakeholders, governmental or non-governmental organs, the formal or informal sectors, for profit or nonprofit schemes, and take into account interactions between the waste management system and other urban systems (World Bank, 1999). White *et.al* (1999) point out that an integrated solid waste management system deals with all types of waste materials, as opposed to focusing on specific materials. It deals with all sources of municipal solid waste and includes such steps as waste collection and sorting followed by one or more of recycling, biological treatment of organic materials, thermal treatment, or landfill.

According to this definition, integrated solid waste management is an approach of solid waste management that takes the solid waste management system as a whole and not in compartments. An integrated system, therefore, includes all kinds of waste regardless of whether they are recyclable or not; involves all stakeholders and most importantly makes use of available innovative waste management techniques. However, it is wrong to conclude that an integrated

solid waste management system is a panacea. Even though it is the most effective and most beneficial to society, it can also be prone to criticism since solid waste management is made up of different compartments. And integrating all these different compartments can be impractical at times depending on the setting where it is being implemented.

The salient features of the ISWM plan are:

- Promote segregation of waste at source.

- Avoid multiple handling of waste.

- Conduct awareness programs.

- Public/NGO participation.

The main objectives of IWMP included the following:

-Developing strategies to address methods of waste management in order to achieve compliance with the requirements of waste management hierarchy

- Increase waste minimization by promoting prevention, reduction, reuse and recycling of waste

- Draft by-laws on solid waste for enforcements

- Adopting strategies for optimization of landfill site and steadily reduce the amount of waste going to landfill

- Adopting integrated approach to all waste management projects so as to prevent adverse social and environmental impacts

-To identify and develop plans for future waste management needs in terms of short, medium and long term strategies.

- Ensure adequate capacity building for the city is made available and long term political support is given to meet the targets set within IWMP

-Present the IWMP for public and stakeholders consultation

2.12. Integrated Solid Waste Management Model

An Integrated Solid Waste Management (ISWM) Model is a model that allows studies of the complex and multi-dimensional systems in an integral way (Anschütz et al., 2004). As indicated above, the model was pioneered by WASTE advisers on urban environment and development (WASTE, 2004). The model was further refined in the mid-1980s by partners or organizations working in developing countries. During the mid-1990s a further refinement was made to it by the Collaborative Working Group (CWG) on solid waste management (Anschütz et al., 2004).

The model acknowledges the importance of seriously and systematically considering three dimensions when analyzing, developing, or changing a waste management system. These include the stakeholders that have an interest in solid waste management; the elements or stages of the movement or flow of materials from the generation points towards treatment; and the final disposal and the third dimensions are aspects. (ISSOWAMA Consortium, 2009; Müller et al., 2002; Müller & Scheinberg, 2002; Wilson et al., 2009; Scheinberg et al., 2010/2011; Zuilen, 2006; Zurbrügg et al., 2005).

The ISWM model, a mixed-integer linear program, is formulated to help solid waste management authorities in the long-term planning of future facilities and the possible implementation of recycling and composting options. The model can determine the optimal design capacity and operations of new facilities, the optimal capacity expansion and operations of existing facilities, and the optimal expansion of landfill stock capacity. Furthermore, it can handle multiple existing and future landfills, recycling programs with promotion costs, and a variety of waste collections. The model also accounts for landfill closure and replacement costs

in its scheduling of multiple solid waste facility operations over a long-term planning period (Wilson et al., 2009).

According to UNEP (2009), ISWM system has six major features: 1) a holistic approach to all waste streams so as to maximize the synergetic benefits in collection, recycling, treatment and disposal; 2) maximizing the opportunities for resource recovery at all stages; from generation to final disposal; 3) accommodating the aspirations of all stakeholders; from waste generators to waste management and service providers; 4) facilitating the life cycle view of products and materials; 5) integrating different response functions such as technical, managerial, financial, policy and 6) local ownership and responsibilities/participation through a consultative approach,

This research work is set within an adapted ISWM framework. It especially focuses on investigating the stakeholders' (community's) action/behavior and the factors that influence the elements of the city's waste management system and the technical, environmental, socio-cultural, legal, institutional, and economic linkages present to enable the overall system to function. To facilitate the analysis of information, existing elements of the waste management systems are described in terms of waste generation, separation, collection, transfer, transport, treatment, recycling, and final disposal.

2.13. The Challenges of Poor Solid Waste Management

The problems caused by solid waste critically impacts planet earth. Poor waste management has multidimensional challenges on the environment, health, socio-economic and aesthetic value (UNEP, 2005, UN-Habitat, 2009). The problem is more acute in developing countries, where financial, human, and other critical resources are generally scarce. Although several publications

dealt with a variety of topics in the field of solid waste management, most of these documents have been published to address the needs of industrialized nations. Only a few documents have been specifically written to provide information on the impacts of improper management of solid waste that is required by those in developing countries (UNEP, 2005). This study also aims to fill this gap in the literature.

2.14. Environmental Challenges

Inappropriate management of solid waste hurts the environment in many ways. Poor solid waste management can provide a breeding ground for rodents and vector insects for which it provides food and shelter. On the other hand, the foul odors and unsightliness, which comes from unmanaged solid waste, make the environment less attractive for humans to enjoy and cherish. These impacts are not confined merely to solid waste disposal sites. In fact, they pervade the area surrounding the disposal sites and wherever the wastes are generated, spread, accumulated, or sites to which the waste is temporarily transferred (UNEP, 2005). Unless an organic waste is appropriately managed, its adverse impact will continue until it has fully decomposed or otherwise stabilized. Uncontrolled or poorly managed intermediate decomposition products can also contaminate the air, water, and soil resources.

Uncontrolled solid waste dumping exposes urban residents to potential risks from polluted water, particularly, those living adjacent to dumpsites, unhealthy food sources, air, land and vegetation pollution. Poor solid waste disposal and handling of wastes leads to environmental degradation, ecosystem destruction, and high risks to public health. Such accumulations of solid wastes are health hazards not only to urban residents but also threaten the environment (UNEP, 2005).

2.15. Climate Change Challenges

The importance of public health, environmental protection, and resource management are reinforced by the imperative to reduce carbon emissions in a move to a sustainable, carbon neutral, society. Municipal solid waste management and wastewater contribute about 3% to current global anthropogenic greenhouse gas emissions, about half of which is methane from anaerobic decomposition of organic waste in landfills and other waste disposal sites. One forecast suggests that, without mitigation, this could double by 2020 and quadruple by 2050. It is ironic that these alarming increases are largely due to improved disposal in low and middle-income countries open dumps decompose partly aerobically, and so generate less methane than – mostly anaerobic sanitary landfills (UN-HABITAT, 2009).

2.16. Health and Social Challenges

Unmanaged solid waste is causing many health complications. Studies have shown that a high percentage of workers who handle refuse, and individuals who live near or on disposal sites, are infected with gastrointestinal parasites, worms, and related organisms. Contamination of this kind is likely at all points where waste is handled. Although vector insects and rodents can certainly transmit various pathogenic agents (amoebic and bacillary dysenteries, typhoid fever, salmonellosis, and many others), it often is difficult to trace the sources of such scourges as the cholera, yellow fever, plague, and the various ailments caused by parasites to specific populations (UNEP,2005).

One thing is not in dispute: That there is a significant increase in the incidence of sickness among children who live in households where garbage is dumped or burned in the yard. Uncollected solid waste clogs the drain and causes flooding and subsequent water-borne

diseases. People living downwind of a burning dumpsite will likely suffer from respiratory diseases. Contaminated liquids or leachate, leaking from dumpsite could pollute the city's drinking water supplies. Unmanaged waste dumps potentially serve as a breeding ground for Malaria, thus having negative implications in achieving Millennium Development Goals (UN-Habitat, 2009).

The social impacts created by MSW include the unpleasant odour when garbage is left uncollected and the unpleasant odour one suffers due to proximity to a landfill site, dirty surroundings, breeding of mosquito, worms, insects and flies due to the landfill site and the uncollected garbage and the release of smoke and poisonous gases giving rise to safety problems. These impacts are also referred to as disamenities due to MSW (Blore & Naun, 1996).

2.17. Economic Challenges

In some developing countries, municipalities spend a disproportionate amount of their meagre financial resources on certain solid waste services, in particular, waste collection and sweeping. In the past, a common approach to curing poor service provision was to simply expend more capital to acquire additional equipment, make new design, and construct new facilities. The problem is that even after spending a considerable amount of resources on such efforts, rarely are these efforts sufficient and effective in addressing and remedying inefficiencies inherent in the system. Unfortunately, high capital investment in the solid waste management sector does not necessarily lead to improvements in the quality of service in many developing countries (Woldetsadik, 2017).

The economic impact of poor waste management is often not considered in planning decisions. For health issues, costs can be associated with days lost from work, the costs of

medical treatment and even loss of life. Although this analysis has not been done for Ethiopia (Hailu, 2011), it is likely to result in losses of millions of birr a year. In addition, an outbreak of a serious disease like cholera could cost millions in lost commercial earnings. On the environmental side, the costs can be less primary productivity on land or sea due to pollution, loss of value of property near pollution, loss of environmental services if important habitats are degraded, loss of commercial earnings and the cost of cleanup. The reduction in quality of natural assets and aesthetic value because of pollution from waste can lead to economic costs.

2.18. The Concept of Community Participation

The term community refers to a group of people living in a specified geographical area and sharing some common values and facilities, may be of different backgrounds, experiences, and skills but living together (Mutungwa, 2016). The community can be viewed as a social group; referring to the group of residents who identify themselves as a community, because of the social or cultural relationships among them. Smith and Zhao (2016) also defined community as the whole population of a city; a section of the city; or an ethnic or social group within the city.

It can also mean a group of people living in a particular geographical or administrative area such as, a neighborhood and who has access to and uses the same services (Mutungwa, 2016). From these definitions, one can understand that community is a group of people who have something in common living within a specific geographical area where their needs are met through interdependent relationships.

While Oakley and Marsden (1984) argued that participation is a process and not just a product, they were also quick to note that it is very difficult to establish a universal definition for participation. This indicates that different scholars, authors, and organizations define and

understand participation differently. Their definitions and understandings are often guided by the orientation and intent of the individual or organization defining participation, given the circumstances. Although participation is widely known to be a free process, in some instances it practically requires that people are dragged into getting involved in operations that are of no interest to them, but they are coerced in the name of participation. Oakley and Marsden (1984) looked at participation as a concept that is closely linked to rural development.

Oakley and Marsden (1984) also explain that very often, participation is seen as some kind of ingredient that can be added to the recipe for rural development so that the results from the development project are palatable. The conception that participation is an important ingredient in development presents a temptation to force participation at any cost. However, it is perhaps helpful to note that there is what Oakley and Marsden (1984) refer to as authentic participation, which is described to be usually effective because of the bottom-up nature of the process of development. Consequently, the concept of participation requires a clearer interpretation and a more careful comprehension before it is adopted for any given purpose.

Oakley and Marsden (1984) try to explain the different interpretations of the concept of participation by use of four "terms", that is: collaboration-input-sponsorship, community development, organization, and empowering. These terms are used to explain the different orientations in the participation discourse, and the different terms represent different intentions or purposes for which participation is adopted by the implementers. According to these scholars, participation can be looked at as a means as much as it can be looked at as an end in itself. Participation can be perceived as a means if it is adopted as a method of achieving success in a development program. It can also be viewed as an end in itself if it is seen as a process the outcome of which is meaningful participation (Oakley & Marsden, 1984,).

In the contemporary practice of participation, the former perception is more prominent. Participation is adopted as a catalyst to the success of a beneficial undertaking in a community. Barnes (2005) rejects the one-size-fits-all model of participation and advises not to look for the perfect model of participation. After all, participation within the context of solid waste management is a means rather than an end, which is the perspective of participation taken by this study.

The fact is there is not and cannot be one fixed definition to describe community participation and it is rather defined differently by different people to meet their specific ends (Maya & Thomas, 2007). For instance, Njau and Mruma (2004) defined community participation as involving people in the development process as active participants in all levels regardless of gender. For Tukahirwa et al. (2010) community participation is an active process by which the community plays a role in a development project to improve their wellbeing. According to Baud and Post (2002) community participation is a process through which stakeholders' influence and share control over development initiatives, decisions, and resources which affect them. As a process, community participation involves informing, gathering input or involving the community in some decision-making processes (Baud & Post, 2002). It also covers all levels of information, awareness creation, outreach, input, involvement, and collaboration. Therefore, community participation is far more than the direct delivery of services.

Participation involves a significant number of persons in situations or actions, which enhance their well-being. Howlett and Nagu (2001) argued that community participation is one of the critical components of the success of a society by mobilizing resources and increasing a sense of ownership of polices and projects, enhancing social cohesion, delivering cost-effective services, creating transparency and accountability; increasing empowerment and strengthening

human capacity to learn and act collectively. Proponents of participatory approaches highlight the value of engagement with stakeholders in terms of greater local ownership of public actions or development projects, reduced incidences of strong resistance from stakeholders to impositions from above, which have been known to kill otherwise worthy initiatives, as well as its potent potential of adapting local solutions to local problems (Haile, 2012).

2.19. Theoretical Approaches of Community Participation

Choosing the theoretical framework for a given research study is not exclusively a matter of the personal choice of the investigator. It is more a considered judgment on the most appropriate literature and theories that are considered to be most relevant to the study at hand. And it is not unusual for studies to deploy multiple theories to form a distinct framework. In this study, which attempts to understand how solid waste is being managed in the Lagatafo Lagadadhi Town through community participation, the Social Capital theory articulated by Putname (2000) and the Bottom-up approach theorized by Chambers (Field, 2003) appear to be the most appropriate framework.

Although it predates them by decades, the concept of Social Capital is popularized by the works of Pierre Bourdieu, James Coleman, and Robert Putnam (Adriani, 2013). Whereas for Bourdieu social capital is a resource possessed only by individual actors, Putnam and Coleman posit that social capital can be possessed by corporate actors. Accordingly, Putnam's and Coleman's view of social capital can help us explain the interactions between and within the two relevant corporate actors in this study the municipality administration and the community residing in Lagatafo Lagadadhi town vis-à-vis waste management in the Town. Although Coleman's view of social capital can help discern the trustworthiness of the efforts by the

Lagatafo Lagadadhi town administration to illicit obligations and expectations and communication from the community to engage in waste management and a trustworthy channel of information for this purpose. However, the more bottom-up approach to social capital perused by Putnam appears to be apt choice as a theoretical framework to guide this study, Putnam's (2000) take on social capital goes straight to one of the main purposes of this study: the question of the state of community participation in managing municipal waste in Lagatafo Lagadadhi town, which depends on how and whether the community is itself mutually connected to each other in a trustful way as to actively and genuinely participate in waste management as a civic duty and also how strongly and trustfully the Municipality is connected to the community.

Despite increasing efforts to utilize social capital to explain a large number and variety of social processes these days, the very definition of social capital "is still elusive with lots of confusion among scholars in the wish to distinguish between what it is from what it does" (Adriani, 2013, p. 19). The World Bank (2005) defined Social Capital as the institutions, relationships, and norms that shape the quality and quantity of a society's social interactions, which make societies or communities work. It is not just the sum of social institutions that underpin society; it is the glue that holds them together (World Bank, 2005). Social Capital is more about the connections among individuals, social networks, and the norms of reciprocity and trustworthiness that arise from them (John Field 2003). The basic tenet of social capital theory is that interactions enable people to build communities, to commit themselves to each other and to knit the social fabric. The Social Capital theory advances a normal argument that trust between individuals thus becomes trust between strangers and trust of a broad fabric of shared institutions and shared sets of values (Field, 2003). According to Bourdieu, social capital is the productive

resources obtained through the “possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition” (Bourdieu, 1986, p. 248).

From the foregoing discussion, it is clear that there are many ways to define social capital. As a result, how to operationalize this illusive concept in this particular study is of paramount importance. Even though trust and social participation (civic virtue) are usually considered as the proxies and key indicators of social capital, Social Capital is operational in this study through its chief proxy social participation. This is because social (civic) participation presumes the presence of trust**.**

The other key concept needing a working definition, thus operational for this study, is community participation. Let us first unpack this composite concept. According to Thomas-Hope (1998), a community is an entity with knowledgeable actors who should be afforded a special platform in the solid waste management process. This entails scrutinizing what the community knows, thinks, and feels about the whole process of waste management. Knowledge, practices, and attitudes form part of their social worlds. Thomas-Hope (1998) argued that social networks have value and there is tangible evidence that communities with a good 'stock' of such social capital are more likely to benefit from lower crime figures, better health, high educational achievement, and better economic growth. Thomas-Hope (1998) postulated that community members have social capital where a community has accumulated substantial levels of mutual trust, mutual obligations and expectations, and effective channels of communication. Thus a community with a strong social capital is better positioned to reorganize the existing solid waste management system and deal more effectively with the environmental issues that necessitated the system in the first place.

Community participation is therefore not an afterthought but rather an integral part of the waste management process. According to Chambers (1985), who contextualized the theory of social capital ideology within the context of the Solid Waste Management process, the community needs to be an integral part of Waste Management programs. Such an approach gives the community greater ownership of the program which would translate into less resistance from stakeholders to the program and affords the community the opportunity to devise local solutions to deal with local problems. Being an integral part of the contextualized social capital ideology with the Solid Waste Management process does not mean involuntary participation. It rather means being genuinely involved in the planning, implementation, and evaluation of the entire process.

This bottom-up approach is a model that helps to investigate the multifaceted pieces and parts of a system in a holistic form. The bottom-up approach is distinguished by its recognition of the significance of three dimensions of a waste management system (WASTE, 2004): 1) stakeholders concerned about solid waste management; 2) the physical chain of solid waste management, and 3) the different aspects of the waste management system. Hence, this model presents itself to be a more appropriate model to guide and ground this research work. This model also provides a conceptual framework that the Integrated Waste Management (IWM) practices through strong community participation to mitigate the deleterious impacts of solid waste on health, the environmental, and socio-economic development.

The model can show the perception of the community about IWM thereby helping in assessing the impact of a solid waste management on the environment and sustainable town development. Furthermore, it is inclusive; materializing the principle that those who generate waste should take responsibility for its proper management and not leaving the responsibility of

Solid Waste Management (SWM) exclusively to the municipal authority. It allows solid waste management to be practiced throughout the community, endorses, and legitimates the involvement of every individual who generates waste in the SWM system.

Finally, yet importantly, this research study follows a more inductive approach (Merriam & Tisdell, 2016). After collecting and analyzing the data, revealing the patterns of relationship between variables that would emerge from the analysis, which will be the finding of the study, the study aims to make generalizations and evaluate those generalizations against the chosen theories/theoretical framework for compliance or variance. The mixed-nature of this study, employing both quantitative and qualitative tools and data, allows for a more nuanced and more logical interpretation of data, which one can hope to achieve only through a more inductive approach.

2.20. Community Participation in Solid Waste Management

Waste is an unavoidable fact of our human existence as long as we are dependent on the use and reuse of scarce resources. The intention of all societies is to achieve a greater degree of socio-economic wellbeing. However, as countries achieve greater socio-economic well-being, they also generate significantly more waste per capita (Mbanda& Lawton, 2015). Improvement in the living standards of societies requires greater industrial diversification, which in turn lead to greater increases in the quantity and complexity of waste. These, in turn, urge the critical need for a waste management system, which can rarely be achieved without meaningful community participation (Rangeti et al., 2018). As every person is a likely generator of waste and also a potential victim of the problems caused by waste, community participation is one of the key ingredients of an effective waste management system. Such a system gives the community a

sense of ownership (Norman, 2000). Significant works of literature have also indicated the importance of community participation in any and every developmental activity, including waste management (Ahmed & Ali, 2004; Henry et al., 2006; Joseph, 2006; Tukahirwa et al., 2010).

In the solid waste management context, the term community participation means active and meaningful involvement of the beneficiaries in the management of solid waste. Such participation includes the entire population as a whole or specific interest groups such as waste generators; waste pickers; recycling industries; waste collection contractors; SWM facility operators and their staff, residents close to SWM facilities, politicians, central government, and public agencies; financial agencies; etc. Since SWM involves everyone in the country, there is a wide range of stakeholders who are required to operate and manage SWM systems (Ahmed & Ali, 2004; Henry et al., 2006; Joseph, 2006; Tukahirwa et al., 2010).

The most common roles that communities could undertake are managing waste within the household and removing them from their premises, reducing waste production and facilitating recovery for recycling and keeping public areas around the neighborhood clean (Sylvaine, 1999). The rationale of effective public participation has been based on the idea that everyone generates waste and can be affected directly and indirectly if waste is not well managed.

2.21. Significance of Community Participation in Solid Waste Management

The approaches of waste management attribute involvement of communities in service delivery as well as giving technical and financial supports (Rangeti et al., 2018). As the community continues to be looked at as passive recipients of solid waste management, citizens fail to put in their effort in waste management, which could ultimately culminate in an unwillingness to pay for the service itself (Rangeti *et al.*, 2018). Many towns and cities,

particularly in developing countries, are severely constrained by lack of financial, technical and human resources to manage solid waste (Henry et al., 2006). Meanwhile, studies have consistently demonstrated that municipalities and local authorities that engage their community in service delivery tend to raise more resources and achieve better results (Ahmed & Ali, 2004; Henry *et al.,* 2006; Joseph, 2006; Tukahirwa et al., 2010).

Tsai (2007) argued that the wiliness of the community to work together offers an opportunity for creativity and innovation in dealing with waste problems. Therefore, community participation on solid waste management is a more effective means of addressing the financial, technical, and human resource constraints and has numerous benefits for municipal authorities resulting in massing costs savings in the collection and disposal of waste (Mbanda &Lawton, 2015). Any effective and meaningful participation in development must involve different players and take on different modalities (Mabula, 2007). For instance, participation could range from the voluntary contributions of labor to forced labor with a legally enforceable penalty for default to work in a group voluntarily joined with or without pressure. According to Mabula (2007) participation in kind develops a sense of belonging towards the community activity; helps develop leadership in the village there by raising their confidence to deal with their problems. The problem is that achieving full community participation is easier said than done.

And the major reason that results in poor participation and poor separation of waste at source is lack of knowledge (Teneja, 2006). Better informed citizens have a greater chance to participate than those who are not well informed. Awareness is thus a key factor for effective participation and the successful implementation of community activities. Studies by Teneja (2006) suggest that lack of awareness is one of the barriers to effective community participation.

2.22. Identified Gaps and their Challenges to Urban Solid Waste Management

Studies have identified several factors that militate against solid waste management efforts by municipalities in poor countries. Linden et al. (1997) identified ten common constraints/ challenges that militate against solid waste management efforts in Asian countries. These were: Inappropriate technologies/processes; Enforcement inefficiencies/non-existent; illegal dumping; Lack of financing; Lack of training/human resource: Lack of political support; Lack of legislation; Policy conflict among levels of government or overlapping responsibilities; Rapid increase in waste generation/limited data; Lack of awareness among public; and Limited land areas and land tenure issues. These factors, according to the report, frustrated the waste management efforts of municipal authorities in Asia and made it difficult for them to keep their city environments clean and safe for their populations.

According to Kironde (1999) the main constraints to effective waste management are financial scarcity, lack of physical, human, and technical resources. Namilyango College (2001), who also investigated some challenges of waste management, identified these constraints: lack of landfill sites, ignorance for appropriate waste disposal, poor collection methods, lack of government commitment, poverty, corruption, and lack of trained employees. These have posed serious constraints to the effectiveness of the waste management sector and dampened efforts towards waste management in municipalities. Many other writers have elaborated on how the factors cited above (plus others) interact to aggravate the solid waste problem in municipalities in poor countries.

2.23. Empirical Evidence

Past studies have identified the stakeholders that may have an interest inadequate waste management. These are: national and local government (Shekdar, 2009); municipal authorities, city corporations; non-governmental organizations (NGOs), households (Sujauddinetal,2008); private contractors; Ministries of Health; Environment, Economy and Finance (Geng et al., 2009) and waste recycling firms (Tai et al., 2011). There are also ample studies that identified factors influencing waste management systems. For instance, Sujauddin *et al*. *(*2008) argued that the generation of waste is affected by education level and income levels of the individuals forming a community.

Household attitudes towards the separation of waste are also found to be affected by the presence or absence of active support and investment from real estate companies, managing properties where the affected community lives, and the ability of residential committees to maximize public participation (Zhuang et al., 2008) and the amount of fee paid for collection service (Ekereet al., 2009; Scheinberg, 2011). Whereas Hazra and Goel (2009) noted that collection, transfer and transport practices are affected by improper bin collection systems, poor route planning and lack of information about the collection schedule, Moghadam et al., (2009) blamed these problems generally on insufficient or poor infrastructure.

Poor infrastructure could be in the form of substandard roads and the limited number of vehicles used for waste collection (Henry et al., 2006). Given these limitations, Sharholy et al. (2008) recommended organizing the informal sector and promoting micro-enterprises engaged in waste management as effective ways of extending affordable waste collection services. Lack of

knowledge of treatment systems by authorities is also reported as one factor affecting the treatment of waste (Chung & Lo, 2008).

Likewise, Tadesse et al. (2008) analyzed the factors that influenced decision making regarding household waste disposal. Results showed that the supply of waste facilities significantly affects waste disposal choice. Inadequate supply of waste containers and longer distance to these containers increases the probability of waste dumping in open areas and roadsides relative to the use of communal containers. Insufficient financial resources, limiting the safe disposal of waste in well-equipped and engineered landfills and the absence of legislation were mentioned by Pokhrel and Viraraghavan (2005) to be among the key factors. Concerning the pricing for disposal Scheinberg (2011), analyzing data from an earlier study entitled "Solid Waste Management in the World's Cities" (Scheinbergetal, 2010), noted that there are indications that high rates of recovery are associated with tipping fee at the disposal site. High disposal pricing has the effect of more recovery of values from the waste, which adds to the value chains and the beneficial reuse of waste.

Concerning why recycling is practiced in some communities and not in others, Gonzalez-Torre and Adenso-Diaz (2005) reported that social influences, altruistic and regulatory factors are some of the reasons why certain communities develop strong recycling habits. The authors also showed that people who frequently go to the bins to dispose of general refuse are more likely to recycle some products at home. And in most cases, as the distance to the recycling bins decreases, the number of fractions that citizens separate and collect waste at home increases. Minghua et al. (2009) stated that to increase recycling rates, the government should encourage markets for recycled materials and encourage increasing professionalism in recycling companies. Some other studies have identified still more factors that affect solid waste management such as

finance (Nissim et al., 2005), number of recycling companies (Henry et al., 2006), allocation of land for waste management (Matete & Trois, 2008) and involvement of the informal sector (Sharholy et al., 2008).

The literature suggests that technical factors influencing the system are related to lack of technical skills among personnel within municipalities and government authorities (Hazra & Goel, 2009), deficient infrastructure (Moghadam et al.,2009), poor roads and vehicles (Henry et al., 2006), insufficient technologies and reliable data (Mrayyan & Hamdi, 2006). According to Matete and Trois (2008) and Asase *et al.* (2009), lack of environmental control systems and evaluation of the real impacts are also major factors affecting the environmental aspect of solid waste management in developing countries. It is to remedy these shortcomings that Ekere et al. (2009) proposed the active involvement of the population in protecting the environment as indispensable ingredients to have better systems of Solid Waste Management.

The huge expenditure needed to provide optimal service (Sharholyet al.,2007), the absence of financial support, limited resources, the unwillingness of users to pay for the service (Sujauddin et al,2008), and lack of economic measures of waste and waste mitigation efforts are among the factors that affect the delivery of proper waste management services. Sharholy et al. (2008) also identified the need to seek the participation of the private sector as a factor to improve the efficiency and cost effectiveness of a waste management system. Whereas Vidanaarachchi et al. (2006) argued that the public need not be obliged to contribute to waste management since waste management is the responsibility of local authorities, Sharholy et al. (2008) emphasized the need to seek the active participation of the community in decision-making process.

There is a valid reason why the reservation to requiring community participation by Vidanaarachchi et al. (2006) need not be dismissed. This is because some researchers that have investigated the institutional factors that affect the system have concluded that local waste management authorities themselves tend to lack organizational capacities (leadership) and professional knowledge about Waste Management. For example, Chung and Lo (2008) concluded that the information available is very scanty from the public domain. The information available is either not complete or is scattered around various agencies. As a result, it is extremely difficult to gain a deep insight into the complex problem of municipal solid waste management and the effectiveness of community participation in mitigating it (Seng et al., 2010).

To make matters worse, waste workers are associated with low social status (Vidanaarachchi et al., 2006). This means solid waste employees have as a result low motivation to do their jobs effectively, efficiently, and professionally. That is not all: as a result, solid waste employees tend to be less trained and less skilled compared to other personnel working for municipalities (Sharholyet al., 2008). Worse still, politicians also give low priority to solid waste compared to other municipal activities (Moghadam et al., 2009). Accordingly, strong waste management systems are a result of strong support from municipal authorities (Zurbrügg et al., 2005) and the presence of strategic plans for waste management that allow monitoring and evaluating the system on a regional basis (Asase et al., 2009). Moreover, having an adequate legal framework is necessary for the emergence of a robust integrated waste management system (Asase et al., 2009; Mrayyan & Hamdi, 2006; Seng et al., 2010).

2.24. Case Studies on Community Participation in Solid Waste Management

2.24.1. Community and Stakeholders Participation in Kigali, Rwanda

Before the year 1999 the solid waste collection and transportation services of the Municipality of Kigali had been hobbled by such problems as lack of finances; irregularity in solid waste collection; the fact that collection sites tended to be temporary and located in residential areas. After 1999, this service was outsourced to the private sector with the aim of increasing the coverage of collection and transportation services.

The intention was especially to reduce the cost borne by the urban poor communities, create jobs for talented and creative local private operators, and improve the quality of service, increasing the frequency of collection and regularizing the schedules of collection. Until the year 2010, so many companies and cooperatives were operating in the solid waste sector. However, these companies were faced with a series of challenges such as the presence of so many informal operators and the congestion caused by the large number of operators in the solid waste collection and transportation services. On their hand, the operators also suffered from limited financial capacity and failed to engage skilled professionals to provide proper sanitation services defeating the very reason that necessitated the participation of the private sector in the first place. The high tariff on waste collection and the lack personal protective equipment for workers were some of the other critical challenges that encountered the system. (Rwanda reg.002, 2015)

To remedy these limitations, the city government of Kigali introduced a structural adjustment in the year 2012, which shed new lights on the facts necessary to bring about a rapid improvement in the solid waste management system of a city. The structural adjustment had resolved the entire preceding solid waste management crisis in the city in an unprecedented

manner and time. The adjustment brought onboard licensed and skilled professional operators and strictly monitored the activity of these operators, each one of whom was assigned in predetermined geographic areas of the city. The Municipality also provided protective gear to workers engaging in solid waste collection and transportation services and strictly monitored their use. Moreover, the city instituted door-to-door collection once a week and made contractual agreement with the customers to this effect. These adjustments brought substantial changes in the waste management system of the city.

The outputs of the restructuring of 2012 are also a result of subsidy from the government in solid waste collection and transportation; job creation; equity in cost distribution through cross-subsidy for the urban poor; improved quality of service and coverage areas; and improvement in waste sorting at the dumpsite. As a result, public participation increased in waste sorting, timely payment of service fee, which also regularly brought their waste to collection points.

Thanks to strong community involvement and private sector participation, which are the key elements of the structural adjustment made in 2012 in the city's solid waste management, the situation showed so remarkable an improvement that the City of Kigali has gained the reputation of being one of the neatest and most beautiful cities in Africa. Currently, the City of Kigali is serving as a Center of Excellence for cities in many African countries, including Ethiopia (RURA& MoUDC, 2015).

2.24.2. Home Composting in Surabaya City, Indonesia

Surabaya is the second largest city in Indonesia serving as an important commercial and industrial capital of East Java. The city generates a total waste of 1,800 tons per day in 2004, of which the residential portion accounted for 68 percent followed by markets 16 percent, and commercial/industrial 11 percent. Since the city's waste collection coverage was 70 percent, the

rest were left on the streets, in the ditches and the open spaces. Keputih, the final disposal site was closed in 2001 due to public opposition leaving the only site as Benowa, which was itself over capacity. And finding a new site was difficult due to the scarcity of public lands. Since the remaining disposal site was not well developed, open dumping and burning were common practices. (Surabaya, 2010)

It was at this point that the city government launched a composting strategy at both the household level and in the urban center in cooperation with the general public and international donors. The strategy mainly involved establishing a separated waste collection system; promoting composting at household, community or city-scale for recycling organic waste; establishing a material recovery facility/ waste bank to convert recyclable materials into resources; integrating the informal sector; raising citizens' awareness on the new SWM system; establishing an incentive system (awards, point-card, pay for service. etc.) for motivating community participation for waste reduction and recycling, promoting partnership among different stakeholders in the city, while facilitating their own innovative activities. The outcome was remarkable: The amount of waste was reduced by 30 percent in 5 years and final disposal site costs were significantly reduced (Jica, 2012).

The key conclusion from the Surabaya City case study is that a successful solution for municipal solid waste management needs to consider all of the three aspects of ISWM. The success of an ISWM system was a result of the partnerships among all stakeholders, including waste generators, the private sector (both formal and informal), national and local governments, and international agencies. A clear vision, political commitment, and change in public attitudes as well as technical, financial, legal, and institutional capacity building enabled these partnerships to bear fruit and maximize its impact (Premakumara *et al.,* 2011*).*

2.24.3. Material-Cycle Society in Japan

Increased volume of municipal waste caused a shortage of landfill sites while the cost of municipal waste collection, transportation, treatment, and disposal sharply increased. The Japanese Cabinet adopted the Fundamental Plan for Establishing a Sound Material-Cycle Society in 2003 (revised in 2008) with concrete numerical targets, including resource productivity, recycling rate, and final disposal volume. The Fundamental Law for Establishing a Sound Material-Cycle Society was enacted in 2000. Within this basic framework, the Law for Promotion of Effective Utilization of Resources has been introduced to cover the production stage along with various laws regulating the collection and the recycling stages in correspondence with the specific characteristics of individual products or goods (D.G.J.Premakumara, 2012).

The Law on Promoting Green Purchasing was strictly enforced and this in turn facilitated the purchase of environmentally friendly products by the public. For instance, waste reduction strategies in Yokohama City introduced a new waste separation and collection system. Public awareness campaigns and seminars covering 80% percent of the populations were conducted, which included 470 campaigns in railway stations, and 2,200 campaigns in waste collection stations.

In the Nagoya City community-based organizations played a key role in organizing waste sorting centers. They established a social system for promoting environmentally friendly lifestyles. The city of Kitakyushu established 300 stations which were managed by community members for collection of recyclable materials. Minamata City introduced zero-waste societies and established a vision of becoming an environmental model city in Japan. More than 300

public meetings were organized along with public campaigns on TV, Radio, and Newspapers to share information on new waste separation and collection systems to the residents. In Oki Town a Recycling-based Society was introduced. This small agricultural town organized community awareness programmes to educate people about new waste separation and collection systems in order to launch a biogas system for kitchen waste, human waste, and septic tank sludge. The city created a market for local farmers generating renewable energy, totaling 700kw/h (D.G.J. Premakumara, 2012).

The implication of the foregoing discussion is that rather than a one size fits for all strategy, cities and towns need to adapt programs that are based on their individual needs and situations. Therefore, it is no wonder that cities and towns in different parts of the world design different system to manage their solid wastes. The aforementioned Japanese cities, for instance, designed a system of converting waste into resources and this was done mainly through the active involvement of the communities *(*V.Weghmann, 2017).

2.25. European Commission Circular Economy in Solid Waste Management

In 2014, the European Commission (EC) published a report entitled "Towards a circular economy: A zero waste program for Europe." The EC's action plan for the circular economy had an ambitious aim: to treat waste as a resource and to turn Europe into a circular economy. While the suggested policies go far beyond the waste sector, waste sector management plays a key role in the transition to a circular economy. As such, the EC's 2015 action for a circular economy sets the current scene for a new approach to waste management in Europe. Changes on the waste management legislations were proposed by the EC in order to turn Europe into a circular economy (James Crisp, 2015).

The circular economy is an alternative to a traditional linear economy (make, use, dispose) in which resources are kept in use for as long as possible, extracting the maximum value from them whilst in use, then recovering and regenerating products and materials at the end of each service life. The circular economy aims to fundamentally change how we think about waste: treating it as a resource rather than something we just want to get rid of. Environmental organizations argue that the circular economy bears the potential for humanity to live resource efficiently while enjoying "low-carbon prosperity." A circular economy leads to clean production and sustainable consumption, which in turn contributes to saving the planet (WRAP, 2013).

The circular economy will help reduce costs related to extracting and transporting virgin resources. This will also reduce business resource costs. The significant investments necessary for creating incineration infrastructure could instead be redirected to developing re-use centers and networks, recycling infrastructure and renewable energy, all of which require more, better quality jobs than incineration and land filling. It will reduce the energy required for extraction of virgin materials and production. Processes that use secondary raw materials consume considerably less energy than manufacturing from virgin materials. Reuse of products and materials saves a considerable proportion of the resources needed to manufacture goods from virgin materials. The Circular Economy will represent a significant step towards a low-carbon, resource efficient economy, advancing towards the EU's objective for 2050. Reducing hazardous chemicals in production and in products will consequently reduce the impact on human health caused by close daily contact or from indirect exposure from emissions into the environment (WRAP, 2015).

The world's leading multinationals in waste management are also very enthusiastic about the circular economy but for very different reasons. In the circular economy, the companies can profit twice from the same material: for disposing it and for selling it as a resource to producers. The circular economy also bears an opportunity for small companies to reinforce their market position. Small companies argue that because of their long experience and expertise, they are the ones who can successfully deliver in a circular economy, as the municipalities do not reach this standard. This is especially important in light of the threat of municipality. The circular economy is also promoted by the World Economic Forum (WEF), demonstrating the increasing business interests in waste as a resource.

EC's action plan on circular economy proposed three specific changes to the regulations by including the following targets by 2030: (1) a binding landfill target to reduce landfill to a maximum of 10 per cent of municipal waste; (2) a target to prepare 65 percent of municipal waste for re-use and recycling; (3) a target to prepare 75 percent of packaging waste for re-use and recycling by 2030.

By the end of 2014, only 2,500 more people were employed in the sector in the 28 countries constituting the European Union (EU). This equates to a 1.3% increase in nearly 2 years. The circular economy has the potential to create jobs because re-use and recycling are more labor-intensive than disposal. Public participation plays a key role, especially in waste separation for recycling and reusing of useful materials, in a circular economy (Weghmann, 2017).

2.26. Recent Studies about SWM in Ethiopia

Parallel with the rapid increase in urban population (MoUDHC, 2014), many Ethiopian towns and cities are experiencing an alarming increase in the production of solid wastes. Existing solid waste management systems are suffering from many limitations and shortcomings (FMoH, 2004; Nigatu et al., 2011). While budget limitations play a part, the shortcomings have been attributed to poor community involvement, poor infrastructure, bureaucratic incompetence, and limited institutional capacity of the municipalities (Yohanis & Genemo, 2015). The case studies conducted in 12 cities of Ethiopia like Awodai, Bale Robe, Bishoftu, Woliso, Wuqro, Bure, Dilla, and Dire Dawa showed that collection services are woefully insufficient. Besides, lack of equipment and poor capacities are common in all these municipalities.

The case studies indicated that reliability and trust in the system are not established. Collection coverage ranges from 5 – 80 percent with 45 percent being the average; and the collection rate is lower ranging between 5 and 60 percent of the total waste generated, with 40 percent being the average. The absence of personal protective equipment for workers within both the formal and informal sectors is a serious and growing concern (MoUDC, 2015).

Most towns and cities in Ethiopia dump wastes in open dumpsites with little to no controls whatsoever. As the summary of recent studies on SWM in Table 2.1 below shows, the management of solid waste is generally weak and particularly suffer from poor community participation (Birhanu & Berisa, 2015; Desta et al., 2014; Erasu et al., 2018; Gedefaw, 2015; Heyi, 2018; Lemma et al., 2019; Tyagi et al., 2014; Woldetsadik, 2017) even though the government has endorsed a strategic framework to involve the community in solid waste management. This is particularly the case in emerging towns and cities where resources are

scarce, administrative capacity are weak made worse by the increasing and high rate of rural-urban migration (EPA, 2012; MoUDC, 2014). Most municipalities do not comply with the requirements set under the National Solid Waste Management Standards and have been facing increasing and major challenges with regards to solid waste collection and landfill management (MoUDC, 2015).

TABLE 2.1: SUMMARY OF RECENT STUDIES ON SWM IN ETHIOPIA

Author (s)	Research Site	Methodology	Key Findings	Recommendations
Tyagi, Fantaw, & Sharma (2014)	Debre Berhan	Both qualitative and quantitative research design	Only 25 % of the households have access to waste collection and transportation services. Recycling is not being practiced in the town	Urgent and immediate improvement in building the capacities of the municipality is necessary to meet the current demand for improved municipal waste management
Gedefaw (2015)	Gondar	Both qualitative and quantitative techniques	Even though municipality did full range of waste collection, transportation and disposal service, its coverage was only spatial. The town's solid waste management system was still poor.	There should be sustainable solid waste management systems (reuse, recycle, composting, and incineration) through awareness creation and training, improvement of SB institutional structure and capacity, and implementation of integrated MSWM recognizing and comprising all stakeholders.
Lema, Mesfun, Eshete, &Abdeta (2019)	Asalla	Community-based cross-sectional study design	The majority of the residents practiced improper solid waste management. Lack of adequate knowledge about solid waste management.	The need to enhance the awareness of the community about proper SWM and to improve the door to door solid waste collection service by the municipality.

Author (s)	Research Site	Methodology	Key Findings	Recommendations
			Lack of access to door to door solid waste collection.	
Woldetsadik (2017)	Adama	Descriptive research design.	Municipal solid waste management focused mainly on collection, transport, and disposal of wastes. Uncollected waste having negative effect on environments and health. Municipality not yet properly utilizing this opportunity to create wider awareness. Recognized that the society lack awareness Community has interest and willingness to pay for a more proper service. Challenges in maintaining hazardous wastes, recycling, composting, and disposing sites.	Allowing stakeholders to participate in SWM practices like planning, Establishing solid waste task force including waste producers and industries. Training on separation of hazardous waste from other municipal wastes. Capacity-building on SWM for municipal technicians and decision makers. Ensuring community not ignores uncollected waste becomes a factor in the spread of diseases. Importance of a Recycling Plant, Hazardous Waste Storage Depot, Composting Plant and a sufficient dumping site.
Erasu, Feye, Kiros, &Balew(2018)	Robe Bale		About 57.5% of solid waste is properly disposed to a landfill site and the remaining dumped at roadsides and open fields. Households have low levels of awareness toward solid waste management and associated problems.	Municipality must work on waste reduction measures like reducing, recycling, reusing, and composting. The municipality must deliver training to raise household awareness. Municipality must build a well-standardized landfill to control leachate and gasses outgoing from site.

Author (s)	Research Site	Methodology	Key Findings	Recommendations
Desta, Worku, &Fetene (2014)	Addis Ababa	Both quantitative and qualitative sampling methods	No sufficient budget, inadequate and malfunctioning equipment, illegal dumping on undesignated sites, open disposals, poor condition of dump site. Lack of effective public participation and inadequate governance in SWMS.	Early involvement of representatives from all concerned stakeholders in the planning process Continuous community awareness is critical elements of successful solid waste management programs.
Berhanu, &Berisa(2015)	Jijjiga	Both QUAL and QUAN survey methods	The city's SWM has low performance Insufficient funds as well as lack of promotion on-waste Improper outlook for waste workers Incompetence of organizations in terms of equipment and staff qualifications Existing open dumpsite is environmentally unsound and socially unaccepted.	Composting and land filling site selection requires special attention; Standard measures to control contamination of surface and ground water as well as air. Environmental impact assessment needed on new landfill site. Need for community based waste management system to alleviate challenges of waste.

Source: Researcher's own construction, 2019

2.27. Conceptual Framework

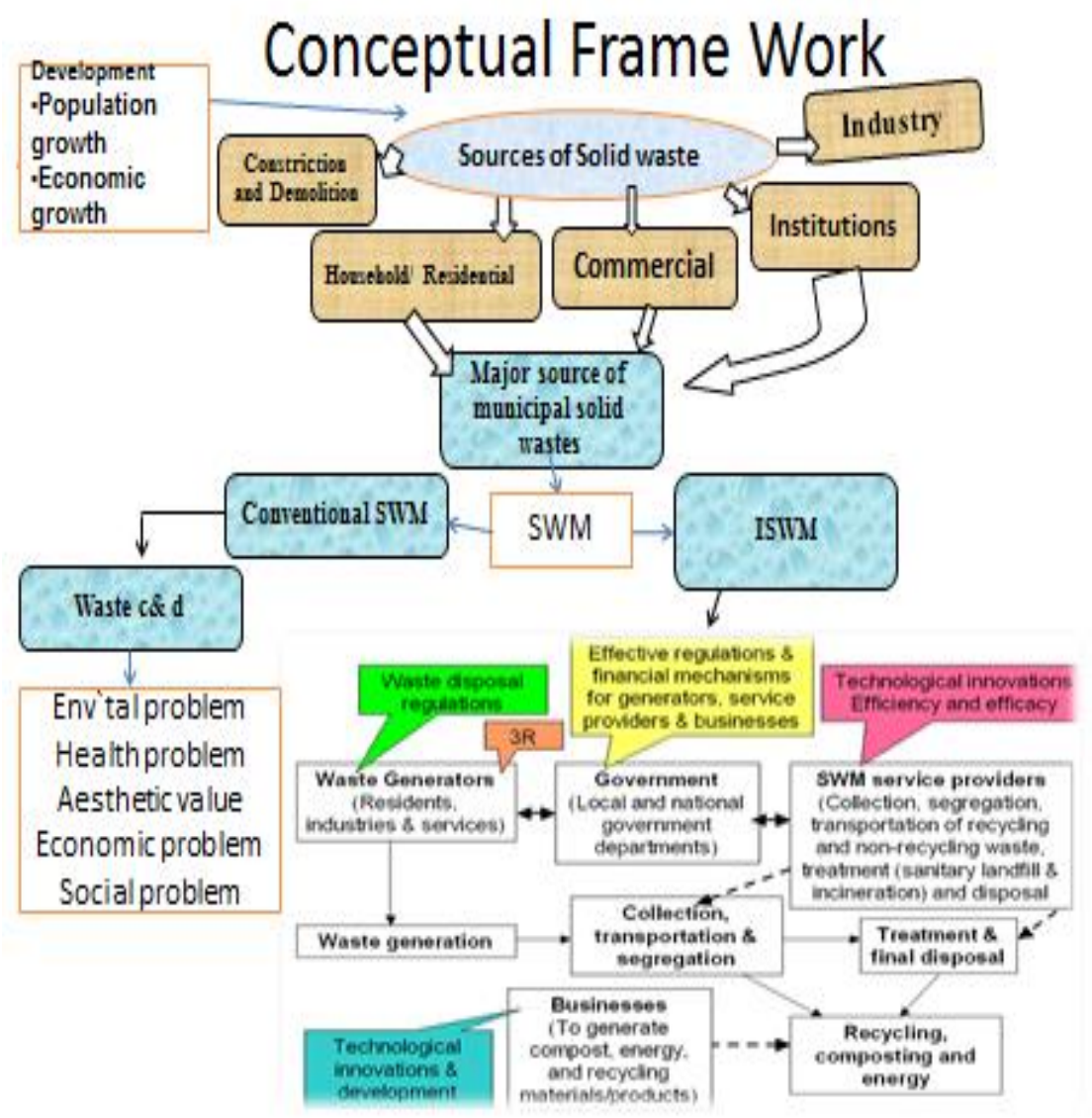
Management of Solid waste is one of the greatest challenges of cities all over the world. The problem is very serious in cities of developing countries. This is not only due to the growing impact of solid waste on the environment, the health, and aesthetic of city. More importantly, poor implementation of SWM hinders a town`s progress towards Sustainable Development. Accordingly, there is a need for more comprehensive and holistic strategies for SWM within the city or town development processes. It is vital to improve SWM for Sustainable City Development through community participation.

Accordingly, the conceptual framework of the study includes the practices of the ISWM to reduce the impact of solid waste on health, environmental, and socio-economic developments. The study does not view SWM just as a municipal responsibility. The community should also do its part since each and every individual generates waste. These two key concepts Integrated Solid Waste Management and community participation are the integral components of the conceptual framework of this study. Both are necessary for the Sustainable Development of the Lagatafo Lagadadhi town.

Figure 2.1 below shows the conceptual framework applied in the study. The figure explains the link between ISWM, environmental conservation, and Sustainable Development in a town. Further, it also shows how a growing economy and population generate Solid Waste, the cause of pollution and environmental degradation. Waste reduction, separation, recycling, and composting are key aspects of ISWM but these are not enough without the appropriate legal structure, awareness creation, attitude change, and the creation of synergy between the municipal authority and the community. The rationale behind this is that ISWM provides the most fertile

ground for environmental conservation and sustainable development. This way, the development process could improve socio-economic development, while waste management is tasked with keeping the environment allowing for sustainable development at the end.

Figure 2.1: Conceptual Framework



Source: Adapted from UNEP, 2009

CHAPTER THREE

3. RESEARCH METHODOLOGY

This chapter of the manuscript presents description of the study area, philosophical claim, study methodologies such research method and design, paradigms, population, sample, sample size and sampling techniques, data collection instrument and analysis method

3.1. Descriptions of the Study Area

This study investigates how solid waste is being managed in the Lagatafo Lagadadhi town through community participation. It is important to discuss the particulars of the study area, the Lagatafo Lagadadhi town; its history, location, its climate and topography, its population, and its socio-economic characteristics, before developing into the research methodology employed.

3.1.1. History of the Town

The current area of the town was originally the settlement of farmers, that was called Kebele Gebere Mahiber (peasant association), under the administration of the Oromia National Regional State, North Shewa Administrative Zone, Berek Woreda). Oral sources demonstrate that the town`s name derived from the names of the two rivers crossing the area: The Lagatafo river and the Lagadadi rivers. In Lagatafo settlement areas (formerly village) a wide range of investment activities began to flourish that finally gave rise to the birth of the Lagatafo town. The Lagatafo village was later combined with Lagadadi town paving the way for the emergence of the new town Administration referred to as Lagatafo Lagadadhi 2006.

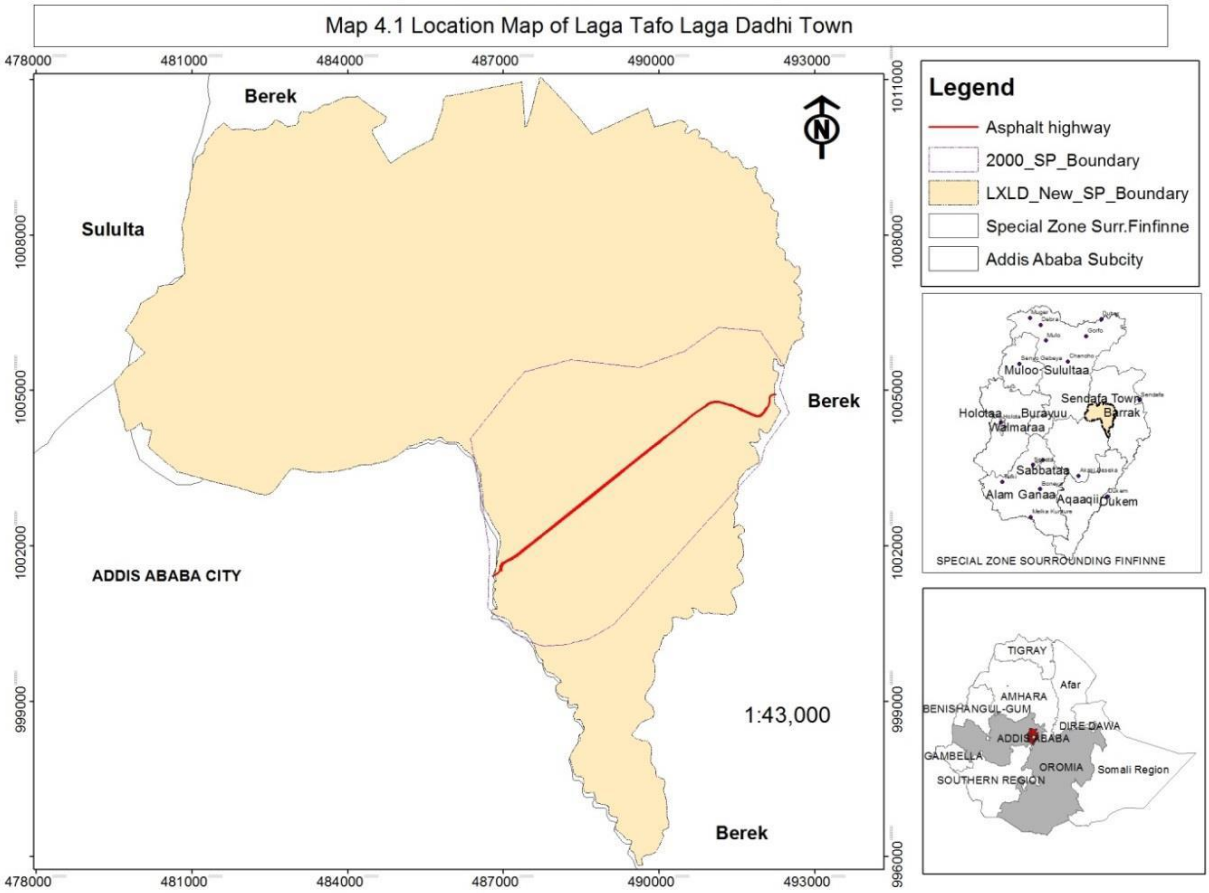
On the other hand, Lagadadi is claimed to have received its name from two Afaan Oromo local vernacular words: Lege means river, and Daadhi represents a drink made of honey (locally

called tej or mead). During the old times, people proceeded to the war front carrying Dadi (locally called tej) in a pot; sadly, while crossing the stream, the Daadhii (locally called tej) pot fell into the river and was broken upon which it modified the color of the river into yellow-the natural color of the tej. That is how the river reportedly got its name, Lege daadhii (Lagadadi). The people settled nearby Lege (the river) used to call their settlement as Lagadadhi. (Lagatafo Lagadadhi town, 2019). Lagatafo Lagadadhi town was recognized as one of the urban administrations within the Oromia Special Zone bordering Addis Ababa, the capital of Ethiopia. It is ranked as second "A" level (Higher Level) town administration by Oromia National Regional State towns and Cities Ranking Proclamation No. 65/ 2016.

3.1.2. Location of the Study

Geographically, Lagatafo Lagadadhi town Administration is a Town in Finfinne Special Zone of Oromia National Regional State of Ethiopia. The Town is located 21 Km away from Addis Ababa to the North East on the main road leading to Dessie Town of the Amhara National Regional State. Astronomically, it is located between 350 51' 0''and 350 56' 30'' North Latitudes and between 90 05' 0" and 90 80' 0" East Longitudes. In terms of relative location, Addis Ababa and Sululta Wereda (District) border the Town in the West. Berek Wereda surrounds the North, East, and South areas of the Town. Currently, the Town is divided into four Kebeles namely: Lagatafo 01, Lagadadi 02, Ekkadalle 03, and Dembel 04 covering a total area of 10,056 hectares of land (Lagatafo LagadadhiTown, 2018).

Figure 3.1: Map of Lagatafo Lagadadhi Town



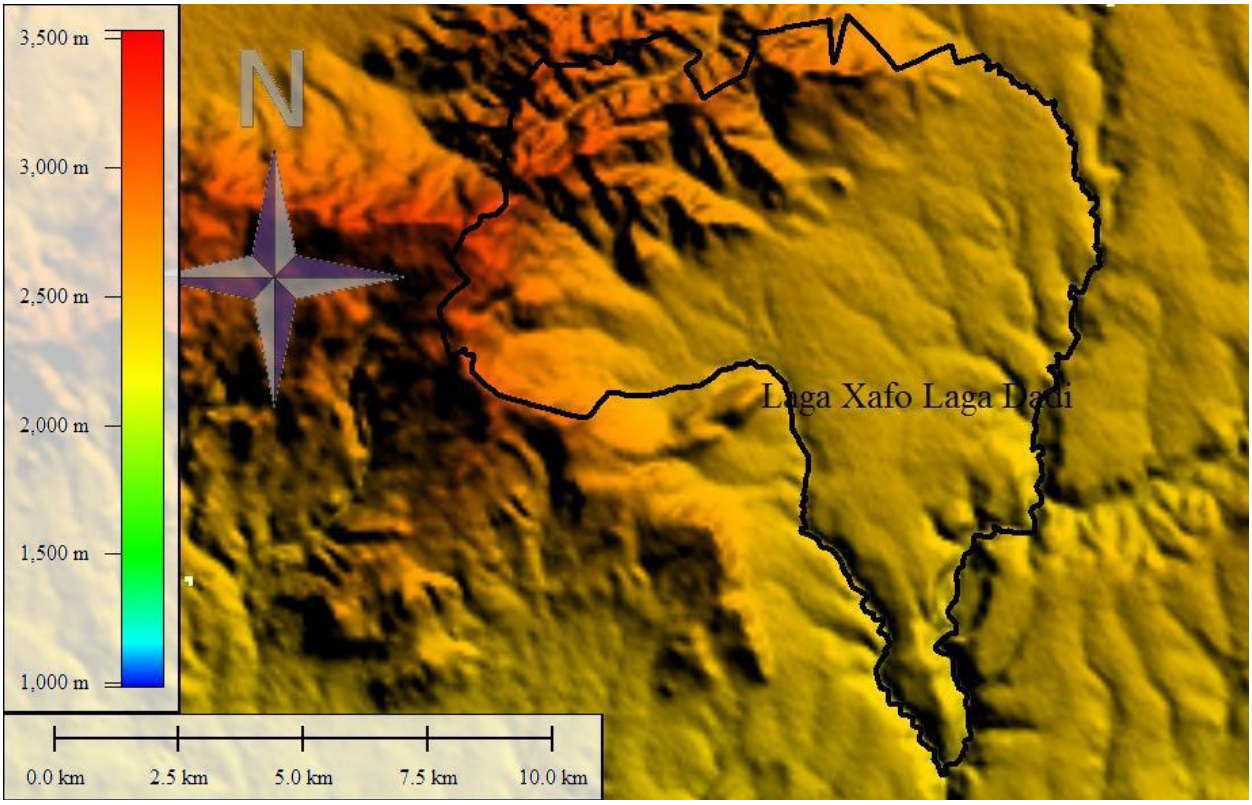
Source: Lagatafo LagadadhiTown Administration, 2017

3.1.3. Topography and Climatic Condition

Laga Tafo Laga Dadhi town mainly lies on plateau landscape within this landscape there are also gullies, streams, and river. The elevation ranges from 2,248 to 3,192 meters above sea level (m.a.s.l). The lowest and highest point is located at south and northwest part of the town respectively. The Town is situated near two major permanent rivers: The Lagatafo River and the Lagadadi River. The climatic condition of the Town is moderately warm (often between 23^{o}C and10^{o}C), which is suitable for living. The mean

annual rainfall is about 1,223.54 millimeter and the highest rainfall occurs during the Belg (Autumn) season (from December to February) and the main rain season, Kiremt (Summer) lasting from June to August. The mean monthly relative humidity as adopted from Ethiopian Meteorological Agency varies from 68.23 percent in August to 38.73 percent in December, which is comfortable for habitation.

Figure: 3. 2 Satellite Map of Lagatafo Lagadadhi Town



Source: Oromia Planning Institute, 2017

3.1.4. Population

The 2007 Ethiopian census report showed that the projected population of the Lagatafo Lagadadhi was 22,868 (CSA, 2007). However, the Oromia Regional Planning Institute (2016)

showed that the population has increased to 52,054 making the town one of the fastest growing in the country. The number of households is estimated to be 10,411 with each household comprising five family members on average. By taking the CSA's exponential method of population projection, considering the 2016 population size as a baseline (52,054) and with the Oromia Region population growth rate of 3.8 percent per year, the Town`s population is projected to be about 58,512 with 11,702 households by 2025. The projection of the solid waste generation rate of the Town by 2025 will therefore be estimated to be 23,989.92 kilogram per day (0.41 cap/day times 58,702).

3.1.5. Socio-economic Characteristics of the Residents of the Town

While the Oromo ethnic group constitutes the majority of the population, Lagatafo Lagadadhi town is the abode of various Nations, Nationalities, and Peoples. Most of the residents of the Town are engaged in different economic activities, including government and nongovernment jobs and in a wide range of privately-owned industries. The town is home to many small-scale industries, be it in the manufacturing or service sector, and large and small business activities. Agriculture is also the predominant economic activity on the outskirt of the Town.

The Town's economy is primarily based on merchandize trade in which the majority of people are engaged. Besides, Micro and Small-Scale Enterprises and factories are contributing their parts in supplementing the livelihood of a significant number of the dwellers. Two pioneering real estate projects, Ropak International and the CCD Village have been instrumental in bringing with them some big name in business and society greatly enhancing the profile and desirability of the town. The two real estates have also created jobs for thousands of youngsters.

However, the town is poorly planned. Most modern buildings are concentrated along the main thoroughfare. Houses on either side of this road are highly congested together. The town has one of the poorest solid waste management systems, which has imposed great strain on the socio-economic development endeavors of the Town, not to mention the psychological discomfort to the habitants, investors, and tourists (Lagatafo Lagadadhi Town, 2019).

3.1.5.1. Mining and Industry

It is commonly known that minerals play a vital role in the economic and social development of any country. Minerals are among the non-renewable resources that need careful exploitation. Their sustainable utilization is important if one were to serve the current as well as the future generation. The main type of minerals found in Lagatafo Lagadadhi town is the basalt rock that is used for buildings, asphalt, and gravel road, and cobblestone road construction. The basalt rock is also used for the production of traditional pots in the Town. There are no known reports of mining for any precious metals. And the mining for these base minerals is largely small-sale and survival type.

The many small-scale industries that are registered to operate in the town are mainly engaged in urban agriculture, basalt rock mining, catering, animal fattening, etc. A few large-scale industries like real estates, manufacturing industries, agro-processing industries, commercial, hotel, and tourism are also operating in the Town (Lagatafo Lagadadhi Town, 2019).

3.1.5.2. Health Facilities

The WHO (2015) reported that Ethiopia has brought remarkable achievements in the health sector and met the target set out by the Millennium Development Goals (MDGs) on child health

over the last decade and a half. The report verified that Ethiopia reduced the infant mortality rate and the under-five child mortality rate by 42 percent and 47 percent, respectively. However, the effort in the reduction of maternal mortality rate in the country has not shown a lot of progress. The Ethiopian Ministry of Health (2016) indicated that the government implemented five years of health sector development programs aligned with international commitments such as the MDGs and the country`s Growth and Transformation Plan to accelerate growth to end poverty and induce sustainable growth. To this end, the government introduced human resources reforms to improve the capabilities of existing health care personnel and the expansion of health facilities which resulted in a major increase of health personnel supplemented by health extension workers. Still, Ethiopia is ranked the lowest among Sub-Sahara African countries in terms of the density of health care personnel indicating 11 health care personnel per 10,000 population by 2015 (FMoH, 2015).

The presence or absences of health facilities are critical for any town. The health status of a country's/town's population has a great share in determining the quality of its manpower. This is because an unhealthy community cannot be productive by any means and rather it becomes a burden on others. The abundanceand density of health institutions, their distribution, and the number, as well as the quality of the workers in these institutions, are some of the main factors that influence the health condition of the community and thereby affecting its overall development. In the context of Lagatafo Lagadadhi Town, as it shown in Table 3.1 below there are two government owned health centers, nine private clinics, and ten drug stores (Lagatafo Lagadadhi Town, 2019). There is no hospital to date.

Table 3.1: Number of Government and Privately-Owned Health Institutions in Lagatafo Lagadadhi Town

No	Health Institutions	Number of Government institutions	Number of Private institutions	Total
1	Health post	0	0	0
2	Health center	2	0	2
3	Clinic	0	20	20
4	Hospital	0	0	0
5	Pharmacy	2	9	11
Total		**4**	**29**	**33**

Source: Lagatafo Lagadadhi Health Office, 2019

3.1.5.3. Education Facilities

Ethiopia`s education has been expanded rapidly since the change of regime in 1991. The net enrollment rate in primary, secondary, and tertiary levels has shown dramatic progress (Stefan, 2018). Currently, the education system has enrollment over 25 million learners from what had been 10 million learners a decade ago (www.global partnership.org/Ethiopia, browsed on January 14, 2020). The government designed a sector plan for 2015/16-2019/20, the Education Sector Development program whose objective is to expand quality and equitable general education, establish technical and vocational education, and training institutes, and providing lifelong learning opportunities in all Woredas (Districts) of Ethiopia (www.global partnership.org/Ethiopia, browsed on January 14, 2020).

However, in spite of the changes witnessed in the last two decades and a half, Ethiopia is the least among the least developed countries in key education indicators. For instance, Ethiopia`s

adult literacy rate is only 39 percent in 2012, the lowest in the world and far below the average adult literacy rate of the least developed countries which is 77 percent. Thus, offering quality education in the country at all levels is a serious problem facing the government (Stefan, 2018). Improving primary, secondary and tertiary enrollments one thing since access to education is indispensable for development. To meet this need, the town has scores of public and private schools. Consequently, as shown in Table 3.2 below, the number of children, youth, and adult learners is increasing from time to time. However, it is worth noting here that the town as well as the country has a long way to go to provide access to high quality education.

Table 3.2: Number of Public and Private Schools in Lagatafo Lagadadhi Town

No	Type	Number of Government Institutions	Number of Private Institutions	Total
1	Special Needs	-	-	-
2	Kindergarten	5	34	39
3	Primary (1-4)	2	6	8
4	Primary (1-8)	6	22	28
5	Secondary (9-10)	2	1	3
6	Preparatory (11-12)	1	1	2
7	TVET College	1	-	1
8	College	0	2	2
9	University	0	1	1
Total	**17**	**17**	**67**	**84**

Source: Lagatafo Lagadadhi Education Office, 2019

3.1.6. Provision of Utilities in the Town

The International Labour Organization (ILO) stated that utilities such as water, electricity, and gas play a vital role in improving the prospects for economic and social development. The provision of quality utilities is a precondition to combat poverty and improve the quality of life. It is the responsibility of governments to ensure universal access of such utilities under

regulatory frameworks (www.ilo.org, browsed on January 14, 2020). The town of Lagatafo Lagadadhi does have access to the country's hydroelectric power supply even though the question of reliable power supply is still a long promise than a reality.

The Town is also supplied with potable water (piped water). However, the potable water supply is inadequate given the rapid population increase in the Town, the growing number of hotels and tourism services (Lagatafo Lagadadhi Town, 2019).

3.1.7. Environmental Protection in the Town

Environmental protection is becoming a pressing concern of individuals, organizations, and governments across the world. The environment should be safeguarded from various reckless activities of human beings. The actions orchestrated by human beings are creating pollutions (air, water, and land) causing loss of biodiversity, the emergence of invasive species, and the release of methane gas (CH4) and toxic substances among many other things.

Reckless human activity has rendered our ecosystem so fragile as to place life itself on the balance. The excessive misuse of natural resources, their imprudent use by human beings, and the resulting environmental degradation have been posing formidable challenges to the fragile ecosystem. Therefore, the protection of the environment is indispensable not only for human wellbeing but also for sustainable development. Excessive exploitation of natural resources creates a danger to the environment and human survival (Environmental Protection Law, 2008).

In Ethiopia, the government has given due attention to protecting the environment from all forms of threats posed by human activities. These actions of the government are multi-faceted ranging from adopting and ratifying environmental protection policies and subsequent legal frameworks, and the implementation of climate resilient programs and projects. In principle, all

the development activities carried out in the country should be linked with environmental protection (EPA, 2010).

However, the implementation seriously lags behind the legal provisions. Moreover, the government, be it at the Federal, State, Municipality and Local government levels, is yet to develop the necessary institutional, regulatory, and human resource framework to ensure adequate protection of the environment. This is crucial, since the country still relies heavily on rain-fed traditional agriculture and the protection of its fragile environment is a matter of life and death. Similarly, all economic activities being undertaken in Lagatafo Lagadadhi Town are supposed to be eco-friendly. The Environmental Protection Office is tasked to ensure that this is the case. Robust action by the attempts to regulate activities conducted in the Town need to be upgraded, coordinated with pertinent stakeholders, consolidated, restructured and organized to the extent of reversing the ongoing depletion of the Town`s environment (Lagatafo Lagadadhi Town, 2019). This Office is important has given the low-level of environmental awareness in the country.

3.2. Research Design

In this study, both quantitative and qualitative data have been used. It specifically followed what is called a convergent design in which "the qualitative and quantitative data are collected more or less simultaneously; both data sets are analyzed and the results are compared" (Merriam & Tisdell, 2016, p. 45) as shown in the pictorial diagram below. This also corresponds to what Bryman describes as a Cross-sectional research design that aims at getting data from multiple cases at a given point in time to analyze relationships across a number of variables of interest (Bryman, 2004). The study followed this design because its quantification characteristic helps in

consistent benchmarking (Bryman, 2004). However, cross-sectional studies usually lack internal validity (Bryman, 2004) and the researcher tried to respond to this concern through the qualitative component. The quantitative portion of the study employed a descriptive survey that helps to describe the phenomena as accurately and thoroughly as possible (Blanche et al., 2006). In this study, therefore, qualitative data have been used to enrich the descriptions generated by and from the quantitative data so as to build a clear picture of the state of solid waste management in the study area.

3.3. Research Approach

This study inquires how solid waste is being managed in the Lagatafo Lagadadhi town through community participation. To achieve this, the study employed a mixed-method research approach, which integrates a wide variety of quantitative and qualitative methods and data to gain a greater and deeper understanding about the problem under consideration. Criswell and Criswell (2018) defined the mixed-method as follows:

Mixed methods research is an approach to inquiry involving collecting both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks. The core assumption of this form of inquiry is that the integration of qualitative and quantitative data yields additional insight beyond the information provided by either the quantitative or qualitative data alone. (p. 44).

While the adoption of a mixed-method research design is aimed at creating a fairly sufficient opportunity to collect different types of data in order to adequately answer the research questions. Synthesizing the finds from the quantitative and qualitative methods and data in an

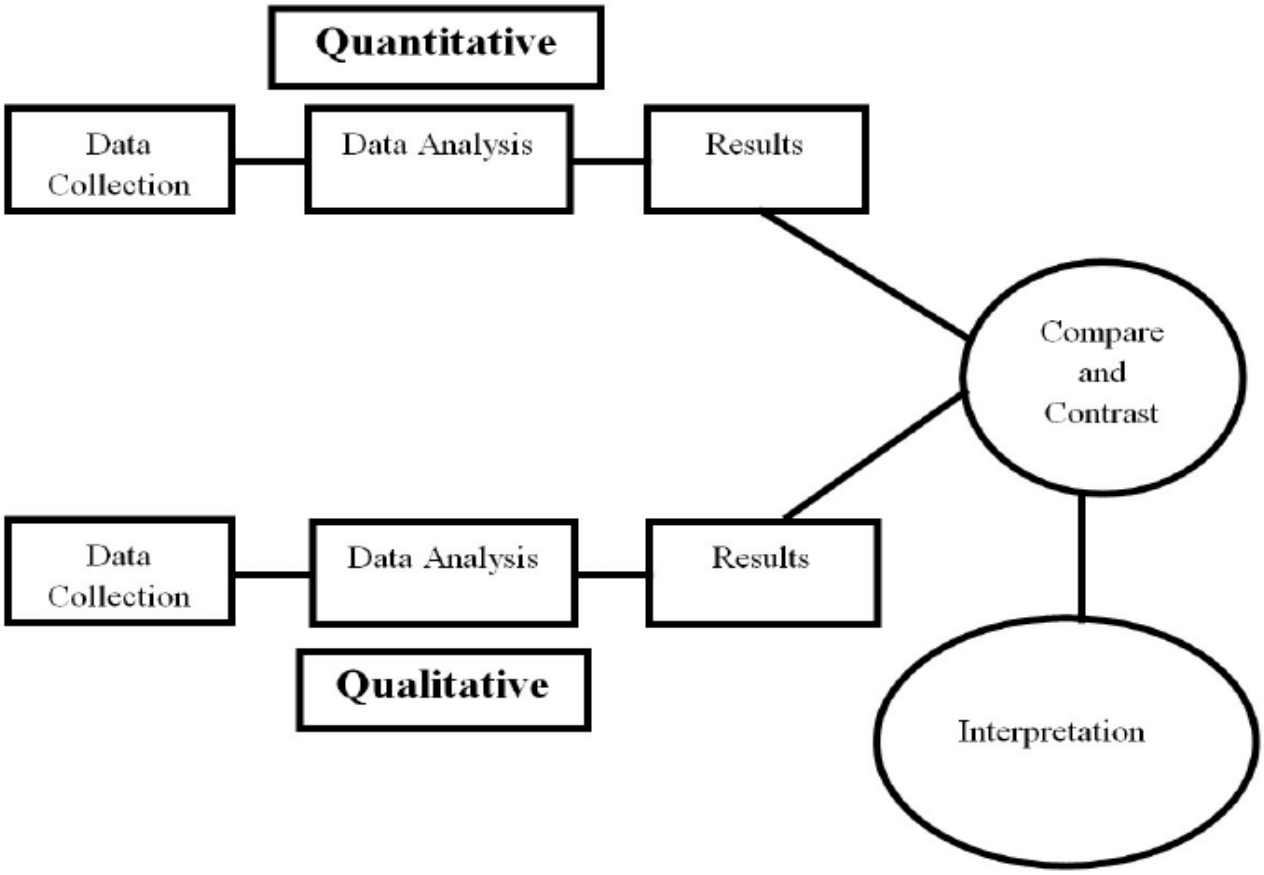
integrated manner improves the quality and rigor of the inferences drawn from the findings (Bergman, 2008).

No research study is free from being influenced by some deeply-held philosophical assumptions. This philosophical assumption mainly pertains to the nature of reality (ontology) and the nature of human knowledge (epistemology). The researcher, rather than bogging down with a fixed and inflexible view of reality or knowledge, takes a Pragmatist stance in this study. As such, the main concern is what works under the specific circumstances and hence the need to utilize all approaches not only to understand but also to solve the problem (Creswell & Creswell, 2018, p. 51; Hesse-Biber & Johnson, 2015) so as to make "a difference in people's lives" (Merriam & Tisdell, 2016, p. 1). The goal behind the use of a mixed method approach was therefore to enable the researcher to be able to look at the phenomenon from multiple angles so as to gain a better understanding of the problem that was being considered in its complexity and totality (Leedy & Ormrod, 2005). This allowed the researcher to gain a clearer grasp of the phenomenon under consideration and to interpret the people's lived experiences in light of the related social context and the concepts and theories reviewed in the literature.

The study also applied aspects of phenomenology (Merriam & Tisdell, 2016, p. 26) to guide data collection and analysis in the qualitative portions of the study by exploring the beliefs and perceptions of the community regarding integrated solid waste management in the Town. Moreover, this study is an applied social science research where its "problems arise from issues, difficulties, and current practices in real-life situations" (Creswell & Creswell, 2018, p. 188). A mixed-method lends itself better to applied research (Ladner, 2019). The intention of the study is therefore to draw findings from the particular context under study so that the conclusions so

drawn will inform decision-making by the municipal administration of the Lagatafo Lagadadhi town.

Figure 3.3: A Convergent Mixed-Method Research Design



Source: Organized by Researcher, 2019

3.4. Data Sources and Types

The data sources for the research study were from both primary and secondary sources. The primary data was collected from households, key informants, focus group participants, and concerned government officials at different levels. These were supported and complemented by additional data drawn from direct observation by the researcher while visiting the study sites.

The secondary sources reviewed included published articles, research works, previous studies, books, government reports from the federal and regional offices, reports of municipal administration offices, and the Central Statistical Agency and other sources. In addition to these, both qualitative and quantitative data have been collected through data collection instruments used for the research.

3.5. Data Collection Tools

To collect data, the study used key informant interview, document review, observation, Focus Group Discussions, questionnaires, and non-participatory observations. Depending on the kind of data, the researcher used the most appropriate data collection method to get the data from the different respondents.

3.5.1. Document Review

Secondary data was gathered through the review of annual and quarterly reports, proclamations, relevant articles, research works, and books. The use of this data collection method was necessary to bolster the reliability of the findings of the study because document review is non-reactive since documents cannot be influenced by the fact that they were used (Robson, 2002). Organizations as well as governments and in this case local government, produce many documents. Indeed, the researcher was able to gain access to several documents: annual reports; survey reports; planning documents; and other relevant documents of the Town Administration. These documents were rich with both quantitative and qualitative data. The researcher requested for permission for access to these documents and the review were done after being granted permission from those concerned and duly authorized to give permission.

3.5.2. Survey Questionnaire

The structured questionnaires prepared for the household survey included open-ended and close-ended questions. The questionnaire had three parts, namely: The first part dealing with the demography of the respondents, the second part dealing with the perceptions and beliefs of the respondents on the solid waste management system being practiced in the town, and the third items regarding community participation in this effort. The questionnaire was first designed in English and later translated into Afaan Oromo and Amharic languages with the help of enumerators. The response formats for close-ended items contained multiple choices, dichotomy, and a five-points rating scale ranging from very low to very high.

3.5.2.1. The Reliability and Validity of the Questionnaire

Based on the purpose of the study, the researcher reviewed various related and relevant literature and searched different websites looking for existing instruments. However, the researcher could not come across any instruments that could accurately measure the variables of interest. As a result, modification of an existing instrument or using it in its original form was not available as an option. Hence, it needs to develop a new instrument. Development of an instrument passed through four basic procedures such as planning, developing, constructing, evaluating, and checking the questions whether they would work or not to achieve the desired purpose (Creswell & Creswell, 2018). Accordingly, the researcher identified the variables to be measured given the objectives to be achieved. Based on a review of literature, the researcher constructed the survey questions and tested the items.

During the planning phase, the researcher reviewed enormous related literature to gain insights on both content and methodological matters, including the appropriateness of the item formats and the main components of questionnaires, including the demographic profile of survey participants. The researcher then went on to develop a three-part survey questionnaire. The questionnaires contained both closed-ended and open-ended questions, a rating scale, and prioritization. During the second stage, the researcher tried to assess whether the instrument could be used to collect the data necessary to answer the research questions.

The content validity of instrument was then evaluated by language professionals such as English teachers, professionals of SWM, and finally by the study's principal advisor. Afterwards, each item was linked to the research questions and re-arranged from simple to complex. As a result of this process, certain improvements were made such as replacements of ambiguous and unclear terms. The language experts helped in correcting grammatical errors. The SWM experts consulted not only evaluated the compatibility and capability of the items to collect data sufficient to answer the research questions but also the linkages. Their input resulted in modifying and reshuffling some of the items. During the effort to synchronize the items with the research questions, some items were omitted and others were replaced. For instance, from Part II of the questionnaires item numbers 14 and 15 which requested role and prioritization of activities carried out by different stakeholders were omitted because most of the respondents in the pilot study did not understand and appropriately react on them. At the end, the revised instrument was made ready for quantitative evaluation.

On the third stage, the researcher administered the revised survey instrument to sixty respondents out of the main sample. This enabled the researcher to calculate the internal consistency and reliability of the items using Cronbach alpha and analyze the result. The Cronbach alpha (α) value obtained for the key items, collaboration of society, community participation, organizational structure, and empowerments were .82, .71, .72, and .84, respectively. The overall reliability test based on Cronbach alpha (α) resulted in a value of (α=.89). George and Millery (2003) advised following a simple rule of thumb making judgment on the reliability question. He stated that alpha values>.9 can be viewed as excellent, >.8 as good, >.7 as acceptable, >.6 as questionable, and >.5 as poor. The overall status of item consistency for the survey instrument used in this study lied within good range (.89). At the fourth stage of instrument development, having tried to confirm its validity and reliability, the researcher was ready for duplication. At the end, the researcher added the cover papers that contained information about the instrument such as the purpose the study, the main components of the questionnaire, and assurance for the confidentiality and privacy of respondents.

3.5.2.2. Actual Conduct of Data Collection using the Survey

The purpose of the survey was, among other things, essentially to measure the quantity, composition, and density of solid waste generated. The survey was administered after a comprehensive field assessment of the solid waste management in August, 2018. Later on, the researcher identified a segregation site used by the municipality. The researcher hired data collectors at Laga dadhi temporary dumping site. The actual data collection, measurement, and segregation of solid waste into their categories were conducted by tenth and twelfth grade complete students forming four groups within each of the four kebeles. In addition, the

researcher coordinated and supervised the activities by the hired individuals at the collection and segregation sites double-checking the measurement of the solid waste collected from residential households and non-residential facilities. The solid waste collected from each participant household was categorized, measured for generation rate and density the successive seven days except for governmental institutions and healthcare facilities. The collected and measured solid wastes were transported to the temporary dumping site for segregation and further measurements for density. The data collectors measured and sorted the waste on a regular schedule, which was every day from 7:00 am-4:00 pm according to the work plan with replacement of bags of the same size for the next day measurement. They also identified and coded the residential household versus non-residential wastes.

To make sure that the SWM baseline survey results were accurate and realistic, different strategies and procedures were employed. First, only the most outstanding students from grades 12^{th} and 10^{th} complete were selected from secondary and preparatory schools. After that, the researcher prepared data collection data sheet with a simple format and trained data collectors/surveyors on the purpose, procedures, the overall plan of the study, and their roles and activities for the two days. While the first day was for oral training, the next day was to practice on some selected sample households. The surveyors were organized into four teams, each team having at least two members. Three greenery and beatification team experts volunteered to supervise the surveyors to make sure that they followed proper protocol in doing their jobs. Moreover, these volunteer supervisors helped introduce the surveyors to households for their cooperation. The researcher coordinated the works of both the surveyors and the supervisors providing necessary inputs and guidance as required.

Before data were actually collected, getting the permission of the participants was a fundamental activity. To this effect, the researcher asked the greenery and beautification team coordinator of the municipality if he was kind enough to communicate with the managers of the kebeles to secure the permission of residential households and non-residential owners. Whenever, this approach was found to not produce the required sample, the researcher talked directly with the respondents and secured their consent. The actual selection of participants was done randomly through a 'random walk' door to door with the coordinator and facilitator from kebeles to obtain the required sample.

The survey covered 72 households, 1 real estate of 20 households, 19 hotels and restaurants, 15 other business entities, 5 government institutions; and 5 healthcare facilities. During the survey, each participant was briefed about the objective of the study, activities to be carried out, and what is required of them if they chose to take part in the study. Finally, the survey assessment team collected data from consenting households, real estate residents, hotel and restaurants, other business entities, government institutions and healthcare facilities identifying the generation rate as well as the composition and density of solid wastes they generated. The only role of each participant was to collect solid waste in the plastic bag provided for them on a daily basis during the duration of the survey.

3.5.3. Field Observation

A structured observation tends to be systematic, focused, and aimed at allowing the researcher to generate measurable data from the effort (Cohen, Manion& Morrison, 2000). This being a study that is partly dependent on a survey, the hypothesis is that the behavior of the respondents was most likely inferred. Direct observation of people's behavior was done to check

the accuracy of their responses to the survey questions (Bryman, 2004). Structured observation is particularly used with the help of an observation schedule as a data collection tool (Bryman, 2004).

To make the observation as unobtrusive as possible, and thus as non-participatory, the observation was done in a non-reactive and in a more informal way (Beuving & de Vries, 2015; Leedy & Ormrod, 2005; Robson, 2002). All care and precaution were made to ensure that this process was as natural as possible so as to "avoid creating a formal research setting" (Beuving & de Vries, 2015, p. 79). This is the kind of observation in which one "makes no effort whatsoever to manipulate variables or to control the activities of individuals, but simply observes and records what happens as things naturally occur" (Fraenkel & Wallen, 2009, p. 442). Rather than put himself in the fray, the researcher obtrusively observed residents, traders, market vendors and the like, to supplement and enrich the data gleaned from other data collection methods. While the researcher maintained an open-minded, emphatic, and respectful demeanor towards participants, the observation was conducted without necessarily going native (Creswell & Creswell, 2018) and consistently keeping the professional distance necessary not to compromise the quality of inferences and conclusions made. The insights gained from these observations were highly valuable in shaping the findings of the study and also in validating it.

3.5.4. Structured Interview

Structured interview, also referred to as standardized interview, is one of the methods of collecting data in a survey research (Bryman, 2004; Cohen, Manion & Morrison, 2000). In this study, face-to face structured interviews were used in place of a self-completion of survey

questionnaires. The reason for this choice was that the researcher anticipated that the literacy levels of the potential respondents would vary. Not all the potential respondents possessed literacy mastering the skill of reading, comprehending, and writing. Because looking specifically to respondents who possessed those skills would have introduced an unacceptable level of subjectivity to the study, the researcher rather conducted face-to-face structured interviews. Face-to-face structured interviews have been preferred also for "standardization of both the asking of questions and the recording of answers" (Bryman, 2004, p. 110). Since the interview instrument had been translated into local languages, it was deemed easier to ask the respondents face-to-face than leaving them to write the answers themselves. Accordingly, a structured interview method was used to collect data from residents, traders, and market vendors.

3.5.5. Focus Groups Discussion

Focus group discussions were conducted with individuals (both experts as well as household heads) purposely selected from different sectors. Focus groups are basically group interviews (Leedy & Ormrod, 2005). However, focus groups can be differentiated from group interviews. According to Bryman (2004), while focus groups concentrate on a particular theme, group interviews may take on a wider span, and it helps save time by interviewing a number of people simultaneously. He continued to note that the purpose of focus groups is to understand how people discuss an issue as members of a group.

In the focus group discussions, extra attention was placed on how participants interacted with each other than with the interviewer. Accordingly, the data on Community Participation in Solid Waste Management emerged from the interaction of the participants with each other during the session (Cohen, Manion& Morrison, 2000). In this study, the focus groups comprised

different categories of people, including those who engage privately and individually or collectively in solid waste collection from residences, markets, and trading centers. It was intended to complement the qualitative data that had been collected through the semi-structured interview method.

3.6. Sampling

Cohen, Manion, and Morrison (2000) argue that a sample size is dictated by the type of research technique chosen and the purpose of the study. In a survey study, there is a need for a representative sample of the population for generalizability of the study findings, while in a phenomenological study; the sample will be usually smaller given the large amount of qualitative data that can be collected from a few individuals. Consequently, since this study was a combination of both quantitative and qualitative techniques, the samples varied and were not necessarily representative of the population compared to one which is expected in a pure survey study.

3.7. Sample Size Determination

In any survey, sample size determination is an important step. The size of the samples depends primarily on the cost versus its utility. For higher statistical accuracy and confidence levels, the number of samples will be larger. There are statistical procedures to calculate the correct sample size at each confidence level. Usually for solid waste data, the confidence level is set at 80% or 90% (Cacadia, 2003). In this study, the assessment was done at a 95% confidence level, thus with the allowable standard error of 0.05.

According to OUPI (2016) and the annual report of the Municipal Administration of Laga-tafo and Lagadadi (2018), the total population of the Town is around 52,054. In addition, it is important to take into account the number of households. There are around 10411 households in the Town. The study considered the number of households rather than the total population or the individual residents as the unit of analysis for the study.

The study therefore used household analysis to measure the daily waste generation and disposal rate per day of the households rather than taking individual residents as a unit of analysis. As things stand today, it was very difficult to measure the waste generation and disposal rate per individual as solid waste is managed at the household level. Hence, the study considered each household as its unit of analysis and made households the source of data collection through the questionnaire.

The study therefore considered households living in the Town as the primary source of information for the survey research. Therefore, the population frame is 10411 households who have been living in the Town. In determining the representative sample size for the study, the researcher used two categories of sampling formulas.

The first formula, which is used in the study, is the one proposed by Krejcie and Morgan (1970, p. 610) for determining needed sample size in research when the population is known. The formula is stated as:

Formula 1: $$S = \frac{X^2 NP(1-P)}{D^2(N-1)+X^2 P(1-p)}$$

Where: S = required sample size; X^2= the table value of chi-square for 1 degree of freedom at 0.05 confidence level (3.841); N = the population size; P = the population proportion (assumed

to be 0.50 as this would provide the maximum sample size); and d = the degree of accuracy expressed as a proportion (.05).

Accordingly, using the above sampling formula, a total of 368 households were selected as a representative sample of the population. Moreover, to further ensure that the sample size determined is representative of the population, an additional sampling formula was applied. The second formula considered in the study is the one proposed by Cochran (1977) as a finite population correction to determine the final sample that turns out to be 5% or more of the total population. The formula can be stated as:

Formula 2: $n1 = \frac{S}{1+\frac{S}{N}}$

Where: S = is desired sample size; n1= is the new value for the sample size adjusted using Cochran's population correction formula; N = is the total number of the population from which 'n' is being drawn.

This formula generated a sample of 348 households, which turned out to be 5% or more of the total population. Finally, the following formula used to adjust the sample size for non-response.

Final sample size= $\frac{Effectivesample}{1-non-responserateanticipated} = \frac{348}{1-10\%} = 384$

Accordingly, the formula used to account for non-response yielded a sample of 384 respondents drawn proportionally from both residential households and non-residential entities of Kebeles of the Town. In addition, 35 Commercial centers, 5 government institutions, and 5

health facilities (health center and clinics) were included in the study. Such a limited sample size was justified given the financial, time, and effort constraints (Cohen, Manion& Morrison, 2000).

3.8. Sampling Procedure

A purposive sampling technique was used to draw samples from the four *Kebeles*[1] of the Town Administration. This enabled the researcher to assess the opinion of residents living in the different *Kebeles*, having various demographic characteristics like occupation, income, gender, and the like and also to consider how solid waste management was being conducted at the local and neighborhood levels and to see whether each Kebele followed the same or different organizational structures to manage solid waste.

The procedure for reaching the individual respondents or households selected for sampling was based on a convenience sampling technique. It was not deemed viable to choose the sample by random sampling, because the Town Administration did not have population and households' database or list of all the residents, traders, and market venders. Even if such a data base or list existed, the fast pace and huge infusion of new residents into the Town would have made it obsolete and useless. Hence, the researcher was forced to select four influential residents along with additional four experts of the Town Administration to fill the questionnaires through a convenience sampling method Administration to choose the households which would fill the questionnaires. It is worth noting here that this non-random (non-probability) sampling technique has its limitations chiefly in making generalizations about the findings of the study to wider populations (Abowitz & Toole, 2015). The good news is that to generalize is not the purpose of this study but rather to describe, understand, and explain the phenomenon under investigation

[1] Kebele is the lowest administrative body of towns in the organization structure of Ethiopia.

which is solid waste management in Lagatafo Lagadadhi town within the context of community participation.

The structured and semi-structured interviews were conducted with key informants, like greenery and sanitation experts and team leaders, members of the SME community, the vulnerable community groups around the dumping sites and others. Even though any household could participate in the study, their access to information about SWM in the Town Administration could not be assumed to be uniform. In addition, out of concern that some of them may refuse participation out right, while others rescued themselves out of fear or shyness, or yet others might not have the required information, the researcher did not have any other choice other than following a convenience sampling method.

The sample for participation in the focus group discussions were selected based on their position, placement, and the sector they were engaged in at the time of data collection. As a result, the municipal manger and his deputy, the greenery and sanitation team leader and experts, the environmental protection office expert, health office head and experts of the sanitation department were involved in the focus group discussions.

3.9. Methods of Data Analysis and Interpretation

The non-sequential collection and analyses of both primary and secondary qualitative and quantitative data were carried out with a view to enable substantiation of the qualitative data by quantitative data or the vice versa. In this regard, the qualitative analyses employed the thematic methods to complement the analysis of the quantitative data. Hence, the QUAN + QUAL paradigm was employed for the study. The quantitative data was analyzed using descriptive statistics like frequency and percentile. Furthermore, ordinal regression was employed for

analyzing the community participation variables. Tables and graphs were used to present the data. Besides, logical interpretation of interview and content analyses of documents was carried out in a more cautious and methodical manner.

3.10. Ethical Considerations

The researcher strictly followed all ethical rules and regulations of academic research at all stages of this study. In all his dealings with participants, the investigator maintained a principle-based and professional relationship with all respondents ensuring that their willing consent is secured before requests for information were extended to them and respecting their dignity. The participants of the study were told exactly what the research was about and why the researcher is conducting the study and told in clear and unambiguous terms that participation was totally voluntary. Keeping the confidentiality of the information obtained, maintaining the privacy and anonymity of respondents, and ensuring the presence of a healthy dose of skepticism on all information obtained were the hallmark of this study. No information that could potentially harm the participants, during or in the aftermath of the study, were disclosed to anyone.

The study did not cause, intentionally or otherwise, any harm to the respondents as well as those who provided access to secondary documents. Nor did it impose serious burden on the participants. The participants were all responsible adults and none faced any pressure to take part in the study. Moreover, given his knowledge of the two languages used as medium of communication in the Town, Amharic, and Afaan Oromo, the researcher faced no communication barrier when interacting with the participants in the study. This enabled the researcher to speak with clarity and precision and to hear and understand all the verbal and nonverbal communication of the participants of the study without any glitch. Throughout the

study the researcher showed respect for the different cultures in the Town and there was no occasion for favoritism whatsoever. During the field observations, the researcher made sure that disruptions to the participants were kept to the minimum as much as possible.

Since the study was fully funded by Addis Ababa University, there was no financial interest in the study nor any conflict of interest involved since neither the university nor the researcher is motivated by any interest other than the interest of advancing knowledge. The findings of the study were also reviewed objectively and without any bias. Since the researcher is a key instrument in a mixed method study, the researcher's background is provided in the following paragraph by way of the self-disclosure requirements of the method. This is done in the interest of establishing the "authenticity" and "credibility" of the study and its findings (Creswell & Creswell, 2018).

CHAPTER FOUR

4. RESULTS AND DISCUSSIONS

This chapter presents and discusses the results of the study in an integrated way. The first part of the chapter opens with the response rate, and moves to a discussion of the socio-demographic background of the respondents. This is followed by key facts revealed by the study such as the waste generation rate and characterization of solid waste. The solid waste generation rate of Lagatafo Lagadadhi town is then compared with the rate for some African cities. After presenting the projection, composition, and density of solid waste in the town, the chapter will conclude by exploring the existing solid waste management system of Lagatafo Lagadadhi town in a comprehensive manner.

4.1. Response Rate of the Respondents

The calculated sample size for the survey was 384. The respondents were then selected proportionally from all Kebeles. Out of the sample, 366 respondents completed the questionnaires within the proposed time framework, providing a staggering response rate of 95.3%, which is excellently high.

Table 4.1: The Response Rate of the Respondents

Kebele	Frequency	Response Rate (%)	Share of Sample (%)
Laga Tafo	104	94.5	27.1
Eekka Dale	79	95.2	20.6
Dambal	91	96.8	23.7
Laga Dadi	92	94.8	23.9
Totally Responded	366	95.3	95.3
Missing Respondents	18	4.7	4.7
Grand total	384	100	100

Source: Organized by Researcher, 2019

4.2. Socio-Demographic Background of the Respondents

As discussed in chapter three, the sample for this study is made up of households. Households have different types of social and demographic characteristics like educational level, income, occupations, work culture, family size, and the like. Based on these characteristics, they make different demands on service provision and have different abilities to pay for services. Therefore, municipalities and service providers must consider these characteristics into account when providing solid waste management. Accordingly, the details of these characteristics are discussed in subsequent paragraphs along with their implications for solid waste management.

4.2.1. Demographic Characteristics of the Respondents

Solid waste management strategies should be designed taking into account the existing social diversity, behavioral characteristics, and other profiles of the key stakeholders. The most important social diversity issues that can have a direct or indirect effect on the effectiveness and sustainability of a solid waste management system are poverty, affordability and willingness to pay, gender, age, ethnicity, and other demographic characteristics, as well as the health and safety of especially vulnerable groups, and public awareness and perceptions (Bernstein, 2004).

4.2.2. Sex and Age of the Respondents

About 51.4 percent (188) and 48.6 percent (178) of the respondents were males and females, respectively. Regarding the age of the respondents, 29.5 percent (108) were within the age range of 26-30 years whereas 5.7 percent of the respondents were above the age category of 40 years. This indicates that 58.7 percent of the respondents fell into the age range between 19-30 years. Moreover, the results revealed that the majority of the household heads could read, write, and

understand the questionnaire and express their opinion given their educational backgrounds. See Table 4.2 below for additional information.

Table 4.2: Sex and Age Characteristics of the Respondents

No	Respondents Category		Frequency	Percent
1	Sex	Male	188	51.4
		Female	178	48.6
		Total	366	100
2	Age in Years	15-18	38	10.4
		19-25	107	29.2
		26-30	108	29.5
		31-40	92	25.1
		Over 40	21	5.7
		Total	366	100

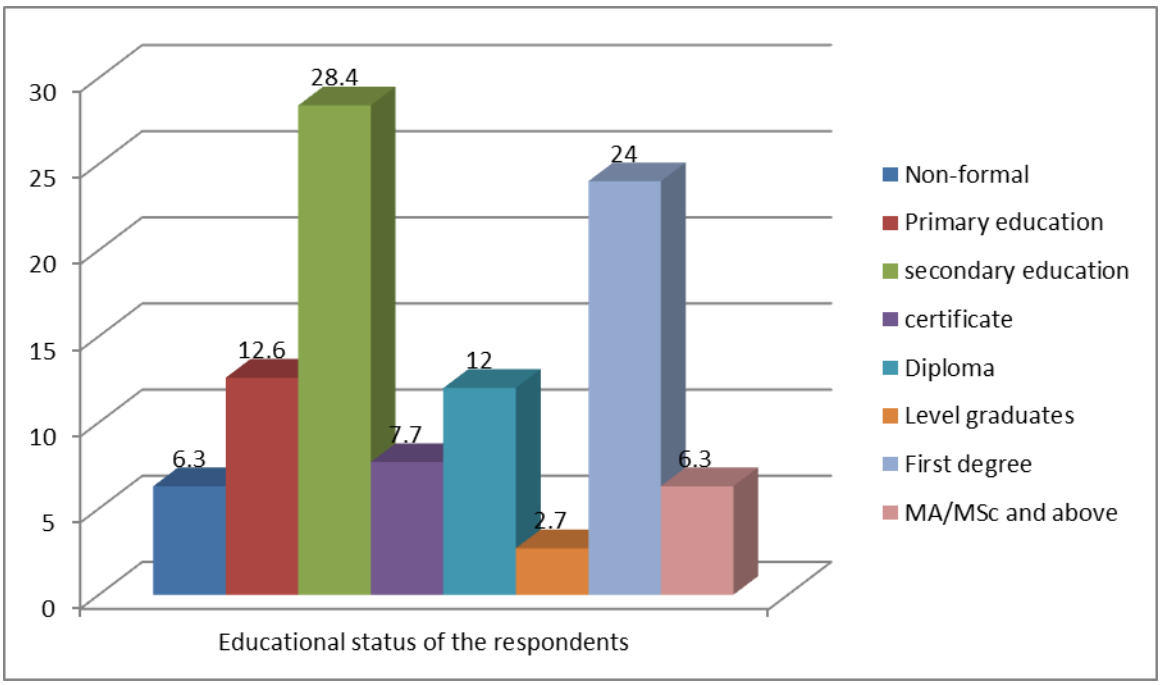
Source: Organized by Researcher, 2019

4.2.3. Educational Status of the Respondents

From the sampled population, whereas the largest group of respondents (28.4 percent) was those who attended secondary school education, the smallest group (2.7 percent) was level graduates (from level one up to level four). About 24 percent and 6.3 percent had attained their first and second degrees, respectively. This means that the vast majority of the respondents could be presumed to be literate with over 81 percent of them having attending high school and above. This demonstrates that the sample was presumably more literate than the general population of the town and thus could be presumed to have a decent understanding of the link between sanitation and environmental protection. Studies show that higher literacy level has a positive implication on ability to accept and implement new ideas thereby making participation in solid waste management desirable and effective. Accordingly, given their high literacy, the respondents could be considered as among those likely to contribute positively towards an

effective solid waste management system in Lagatafo Lagadadhi town. This idea was corroborated by the studying Nairobi, Kenya (Machio, 2017), which showed that the higher the level of education, the better the awareness and the understanding about the proper methods of waste disposal. Similarly, Bernstein (2004) argued that the level of education and environmental awareness could affect the types of products purchased as well as whether unused objects are discarded, recycled, or sold. For more understanding, see figure 4.1below.

Figure 4.1: Educational Status of the Respondents



Source: Organized by Researcher, 2019

4.2.4. Family Size of the Respondents

Most of the respondents, about 37 percent (135) have family sizes ranging from three to four (3-4). Only 15 percent (55) of the households, which is the least, were comprised of over 6 family members. The results show that most households are supporting a significant number of family members that could potentially generate solid wastes daily (refer to Table 4.3 below). A

study done by Alemayehu et al. (2017) in Dire Dawa found that family size could be one of the factors that significantly affect positively or negatively a solid waste management system with larger households generating more waste and vice-versa.

Table 4.3: Respondents` Family Size

Family size (in Range)	Frequency	Percent
1-2	69	18.9
3-4	135	36.9
5-6	107	29.2
Over 6	55	15.0
Total	**366**	**100**

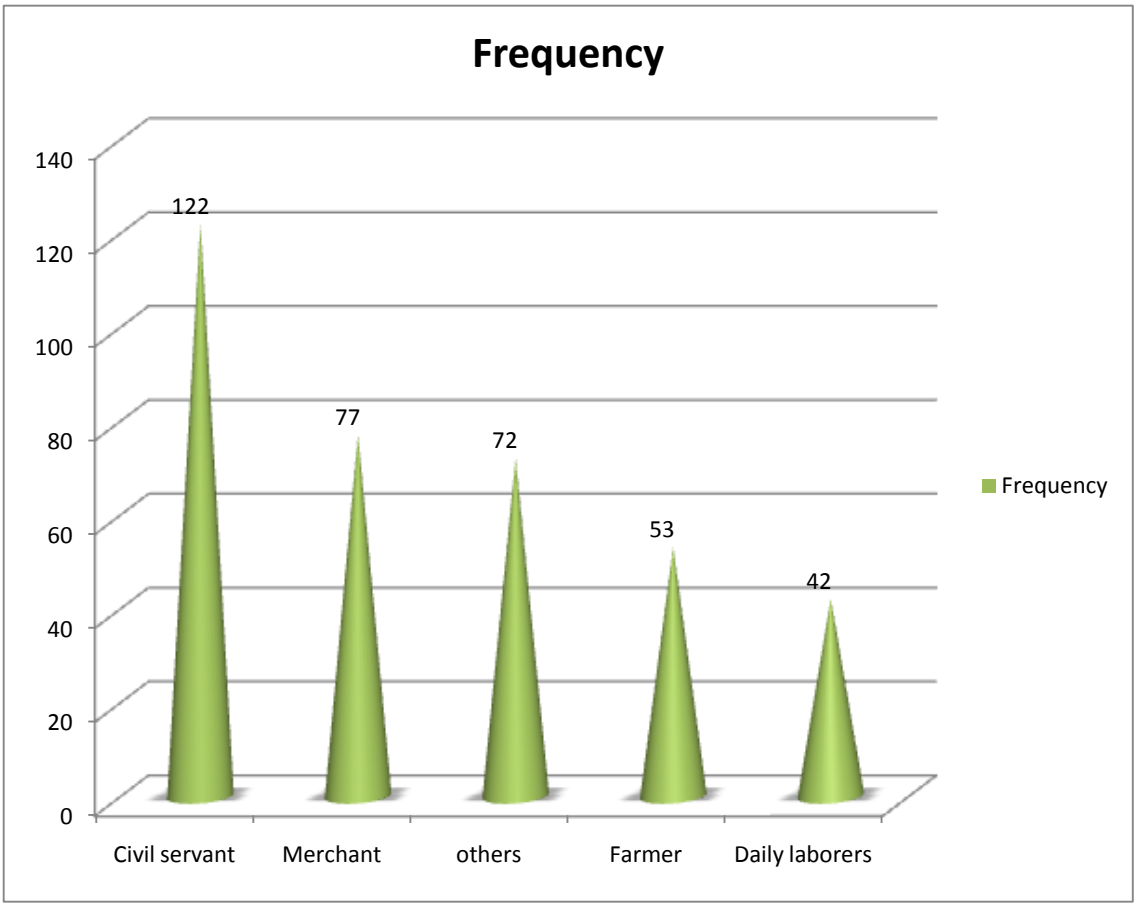
Source: Organized by researcher, 2019

4.2.5. Respondents' Occupations

Regarding the respondents' occupations (as shown in Figure 4.2 below), about 33 percent (122) are civil servants, while 21 percent (77) traders, and 19.7 percent (72) participating in some other activities. The sample also consisted of a significant number of farmers and daily laborers whose frequency were 53 and 42, respectively. Occupation of the family is one of the determining factors of the types and amounts of solid waste generated. For instance, households practicing farming or holding animals in their compounds generate different garbage than high-income households generating waste from packaged foods. This is relevant for organizing wastes sorting at the source (Muller & Hoffman, 2001). Moreover, the garbage from vegetarian households has a different composition than that of meat-eating households. Households headed by women alone have less ability to mobilize resources for construction or repair of soak pits and

the like. This is relevant for the reuse of organic waste in pre-urban agriculture (Muller & Hoffman, 2001).

Figure 4.2: Respondents` Occupation



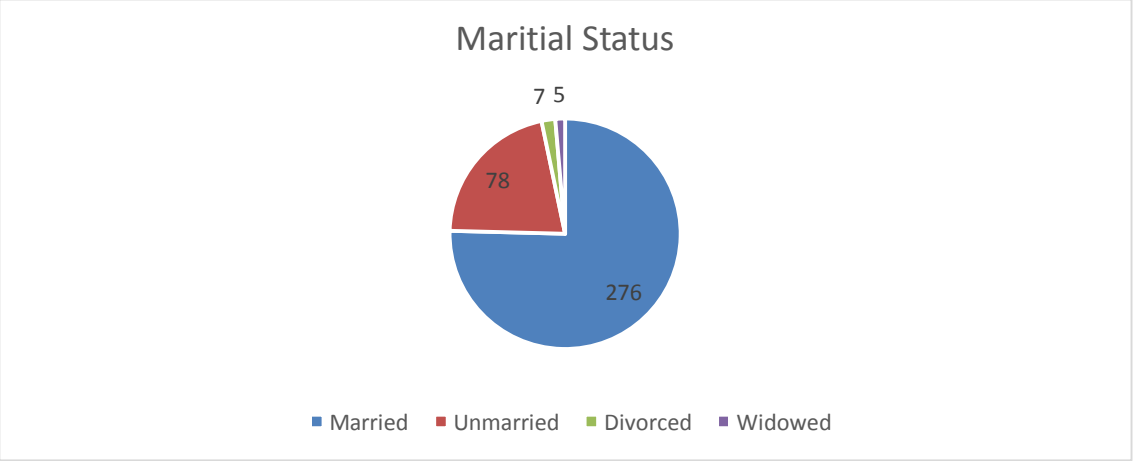
Source: Survey data, 2019

4.2.6. Marital Status of the Respondents

The bulk of the sampled populations, 276 of the respondents, were married (75% percent). About 78 of the respondents are single (21% percent). A few respondents in the households are divorced and widowed as shown in figure 4.3 below. It is worth noting here that according to a

study by Mlozi (2011) and Phillip and Abdillahi (2003) married couples have high levels of participation in solid waste management and other community development activities. However, as we will see later in the chapter, this was not the case in this particular study even though those married 75% of the respondents.

Figure 4.3: The Marital Status of the Respondents



Source: Survey data, 2019

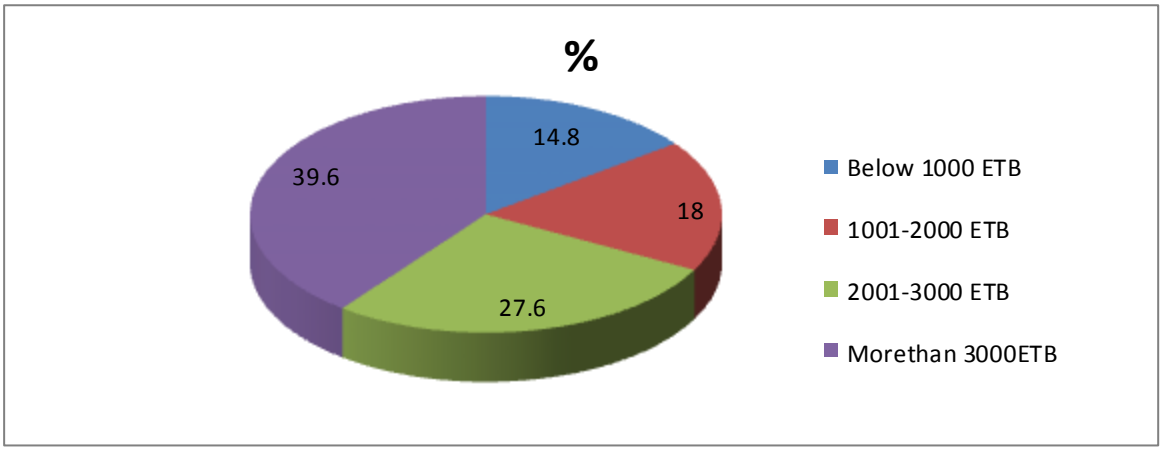
4.2.7. Monthly Income of the Respondents

Studies show that income is one of the most determinant factors affecting communities' participation in solid waste management. Consequently, a close look at the income profile of the respondents for this study is presumed to reveal vitally important information.

The results on income data revealed that 54 respondents (14.8%) earned a monthly income of below 1000 ETB; 66 (18.0%) between 1001-2000 ETB, 101(27.6%) between 2001-3000 ETB; and 145 ETB (39.6%) above 3000 ETB. Studies (Alemayehu et al., 2017) demonstrate that as the average income of households' increases, the greater is their level of participation in solid waste management.

On the other hand, the levels of economic development and household income are important determinants of the volume and composition of wastes generated. Wastes generated in low and middle-income cities (neighborhoods) have a large proportion of organic waste, whereas the wastes in high-income cities (neighborhoods) are more diversified with relatively larger shares of plastics and paper (Modak, 2016). Moreover, the poor would both be unable and unwilling to pay for improved MSWM services (Bernstein, 2004). Consequently, the poor are often unable to have regular access to municipal services and must pay a disproportionately higher share of their income to pay for alternative service arrangements (Bernstein, 2004). Similarly, low-income households have a lower ability to pay for services than middle-income households do. This affects the level of waste collection service and the type of waste facilities to be provided (Muller & Hoffman, 2001). Likewise, low incomes and aggravated poverty denies the poor not only the ability to live in safer environments but also to improve the environment where they live. Figure 4.4 below presents the data on the average income earned by the households that took part in the survey.

Figure 4.4: An Average Monthly Income of the Respondents



Source: *Survey data, 2019*

4.3. Generation Rate and Solid Waste Characterization

4.3.1. Per Capita Solid Waste Generation at Household Level

The minimum daily per capita solid waste generation rate for the sample was found to be zero kg whereas the maximum was 2.71 kg/cap/day; and the mean was found to be 0.41 kg/cap/day at household level in the town in 2018.The per capita solid waste generation rate of households in the town during the survey period is summarized in Table 4.4 below.

Table 4.4: Households' Solid Waste Generation Rate in kg/cap/day

Sampling days	N	Minimum	Maximum	Mean		Standard deviation
	Statistic	Statistic	Statistic	Statistic	Standard error	Statistic
D1	72	0	2.75	0.56	0.07	0.61
D2	72	0	5	0.47	0.08	0.69
D3	72	0	1.55	0.31	0.03	0.3
D4	72	0	2.1	0.3	0.05	0.42
D5	72	0	4.2	0.54	0.08	0.65
D6	72	0	1.6	0.38	0.04	0.31
D7	72	0	1.8	0.31	0.04	0.31
Valid N	**72**	**0**	**2.71**	**0.41**	**0.056**	**0.47**

Source: Survey data, 2019

4.3.2. Per Capita Solid Waste Generation at Ropak Real Estate

As discussed in Chapter Three, Ropak is one of the real estates in the town of Lagatafo Lagadadhi town. The residents of this real estate are presumed to enjoy higher income levels and higher waste generation rates.

The results of the study revealed that the minimum per capita solid waste generation rate of the Ropak Real Estate was 0.011 kg, whereas the maximum was 1.74 kg/cap/day. The mean was found to be 0.46 kg/cap/day with a standard deviation of 0.43. The slight

deviation below the mean indicates that almost all the data are close to the mean. Likewise, there was a slight variation between the residential households and the Ropak community by about 12% in the daily solid waste generation. Therefore, the results of this study confirm that the daily household solid waste generation rate per person increases as the economic status of households and living standard rises. Similar trends were observed in Hawassa and Adama cities, and Arada Sub-city of Addis Ababa (Beyene, 2005; Dereje Diriba, 2009; Lema Asfaw, 2007; Gebre, 2013).

TABLE 4.5: ROPAK REAL ESTATE SOLID WASTE GENERATION RATE IN KG/CAP/DAY

Sampling days	N	Minimum	Maximum	Mean		Standard deviation
	Statistic	Statistic	Statistic	Statistic	Standard error	Statistic
D1	20	-	2	0.44	0.1	0.43
D2	20	0.1	1	0.45	0.06	0.27
D3	20	-	3.5	0.63	0.17	0.78
D4	20	-	1.3	0.36	0.09	0.38
D5	20	0.1	1	0.39	0.07	0.29
D6	20	-	1.9	0.48	0.11	0.48
D7	20	-	1.5	0.46	0.09	0.39
Valid N	**20**	**0.11**	**1.74**	**0.46**	**0.10**	**0.43**

Source: Survey data, 2019

4.3.3. Per Capita Waste Generation at Hotels and Restaurants

The study showed that the average number of employees in hotels and restaurants in the town was six persons per facility. The mean daily solid waste generation of the hotels and restaurants was found to be 1.79 kg/employee/day. The slight deviation below the mean indicates that the data collected clustered to the mean. The per capita solid waste generation rate of the hotels and restaurants in the town over the survey period is summarized as follows (Table 4.6).

Table 4.6: Hotels and Restaurants Solid Waste Generation in Kg/Employee/Day

Sampling days	N	Minimum	Maximum	Mean		Standard deviation
	Statistic	Statistic	Statistic	Statistic	Standard error	Statistic
D1	19	0	6.4	1.56	0.35	1.54
D2	19	0	6	1.58	0.3	1.33
D3	19	0	3.5	1.65	0.21	0.91
D4	19	0	4.4	2.02	0.27	1.19
D5	19	0	2.7	1.47	0.16	0.68
D6	19	0	10	2.06	0.49	2.12
D7	19	0	9	2.25	0.48	2.1
Valid N	**19**	**0**	**6**	**1.79**	**0.32**	**1.41**

Source: Survey data, 2019

4.3.4. Per Capita Waste Generation at other Business Entities

The other businesses employed on average 1.87 persons in the data collection period. The minimum daily solid waste generation was 0.32 kg and the maximum 3.82kg/employee/day. The mean daily SW generation was 1.57kg/employee/day. The standard deviation was 1.03, which is just below the mean revealing that the data were clustered around the mean. The per capita solid waste generation rate of the other business during the survey period summarized as follows (Table 4.7).

Table 4.7: Other Businesses Solid Waste Generation Rate in Kg/Employee/Day

Sampling days	N	Minimum	Maximum	Mean		Standard deviation
	Statistic	Statistic	Statistic	Statistic	Standard Error	Statistic
D1	15	0.6	6.4	2.3	0.47	1.8
D2	15	0.5	5.2	2.24	0.42	1.61
D3	15	0.33	3.7	1.67	0.22	0.87
D4	15	0.2	2.45	1.11	0.18	0.68
D5	15	0.2	2	1.11	0.15	0.58
D6	15	0.15	3	1.15	0.2	0.76
D7	15	0.25	4	1.4	0.24	0.91
Valid N	**15**	**0.32**	**3.82**	**1.59**	**0.27**	**1.03**

Source: Survey data, 2019

4.3.5. Per Capita Waste Generation at Governmental Offices

The average employees for the governmental offices (municipality, finance, etc.) were found to be 6.6 persons per office in the data collection period in the town. The minimum daily solid waste generation was 0.12 kg and the maximum 0.78 kg/employee/day. The mean solid waste generation was 0.40 kg/employee /day. The standard deviation was found to be 0.26, which is below the mean value to reveal the data were clustered close to the mean once again.

Table 4.8: Governmental Offices Solid Waste Generation Rate in kg /Employee/day

Sampling days	N	Minimum	Maximum	Mean		Standard deviation
	Statistic	Statistic	Statistic	Statistic	Standard error	Statistic
D1	5	0.1	1	0.44	0.15	0.34
D2	5	0.1	0.8	0.42	0.13	0.29
D3	5	0.1	0.5	0.22	0.07	0.16
D4	5	0.1	0.6	0.4	0.08	0.19
D5	5	0.2	1	0.54	0.15	0.34
Valid N	**5**	**0.12**	**0.78**	**0.4**	**0.12**	**0.26**

Source: Survey data, 2019

Identifying the quantities and composition of a municipality's solid waste is the milestone to examine the problems of a management of solid waste system and to set solutions through planning and developing an integrated solid waste management model.

The World Bank study revealed that the world generates 2.01 billion tons of municipal solid waste annually. The same study shows that at least 33 percent of this waste is not managed in an environmentally safe manner. Worldwide, waste generated per person per day averages 0.74 kilograms but ranges widely, from 0.11 to 4.54 kilograms. Though the developed countries only

account for 16 percent of the world's population, they generate about 34 percent, (683 million tons), of the world's waste (Kaza et al., 2018).

Kaliet al. (2009) argued that compositional studies are important for several reasons, such as the need to estimate material recovery potential, to identify sources for component generation, to facilitate the design of processing equipment, and to maintain compliance with national laws. For example, if the solid waste generated at the household level consists of large portions of kitchen or food waste, this indicates that frequent collection is needed due to its nature to decompose rapidly causing foul smells. Thus, it would be impossible to successfully understand and manage waste if management does not consider waste generation and composition.

To maintain good waste management, we need not only accurate data on waste generation and characterization but also information on the factors that contribute to their generation and characterization. Several studies (Alemayehu et al. 2017) have shown a strong relationship between waste characteristics (per capita daily waste generation and waste composition) and socio-economic factors. Amongst other socioeconomic factors influencing the per capita solid waste generation are household size and income.

The composition of the generated waste is however extremely variable because of seasonal, lifestyle, demographic, and geographical variations as well as differences in local legislations. These variations make defining and measuring the composition of waste more difficult and at the same time more essential. The characterization of solid waste streams and the estimation of solid waste generation rates are critical data needed to seek alternative solutions to problems created by rising solid waste disposal costs, increasing public opposition to new landfills, and the growing interest in recycling.

In Ethiopia, like similar developing countries, the increase of solid waste generation has resulted from rapid urbanization and the booming and ballooning population. To wit, the amount of solid waste in Addis Ababa and other fast-growing areas of the country have been increasing over time, largely attributed to the rapid population growth rate and growing and diversifying economic activities. For instance, in Addis Ababa, the solid waste collection coverage is about 65 percent of which about 10 percent is recycled. The remaining 25 percent is often dumped in open spaces, ditches, riverbanks, and the like (Getaneh & Tesfaye, 2006).

Table 4.9 below shows the per capita MSW generation rate for different cities in Africa. Based on the World Bank report (2012), the mean per capita solid waste generation rate for Sub-Saharan Africa (SSA) countries is 0.65 kg per day and the range lies between 0.09 to 3 kg/capita/ days. Similarly, based on data from the UNSD (2009), the mean generation rate for Makurdi, Parakou, Ouagadougou, Kumasi, and Lusaka reported being 0.54, 0.59, 0.79, and 0.6 and 0.9 kg/cap/day, respectively. These values are much higher than most cities in Ethiopia whereas cities like Conakry, Harare, and Zinder are somehow similar to most cities in Ethiopia.

Table 4.9: Per Capita Solid Waste Generation in Some Cities of Ethiopia

Town/city name	Population (July 2015 CSA)	Solid waste generation (tons/day)	Solid waste generation rate (kg/cap/day)
Jimma	215,000	53.75	0.25
Dire Dawa	270,000	135	0.5
Bishoftu	147,064	71.25	0.48
Ambo	70,853	23.57	0.33
Fitche	40,467	8.51	0.21
Holeta	34,215	8.53	0.24
Injibara	35,212	13.45	0.38
Finote Selam	40,610	7.68	0.18
Yirgalem	57,971	15.03	0.25
Yirga Chefe	28,877	5.35	0.18
Axum	66,818	16.33	0.24
Adigrat	86,094	21.64	0.25
Dilla	86000	21.5	0.25

Source: MoUDC and GIZ (March, 2015)

4.3.6. Per Capita Generation Rate at Healthcare Facilities

While the minimum daily infectious waste generation was found to be 1.24 kg at Hailu Clinic, a maximum daily infectious waste of 3.76 kg was observed at the Laga Dadi Health Centre. The average infectious waste generation per facility was 2.59 kg day that account for 30.19 percent of the total. The minimum daily sharp waste generation was observed in Melat clinic with 0.93 kg and the maximum was 2.83 kg at the Mission health facility.

The average sharp waste generation was 2.27 kg per facility per day. The minimum municipal solid waste generation was observed in Hailu Clinic with 1.19 kg and the maximum was 4.96 kg at Mission Health facility with the average value of 3.71 kg/facility/day, which accounts for 43.27 percent of the sampled health facility solid waste generated. The results for the two public and three privately-owned healthcare facilities investigated as part of this study are indicated in Table 4.10 below.

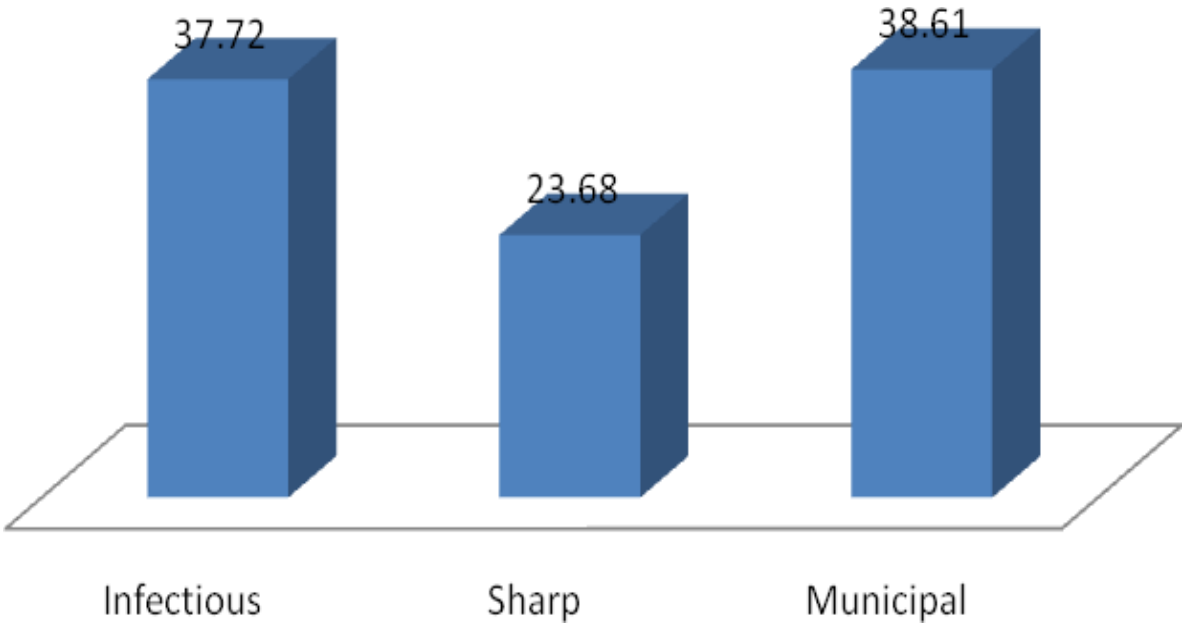
Table 4.10: Daily Average Solid Waste Generation in Kg/Facility/Day

Solid waste category	SWG in kg/facility in health facilities in Laga Tafo Laga Dadi City								
	Lagatafo		Lagadadi		Zebene	Melat	Hailu	Mean	Percent
Infectious	3.29	3.57	3.76	2.39	2.60	1.27	1.24	3.62	37.7
Sharp	2.83	1.61	1.50	1.67	1.71	0.93	1.11	2.27	23.7
Municipal	4.96	3.76	2.73	2.34	2.16	1.41	1.19	3.71	38.6
Total	**11.07**	**8.94**	**7.99**	**6.40**	**6.47**	**3.61**	**3.54**	**9.61**	**100**

Source: Survey data, 2019

It is worth noting here that the overall solid waste generation in the health facilities was 9.61 kg/facility/day of which 56.73 percent was hazardous. The rest 43.27 percent was labeled as a non-hazardous or municipal solid waste. Figure 4.5 below shows percentage of infectious, sharp, and municipal waste generated by the health facilities observed in the town of Lagatafo Lagadadhi during the period covered by this study.

Figure 4.5: Health Facility Daily Solid Waste Generation by Type in Lagatafo Lagadadhi



Source: Survey data, 2019

4.3.7. Total Per Capita Solid Waste Generation Rate

The total per capita solid waste generation for Lagatafo Lagadadhi town was estimated to be 0.43 kg/cap/day and the annual per capita reached about 156.78 kg (see Table 4.11 below). According to a survey conducted in Hosanna city (Tekilu, 2014), the mean per capita solid waste generation was 0.41 kg/cap/day, which is nearly similar to the finding of

this study. A study done in Bahir Dar city found out that the per capita solid waste generation rate was 0.25 kg (FfE, 2010), which deviated significantly below the result of this study. The study conducted in Gerbe Guracha town indicated that the per capita generation rate was 0.35 kg/cap/day (GG Consult, 2015), which is also slightly lower than the result obtained from this study.

The variations might be attributed to socioeconomic dynamics and physical differences across cities. LagaTafo and Laga Dadi Rivers that flow in the town might have contributed to the generation of a large amount of waste. Moreover, the season under which the study was conducted was the rainy season, which might have increased the mass of the solid waste generated. This might have also had a direct effect on the density of the waste. According to some informants, the rapid expansion of residential areas owned by high-income community members might have a direct effect on the quantity of the waste.

Table 4.11: Total Solid Waste Generation in Lagatafo Lagadadhi Town by Sources in Kg/Cap

Solid waste generators[1]	Kg/cap/ day	Household size/facility /empty[2]	Number of units [3]	Total population	Total in kg/unit	Annual in kg/unit
Households	0.41	4.93	10,411	52,054	16,170.40	5,906,238.60
Real estate	0.46	4.29	3,000	12,870	5,920.20	2,162,353.05
Hotel	1.81	5.75	32	184	333.04	121,642.86
Factory			51	0	-	-
School			7	0	-	-
Other	1.57	1.87	23	43.01	67.53	24,663.76
Others2			2	0	-	-
Health Facility	8.57	1	8	8	6856	25,41.54
Gov`t office	0.4	6.6	30	198	79.2	28,927.80
Total			11,153	52,743.01	22,638.93	8,268,867.61
Per capita					**0.43**	**156.78**

Source: Survey data, 2019

4.3.8. Lagatafo Lagadadhi Town vs. African Cities in Solid Waste Generation

Comparing the per capita solid waste generated by Lagatafo Lagadadhi with towns in Sub-Saharan Africa can be revealing. As shown in Table 4.12 below, the per capita waste generation rate of Lagatafo Lagadadhi town (0.43 kg/cap/day) falls within the range of Sub-Sahara African countries; but higher than Conakry`s (0.24 kg/cap/day) and Zinder`s (0.29 kg/cap/day). However, it is significantly less than Ouagadougou's (0.79 kg/cap/day) and Lusaka's (0.9 kg/cap/day).

Solid waste generation rates could directly be influenced by economic development, the degree of industrialization, public habits, and local climate (World Bank, 2012). Pappuetal (2007) also indicated that population growth, the rate of urbanization, and change in lifestyle and food habits, lead to an increased amount and variety of waste. Generally, the higher the economic development and rate of urbanization, the greater the amount of solid waste produced. Income level and urbanization are highly correlated with greater consumption of goods and services and a corresponding increase in the amount of waste generated.

Table 4.12: Comparison of Solid Waste Generation among Cities in Africa

No	List of countries, cities and regions	Mean solid waste generation rate (kg/ per/day
1	East African Default factor	0.29
2	Kenya	0.241 (ranges from 0.15-0.332 kg)
3	Sub-Sahra African Countries	0.65 (ranges from 0.09- 3 kg)
4	Developing countries	0.4
5	Developed countries	>1 kg
6	Crude solid waste generation rate of Ethiopia urban centers	0.3097
7	Parakou, Benin	0.59
8	Ouagadougou, Burkina Faso	0.79
9	Kumasi, Ghana	0.6
10	Conakry, Guinea	0.24
11	Zinder, Niger	0.29
12	Lusaka, Zambia	0.9
13	Harare, Zimbabwe	0.08
14	Makurdi, Nigeria	0.54

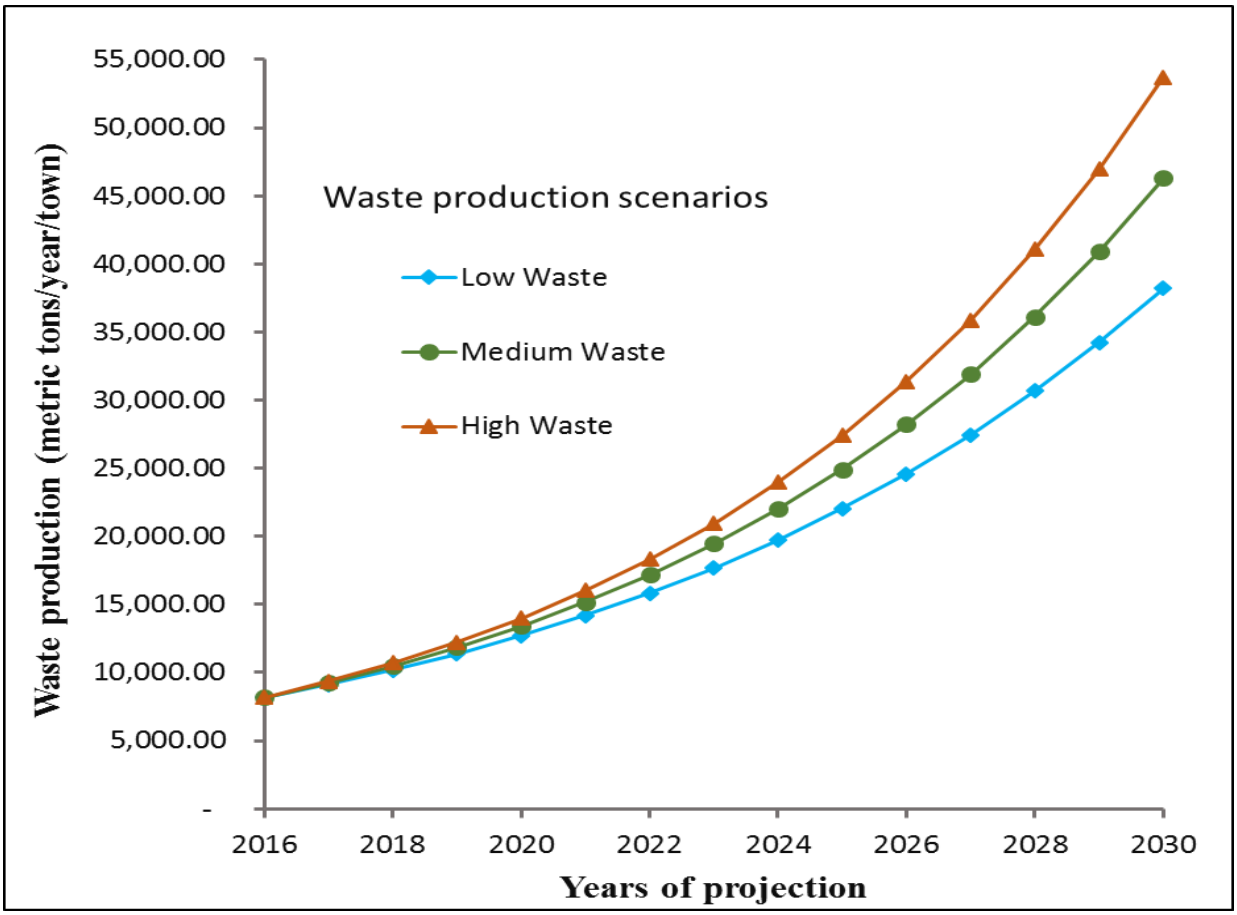
Source: MoUDC, 2015; Sha'ato et al. & IPCC 2006; UNSD& Asase, 2009; World Bank, 2012 Solid Waste Projection for Lagatafo Lagadadhi town

Calculating the total generation rate of solid waste streams enables us to estimate the total waste that can be generated daily, monthly or yearly, which in turn provides a basis for a sound solid waste management plan for a given town or city in the years to come. The total solid waste generation projection was made by taking into account the population growth in a given year or period and estimating the per capita solid waste generation rate of Lagatafo Lagadadhi town as is shown in figure 4.6 below. To predict population growth rate, it was assumed that the population would be increasing in arithmetical progression, and this pattern will persist into the future. For this study, the solid waste generation was also projected based on the assumption of 10% annual growth of waste generated (UN-HABITAT, 2009) as of 2018 and three population growth rate scenarios. The population with low waste generation scenario assumed the annual population growth rate to be 1.5%, which is the average population growth rate for Ethiopian towns. The population with medium waste generation scenario considered the national population growth rate of Ethiopia, which is 2.9%. The population with high waste generation scenario assumes the population growth rate of the town to be 4%, which is 40% higher than the national growth rate, attributed to the town being one of the fast growing because of rural-urban migration. Therefore; the projected annual solid waste generation in the town for the coming 10 years (at the end of 2028), will be 30,656.3 ton under low waste generation scenario (Figure 4.6). Similarly, the annual waste production will be 36,133.7 tons for medium waste generation scenario and 41,051.4tons for medium waste generation scenario, after 10 years.

The population growth and migration, economic development, household size, employment changes, and impact of waste recycling are factors that influence solid waste generation interactively (Karadimas et al.2006). Sastry (2007) reported that the rate of waste generation is

an integral part of the socio-economic development endeavor of towns and cities. Since the estimated quantity of Municipal Solid Waste (MSW) generated worldwide is 1.7 – 1.9 billion metric tons (UNEP, 2010), making generated per capita of 0.24 -0.27 metric tons of MSW, globally. Even though, the projected total amount of solid waste generated by Lagatafo Lagadadhiis significantly below this range.

Figure 4.6: Solid Waste Generation Projection in Lagatafo Lagadadhifor the Prospective 10 Years



Source: Survey data, 2019

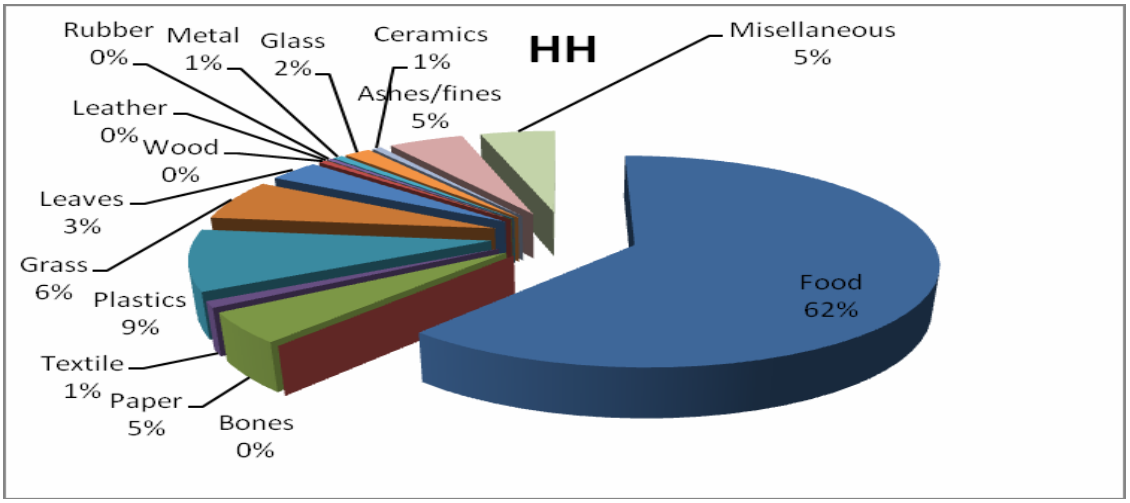
4.4. Solid Waste Composition in Lagatafo Lagadadhi Town

4.4.1. Households Solid Waste

Solid waste composition is fundamental for solid waste management planning (USEPA, 1989). Municipal solid waste is generally classified into organic and inorganic. In this study, the waste composition is categorized as food, bone, paper, textile, plastics, grass, leaves, wood, leather, rubber, metal glass, ceramics/stone, ash/fines, and miscellaneous. These categories can be further refined into secondary categories (See annex1 for further information).

Figure 4.7 demonstrates the household waste composition in Lagatafo Lagadadhi town in which food waste took the lion's share of household wastes (61.53%). The recyclable wastes accounted for 14.75 percent (including plastics, textile rubber, metal, and glass) followed by ash which took a significantly small share of 4.86 percent. Thus, biodegradable wastes, including food waste, accounted for 76.50 percent and miscellaneous wastes such as diapers, bio-medical wastes, and insecticides accounted for 4.84 percent.

Figure 4.7: Household Solid Waste Composition in Lagatafo Lagadadhi



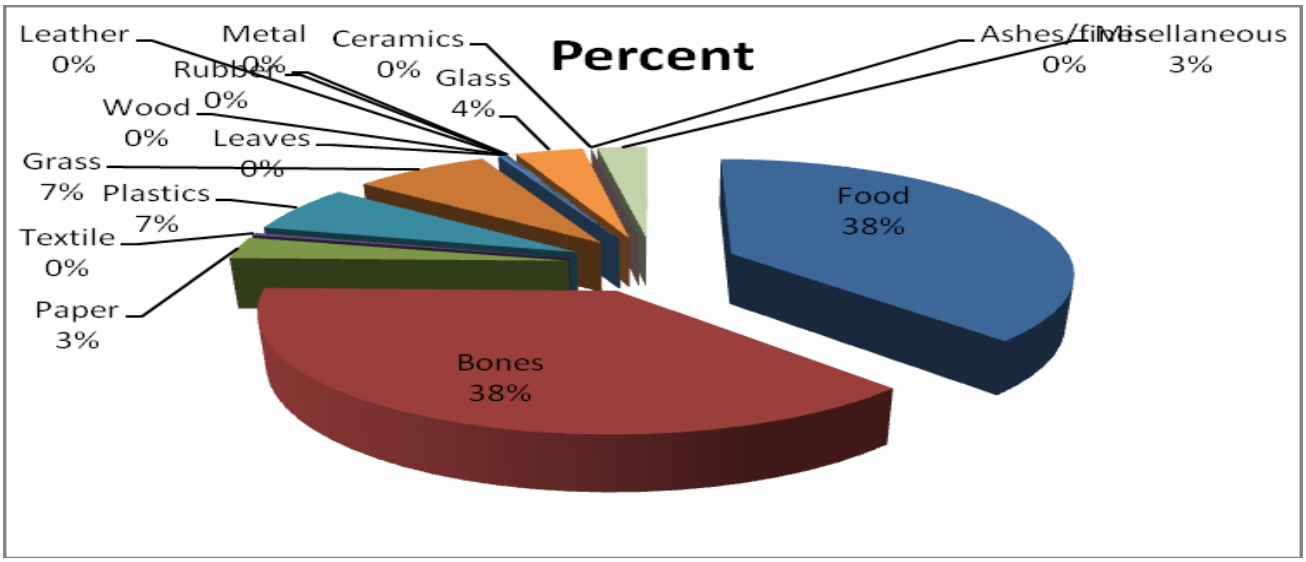
Source: Survey data, 2019

4.4.2. Ropak Real Estate

In Ropak Real Estate, food and bone wastes together accounted for whopping a 76 percent while grass accounted for 7.58 percent. However; the total organic wastes, including food waste took a share of 48.32 percent, which is significantly lower than the share of household wastes in the town. Glass and miscellaneous wastes accounted for 3.79 percent and 2.76 percent, respectively. The share of all other wastes such as textile, rubber, and metal generated from Ropak Real Estate was found to be minimal standing at 0.48 percent.

The high content of the "organic" fraction of solid waste is attributed to the physical environment of this area and the living standard of the households (figure 4.8). As income increases, the amount of organic waste decreases while other wastes increase. This is due to the excessive use of biomass fuels, including firewood and charcoal.

Figure 4.8: Ropak Real Estate Solid Waste Composition in Lagatafo Lagadadhi Town

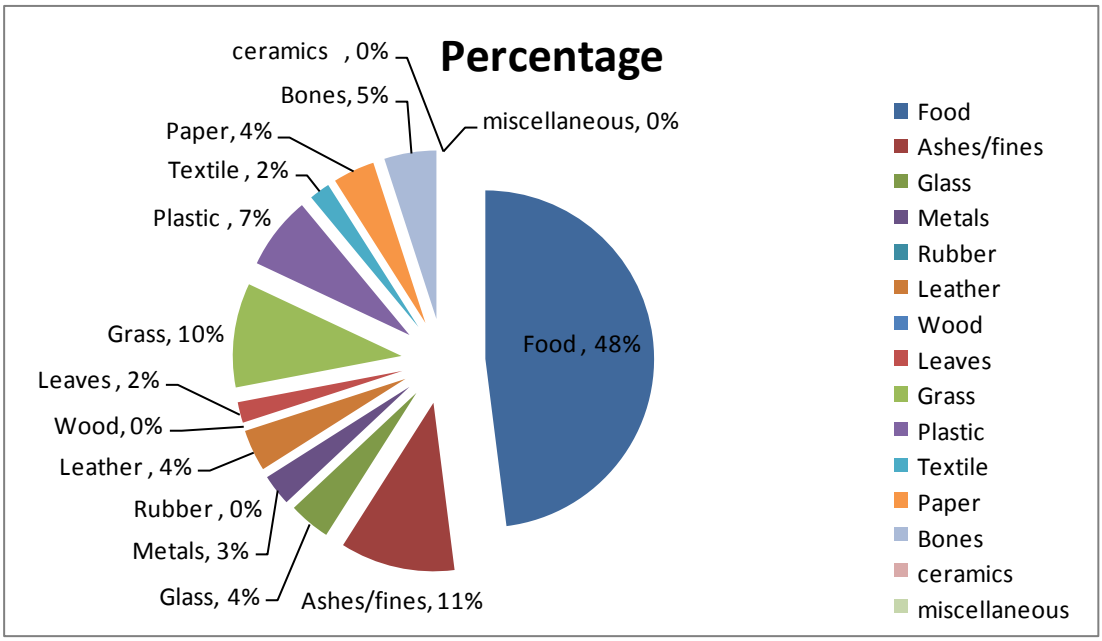


Source: Survey data, 2019

4.4.3. Hotels and Restaurants

As summarized in Figure 4.9, hotels and restaurants generated 48 percent of food waste in the town of Lagatafo Lagadadhi during the study period. About 67.45 percent of the solid waste was biodegradable, including food waste and other organic wastes. Ash/fines accounted for 11.30 percent, followed by plastics, bones, and glass took the share of 6.57%, 4.68 %, and 4.11 %, respectively. The rest of the waste, such as textile, rubber, and ceramics and miscellaneous accounted for a mere 2.44 percent of the total.

Figure 4.9: Hotels and Restaurants Waste Composition in Lagatafo Lagadadhi Town

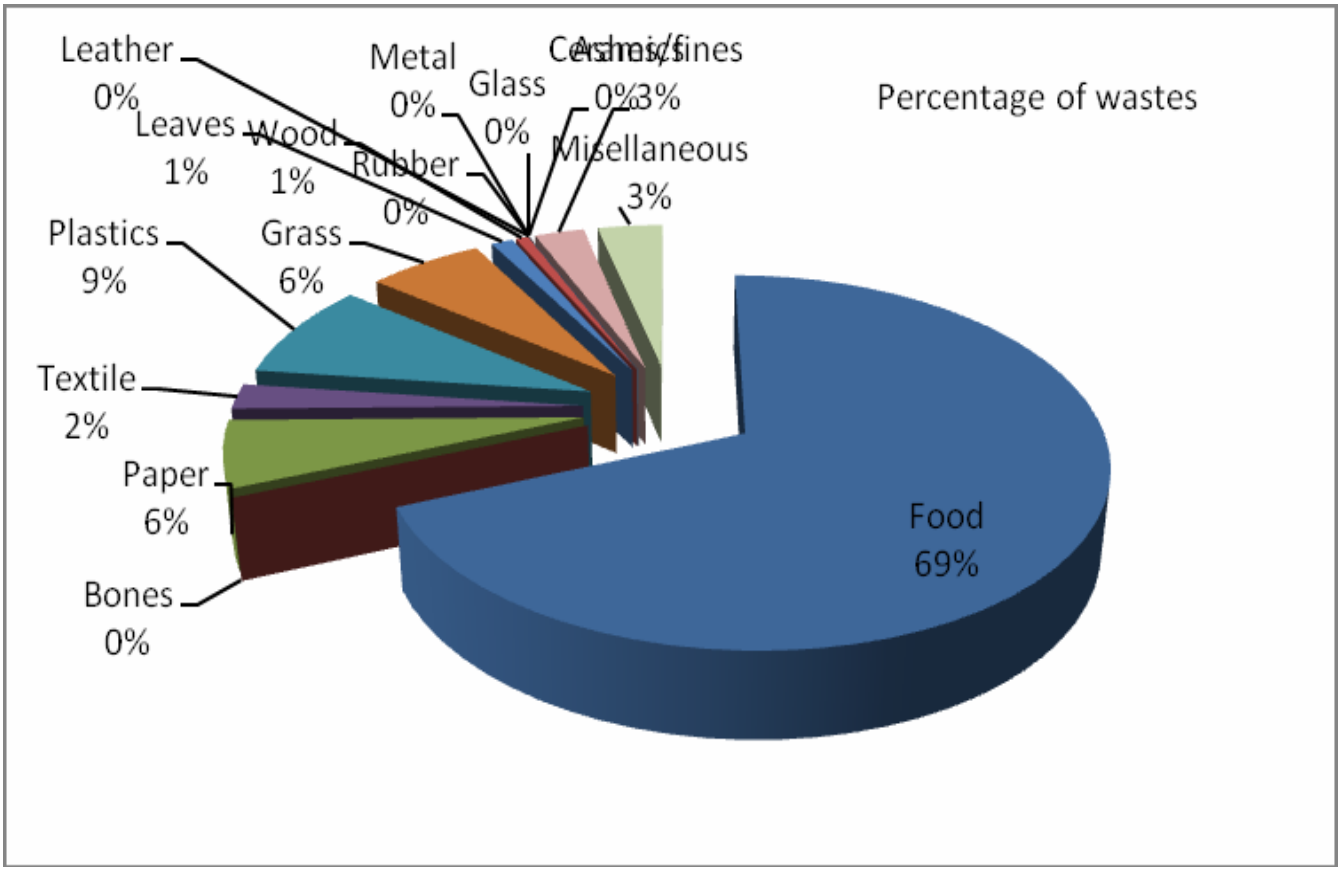


Source: Survey data, 2019

4.4.4. Other Business Entities

As illustrated in Figure 4.10, other business entities generated a large amount of food waste that accounted for 69 percent. The share of plastic, fines, and textiles was 8.70%, 2.68%, and 2.26%, respectively. Miscellaneous wastes took a share of 3.51 percent of the total daily solid waste generated in these business sectors. Generally, in other business entities, it was found that the biodegradable waste became 82.85 percent.

Figure 4.10: Solid Waste Composition of other Business Entities in Lagatafo Lagadadhi



Source: Survey Data, 2019

Table 4.13 shows a glimpse of the recyclable wastes in Lagatafo Lagadadhi town, which is quite significant as compared with other cities of Ethiopia. For instance, the study conducted in Gerbe Guracha town revealed that the share of total household recyclable wastes was only 7 percent (GG Consult, 2015) of the solid waste generated. However, in this study hotels, residential households, others, and Ropak residential village generated 24%, 18%, 17%, and 14%, respectively the average being 18.20 percent from the total waste generated in the Town. A similar survey conducted in Bahir Dar city indicated that food waste constituted 29 percent, ash and soil 48 percent, and recyclable 9 percent of the total weight (FfE, 2010). A study conducted in Hawassa city revealed that putrescible matter accounts for 59.7 percent, fines/ash, and dust/ 31.3 percent and recyclable 6.1 percent by weight (Dereje, 2009). Lemma (2007) also reported for Adama that organic waste contributed 56 percent, fines 36 percent and recyclables covered 6.2 percent of the total weight. Sharholy et al. (2007) also reported that putrescible matter accounted for 36-57 percent for an assessment conducted in Makurdi, Nigeria. The IPCC (2006) regional default value for the composition of municipal solid waste shows that food waste covers 53.9 percent, recyclable 18.4 percent, and others 27.7 percent of the total weight.

The result obtained for organic decomposable fractions is similar to Eastern Africa default value and Makurdi city but significantly higher than Bahir Dar city. The recyclable waste is twice that of Bahir Dar, three times of Hawassa, Adama, and similar to the IPCC regional default value. The World Bank (2012) stipulated that as a country urbanizes and populations become wealthier, consumption of inorganic materials (such as plastics, paper, and aluminum) increases, while the relative organic fraction decreases. It also indicated that low and middle-income

countries have a high percentage of organic matter in the urban waste stream, ranging from 40 to 85% of the total.

Table 4.13: Solid Waste Composition by Source in Lagatafo Lagadadhi Town

Waste item[2]	Household	Ropak	Hotels and Restaurants	Others[3]
Food	61.53	37.69	48.09	68.81
Bones	-	37.69	4.68	
Paper	4.75	3.05	4.11	5.95
Textile	0.98	0.34	1.91	2.26
Plastics	9.5	6.62	6.57	8.7
Grass	6.37	7.58	9.5	6.26
Leaves	3.33	0.34	1.91	1.17
Wood	0.52	-	-	0.66
Leather/skin	-	-	3.83	-
Rubber	0.37	0.07	0.07	
Metal	0.65	0.07	3.4	-
Glass	1.69	3.79	4.11	-

Source: Organized by researcher, 2019

4.5. Solid Waste Density in Lagatafo Lagadadhi Town

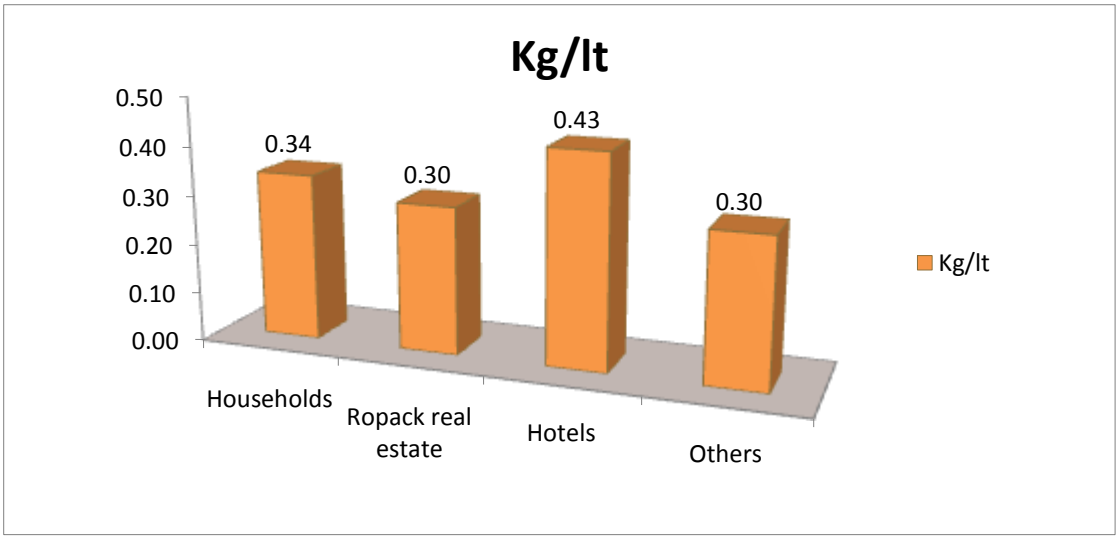
The density of the waste from different sources was also determined as indicated in Figure 4.11 below. The overall density of solid waste in the households, Ropak Real Estate,

[2]. Paper, textile, plastic, leather, rubber, metal and glass for this study

3. Beauty, salons, barber, shops, juice makers etc.

hotels and restaurants, and others was found to be 0.34, 0.30, 0.43, and 0.30 kg/liter, respectively. The mean value of the density of solid waste in the town is determined to be 0.34 kg/liter.

Figure 4.11: Density of Solid Waste by Sources in Lagatafo Lagadadhi Town



Source: Researchers survey, 2019

4.6. Existing Solid Waste Management System in Lagatafo Lagadadhi Town

According to the conceptual framework of the study, the integrated solid waste management system follows solid waste generation, sorting, collection, transportation, segregation, treatment, and finally culminates in safe disposal. However, the field observation and focus group discussion reveal that Lagatafo Lagadadhi town Administration tracks only solid waste generation, collection, transportation, and disposal to the dumping site.

Thus, there was no solid waste segregation or sorting system at the household level. Solid waste was directly transported to the dumping site indiscriminately. In addition, the municipality lacked waste collection materials for collection from door to door, like plastic bags. There were no segregation bins, transfer sites, and waste collection containers for temporary duration. As a result, the solid waste stayed at each household or neighborhood or thrown to the open spaces, which was where residents lived, until the vehicles came to take away the solid waste.

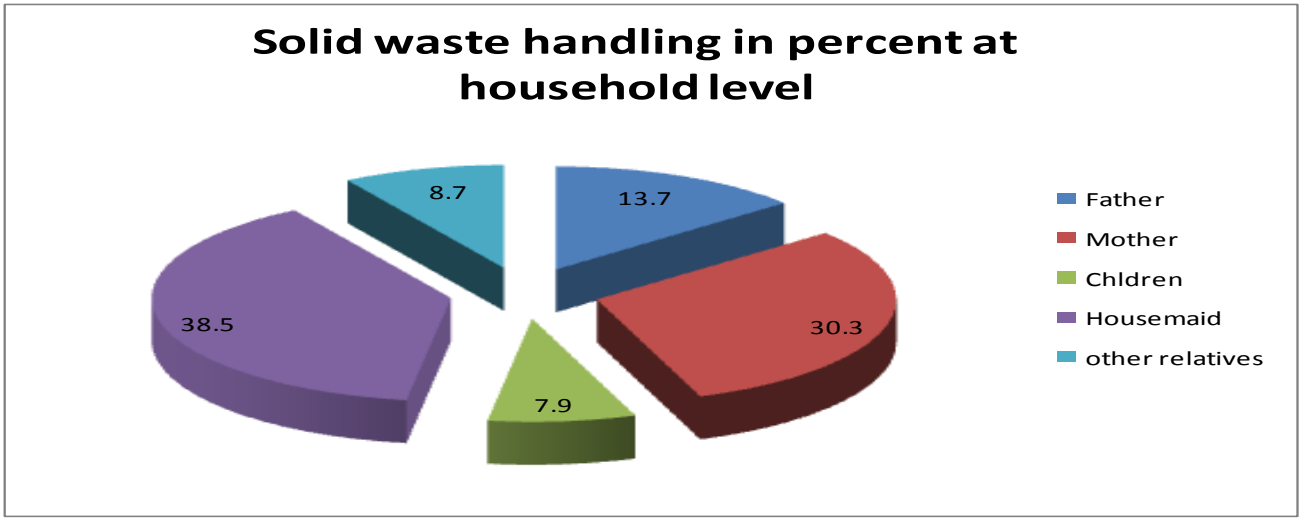
4.6.1. Solid Waste Handling at Household Level

Figure 4.12 provides detailed data about the family composition of households. The data showed that 38.5 percent of the households were comprised of housemaids, 30.3 percent mothers, 13.7 percent fathers, 7.9 percent children and the rest 8.7 percent were other relatives. Presumably, the housemaids and mothers are more responsible for handling wastes at the household level than other family members. The study revealed that 68.8 percent of them have been actively participating in solid waste collection, reduction, and separation.

Bernstein (2004) explained that in many respects, the household is the most important and smallest economic unit in an urban environment. Adum (2013) went on to add that the active participation of women and their involvement in waste management and promotion of sustainable development is vital. The result of this study corroborates the fact that women tend to be the most directly affected as well as concerned about waste management at the household level. Women are the household managers and the members of the household often having the principal responsibility for managing the practical aspects of daily life, such as getting and preparing food, supplying water, assuring cleanliness, and maintaining the physical spaces at the

household level, which strengthens the argument advanced by Adum (2013). Bernstein (2004) also highlighted that women are primarily responsible for managing household work and the socialization of children in a family; which explains why targeting women in environmental education in waste management is very effective and pertinent.

FIGURE 4.12: THE PERCENTAGE SHARE OF SOLID WASTE HANDLING ACTORS AT HOUSEHOLD LEVEL



Source: Own Survey Data, 2019

4.6.2. Solid Waste Collection Practices at Household Level

As shown in Table 4.14, the majority of the respondents, 84.7 percent (310), said that there were door-to-door solid waste collectors whereas 15.3 percent (56) of the respondents reacted that there were no door-to-door solid waste collectors. The Team Coordinator for Greenery and Waste interviewed as part of this study stated that solid waste was transported to the dumping

sites commonly in three ways: namely, centralized point drop-off, door-to-door pick-up, and bringing (loading) to the vehicle directly by residents.

The field observation also confirmed that there were six SMEs with 21 members organized formally in the town to collect waste from door-to-door and drop-off places; and transport to dumping sites. On the other side, informal waste collectors separate the recyclable materials at the dumping site, most of whom are women. The involvement of both formal and informal waste collectors in Lagatafo Lagadadhi perhaps not as peculiar as it sounds. It is a common practice in many places, for example, in India, both unorganized and organized solid waste collectors are working at either informal or formal transfer stations. At landfills, waste collectors are typically organized or are part of a cooperative (Enayetullah & Hashmi 2006) as cited in (Kaza *et al.*, 2018). A more important story is that waste pickers are often the most vulnerable section of societies and they tend to be typically women, children, the elderly, the unemployed, or migrants. This was confirmed by the study done by Kaza et al. (2018) which showed that informal solid waste collectors are generally working in an unhealthy condition, lack social security, or health insurance, subject to fluctuations in the price of recyclable materials, lack of education and training opportunities, and faced strong social stigma. Kaza etal. (2018) emphasized that formalizing informal waste collectors could lead to improved waste collection and recycling and create a conducive environment for social inclusion in the solid waste sector.

After they are formalized, the door-to-door solid waste collectors and segregators would receive the required health care, social security, safety equipment, and dignity during their work. They have also access to credit (loan) from microfinance and receive recognition for their

innovation. This is fundamentally important to capitalize on their experience and knowledge throughout the solid waste management chain.

Table 4.14: Response Regarding the Presence of Door-To-Door Solid Waste Collectors

Responses of the Respondent	Frequency	Percent
Yes	310	84.7
No	56	15.3
Total	366	100

Source: Own survey data, 2019

4.6.3. Solid Waste Transportation Practices to the Open Dumpsite

Table 4.15 presents the frequency of solid waste transportation to the open dumpsite in Lagatafo Lagadadhi town. Asked about how often solid waste is transported to the open dumpsite, 10 percent (37) of the respondents stated that it was daily (throughout the week), 11.3 percent (42) twice a week, and the rest 36.9 percent (137) once per week. About 40.4 percent (150) of the respondents responded that there is no schedule for transportation of wastes to the open dumpsite.

The head of the Work Process Head of the Town's Sanitary and Greenery department, who was interviewed as part of this study, disclosed that due to the shortage of vehicles and facilities, solid waste is not transported to the open dumpsite as per the expectation of the Work Process to meet the demands of the community. Field observation revealed that the frequency of transportation varied from locality to locality. There are areas or places where solid wastes were transported daily throughout the week, particularly around the main asphalt road of the town where the cleaning service was apparently done daily. Some other places saw solid waste being transported twice per week. An example of a place where solid waste was being picked up twice a week was the market place located in Laga Dadhi Kebele (on Sundays and Thursdays).

Thus, the data indicated that the solid waste disposal and transportation time is different from place to place demonstrating the need for an integrated solid waste management that enjoyed high participation by the community. The town does not have vehicles compatible with the health and safety standards set by the National Solid Waste Management Standard. The agricultural tractors transported uncovered and uncompact household wastes into the open dumpsite.

The existing dumpsite does not meet the basic criteria and requirements indicated in the National Solid Waste Management Standard (researcher`s observation, 2018). A study conducted in Macedonia showed that 72 percent of the respondents indicated that the provision of solid waste collection and transportation into landfills took place once per week (Finn, 2007). Similarly, a study conducted in Bahir Dar city revealed that the majority of the respondents, 43 percent did not receive solid waste collection and transportation services at all. The study also found out that only 47.3 percent of the households received solid waste collection and transport services weekly, while 10.7 percent households got solid waste collection and transportation services within 15 days and even beyond (Tassie, 2018).

Table 4.15: Frequency of Solid Waste Collection and Transportation Services into the Open Dumpsite

Frequency of disposal and transportation	Frequency	Percent
Daily	37	10
Twice	42	11.3
Once	137	36
There is no collection schedule	150	40.4
Total	366	98.7
Missing system	5	1.3

Source: Survey data, 2019

4.6.4. Solid Waste Disposal Practices

Table 4.16 shows that 49.6 percent (184) of the household respondents burned wastes; 21.8 percent (81) of the respondents left wastes in the streets; 15.1 percent (56) of the respondents discarded waste in the communal containers; 11.3 percent (42) of them contained wastes in bags/containers in their compounds; 6.7 percent (25) of the emptied wastes in the open dumpsite; 5.7 percent (21) dumped on the street. It indicates that most of the solid wastes (49.6%) were burned and only 47 percent of the total amount was transported to the open dumpsite. On the other hand, 12.2 percent (46) of the respondents reacted that the solid wastes were dumped to the river or the street. During field observations, the researcher observed that this haphazard handling of wastes has polluted the town environment and the water bodies. However, the practice in Lagatafo Lagadadhi does not appear as anomalous as it sounds. In fact, open dumps and open burning continue to be the dominant practice of solid waste disposal in most developing countries (Modak, 2016). The study conducted at Bahir Dar city confirmed that burning, burying, or dumping of solid waste in their compounds is taken as a primary option. The second option is throwing solid waste along roadsides, open spaces, nearby rivers, bridges, and gullies (Tassie, 2018).

Table 4.16: Practice of Solid Wastes Handling at Household Levels

Practice	Frequency	Percent
Burning	184	49.6
Leaving on the street	21	5.7
Throwing into the river	13	3.5
Discarding it into the communal containers	56	15.1
Burying in the backyard	10	2.7
Burying nearby the riverbanks	12	3.2
Transporting it into the dumpsite	25	6.7
Contained waste in bags/ containers in household compound	42	11.3
Total	363	97.8
System	8	2.2
Total	**371**	**100**

Source: Own Survey Data, 2019

4.6.5. Treatment and Disposal - Gaps and Key Challenges

- As little as 47 percent of waste generated is being transported to the official waste disposal site. The rest is being dumped or burnt throughout the town.
- The dumpsite is non-compliant with standards with an absence of management and environmental controls. The necessary plant, equipment, or staff is hardly available.
- As a consequent, waste was routinely dumped outside of the fence of the open dump site and was burnt causing an additional smoke nuisance.

- Local farmers and residents complain about the site and the municipality is planning a new facility further from the center of town.
- The situation is so bad that the town scored 25% for waste disposal services when evaluated using the ISWM benchmark indicator assessment tool (Table 4.17).

Table 4.17: Result Scored by Lagatafo Lagadadhi Town ISWM Benchmark Indicator Assessment of Waste Treatment & Disposal

No.	Short name	Score	Justification
2	Environmental control – waste treatment and disposal (Scoring system = %)		
2.1	Controlled treatment and disposal (%)	0	Un controlled dumping area
2.2	Semi-controlled treatment and disposal (%)	0	No controlled treatment - open landfill in dumping site
2E	Quality of environmental protection of waste treatment and disposal (Scoring system: 0 = very Low; 5 = Low; 10 = Medium; 15 = High; 20 = very High)		
2E.1	Degree of control over waste reception and general site management	0	No site management, no staff, no equipment, and no plan. Landfill/dumping site is without fence
2E.2	Degree of control over waste treatment and disposal	5	No site management, no staff, no equipment, and no plan. Landfill/dumping site is without fence. But the municipality hired two guards to keep the boundaries and other institutions not to dump solid waste without their knowing of it.
2E.3	Degree of monitoring and verification of environmental controls	10	Concerning the monitoring and verification issues, the municipality has a team of sanitation staff that monitors, verifies the way waste is collected from door to door until the disposal site based the schedule. In addition, the sanitation materials purchased annually and administered by the team. However, there are no transfer sites or containers for temporary collection and uncontrolled dumping site exists.
2E.5	Degree of technical competence in the planning, management and operation of treatment and disposal	10	The municipality lacks the competent professional staff as much as the structure invited them, particularly at the kebele level.
2E.6	Occupational health and safety	5	For the daily laborers and cleaners, health and safety materials were purchased and provided annually but it is not sufficient.
Total score out of 100		25	

Source: Lagatafo Lagadadhi town Sanitation and Greenery Core Work Process, 2018

4.6.6. Resource Management – Reduce, Reuse, and Recycle

As shown in Table 4.18, waste reuse and recycling are still very much in their infancy at Lagatafo Lagadadhi town Administration. Operations appear to be limited to ad-hoc separation of hard plastics and metals within the area of the dumpsite for sale through a network of local junk shops throughout the town.

Table 4.18: Result Scored by Lagatafo Lagadadhi Town ISWM Benchmark Indicator Assessment of Reduce, Reuse, and Recycle

No.	Short name	Score	Justification
3	Recycling rate (%)	5	Not formal but there is informal recycling observed or recorded. Informal waste pickers at the open land fill and the neighborhood level collect recyclable materials like plastic containers and metals
3R	Quality of resource management; reduce, reuse and recycle (Scoring system: 0 = very Low; 5 = Low; 10 = Medium; 15 = High; 20 = very High)		
3R.1	Source separation of 'dry recyclables'	5	There is no recyclable solid waste segregation at the household level, however the informal pickers separate the metals and plastic materials at dumping site and neighborhood
No.	Short name	Score	Justification
3R.2	Quality of recycled organic materials	0	Not applicable - no organic material is being composted during survey.
3R.3	Focus on top levels of the waste hierarchy	5	Low effort is being exerted towards waste prevention, reduction or recycling.
3R.4	Integration of community and/or informal recycling sector (IRS) with formal SWM system	0	Neither informal activities observed nor recorded does exist according to municipality SWM staff.
3R.5	Environmental protection in recycling	0	Not relevant - No formal or informal recycling observed or recorded.
3R.6	Occupational health and safety	0	Not relevant - No formal or informal recycling observed or recorded.
Total score out of 100		12.5	

Source: Lagatafo Lagadadhi town Sanitation and Greenery Core Work Process, 2018

One can deduce from the focus group discussion held with stakeholder sectors (such as health, municipality, environmental protection, etc) that separation of the recyclable materials

like plastic bottles, and metals were conducted predominantly at the open dumping site and partly during transportation at the edge of the tractor as shown in the figure below. However, the segregation of the recyclable materials was unsafe for health; the individuals who separate those materials did not have any safety equipment and their children sit within the open dumping site. According to information from the head of the health office, these informal pickers were afflicted with acute upper respiratory infections, fever, typhoid, diarrhea, and other cases. Therefore, unsafe segregation menacing the health of the poor whose livelihood depend on waste.

Figure 4.13: The Unsafe Condition of Solid Waste Open Dumping Site at Lagatafo Lagadadhi Town

Source: Researcher field observation, 2019

4.6.7. Inclusivity

For "user" inclusivity the municipality of Lagatafo Lagadadhi scored 46 percent, which corresponds to a poor/medium level of performance with generally inadequate attention being

paid to issues such as equity of service; pubic involvement and educational initiatives. Only a small percentage of the population has access to waste collection services. Worse still, residents have limited "voice" and the problems are beyond the control of the municipality.

For "provider" inclusivity the town scored 40 percent, indicating a low/medium level of performance, which underlines the need to increase engagement with the private sector; promoting the role of the informal sector; and having an appropriate bid process in place for the private sector.

Table 4.19: Result Scored by Lagatafo Lagadadhi Town Iswm Benchmark

No.	Short name	Score	Justification
4U	User inclusivity (Scoring system: 0 = very Low; 5 = Low; 10 = Medium; 15 = High; 20 = very High)		
4U.1	Equity of service provision	10	Each of the4 Kebeles in the Town Administration. For each Kebele the municipality was assigned four tractors to transport the solid wastes from households to the landfill. Six (6) MSEs worked upon those vehicles. One vehicle served the main road, open drainage (ditch), market and other places.
4U.2	The right to be heard	10	Residents have the right/opportunity to participate in annual planning through their representatives (Town council) and direct involvement either in the development team of their residential areas or to report their issues directly.
4U.3	Level of public involvement	10	The community participates in different activities like contributing money for the SMEs; dispose to the temporary site or on the transportation vehicle. They could also discuss issues with the municipality or raise complaint etc.
4U.4	Public feedback mechanisms	10	Lagatafo Lagadadhi has feedback mechanisms through its office structure, Kebele, development team administration
4U.5	Public education &Awareness	10	There are community clean-up events when the vehicles collect and transport the solid wastes weekly. This is one of the mechanisms to see whether the transportation met its mission or not. While the collection is

			taking place, the MSEs make the society aware, whereas health extensions provide awareness and education to the society, even though their numbers are insufficient to reach each household per the schedule. In addition, the municipality has the sensitization program with all government employing cleansing campaigns twice a year during the Kiremt and Tseday season.
4U.6	Effectiveness in achieving behavior change	5	Behavior change is not feasible with the present collection rate of only 10%. Only when the service reaches a reasonable level can such changes be realized.
Total score out of 100		46	

Source: Lagatafo Lagadadhi town Sanitation and Greenery Core Work Process, 2018

4.6.8. Gaps and Key Challenges

- Limited to non-existent service provision in out-lying low-income communities where the road conditions were poor.
- There was a lack of resources to engage with, and educate, the community to the desired level.
- Householders report a high level of dissatisfaction with the present level of services with a high level of complaints regarding the impacts from the negative of the disposal site.
- There were no transparency and publishable key performance indicators which could lead to improved public confidence in municipal service delivery is lacking.
- Inadequate public engagement in planning and decision making.

Accordingly, as shown in Table 4.20, the Lagatafo Lagadadhi town scored 46 percent for “user” inclusivity that equates to poor/medium level of service and 40% for “provider” inclusivity that equates to a poor level of service.

Table 4.20: Result Scored by Lagatafo Lagadadhi Town ISWM Benchmark Indicator Assessment of Provider Inclusivity

No.	Short name	Score	Justification
4P	Provider inclusivity (Scoring system: 0 = very Low; 5 = Low; 10 = Medium; 15 = High; 20 = very High)		
4P.1	Legal framework	10	Local Town bye-laws exist and are sufficient – but they cannot be enforced due to a chronic absence of financial, human, and technical resources and poor capacity of the municipality.
4P.2	Representation of the private sector	0	No private sector involvement in the planning process.
4P.3	Role of the 'informal' and community sector	10	There were informal waste-picking operations at waste disposal site.
4P.4	The balance of public vs. private sector interests in delivering services	10	Private sector activities are extremely limited and the working environment, health and safety, and levels of remuneration were poor.
4P.5	Bid processes	10	According to FEC Bureau of Oromia, bids for services will be based on a fixed price rate. Based on this regulation 199/2010 and directive, all the six (6) MSEs were awarded contracts to provide the services of collection and disposal of the solid waste based on the rate.
Total score out of 100		40	

Source: Lagatafo Lagadadhi town Sanitation and Greenery Core Work Process, 2018

4.6.9. Financial Sustainability - Gaps and Key Challenges

- Clearly, the present budget is woefully inadequate to cover all but a small minority of operational costs related to ISWM. Hence a collection rate of only 42 percent reliant on a single aging agricultural tractor and one trailer.
- As the case in all municipalities, the budget for SWM activities within Lagatafo Lagadadhi town was shared with the Town's beautification program.
- The municipality has difficulty in discussing the SWM budget, as there is no separate account, or accounting procedures. In 2007, SWM operations accounted for 11% of the municipality's budget nearly half of the average for low-income countries (Ndum, 2013).

- The community is charged twice for solid waste disposal, once for door-to-door pickers and at the other time when they pay their occupational taxes.

Overall for financial sustainability, the Town of Lagatafo Lagadadhi scored 42 percent that equates to a poor performance level.

Table 4.21: Result Scored by Lagatafo Lagadadhi Town ISWM Benchmark Indicator Assessment of Financial Sustainability

No.	Short name	Score	Justification
5F	Financial Sustainability (Scoring system: 0 = very Low; 5 = Low; 10 = Medium; 15 = High; 20 = very High)		
5F.1	Cost accounting	5	Budget shared with greenery activities; reflects only some 11% of the municipal budget.
5F.2	Coverage of the available budget	5	The budget is woefully inadequate resulting in shortage of staff and equipment and only 30% coverage.
5F.3	Local cost recovery from households	10	Customers, households, commercial or business centers, real estate, investment projects, can afford the total fee for MSEs to collect/dispose the waste.
5F.4	Affordability of user charges	15	Affordability needed to be linked with amount of solid waste collected to be disposed at dumping sites
5F.5	Coverage of disposal costs	10	Solid waste collected in each household and business area was disposed to the open dumpsite by MSEs, which arrive at each household weekly. Estimated coverage rate was 47% as per the focus group discussion and secondary data.
5F.6	Access to capital for investment	5	There was no solid waste for recycle and reuse
	Total score out of 100	42	

Source: Lagatafo Lagadadhitown Sanitation and Greenery Core Work Process, 2018

4.6.10. Current Solid Waste Status in Lagatafo Lagadadhi Town

Table 4.22: Benchmark Indicator Summary of Current SWM Status

Background information on the Town				
Town		Lagatafo Lagadadhi town		
B2	Population of T	Total population of the Town		52,054 (OUPI, 2017)
B3	Waste generation	Total municipal solid waste generation (Tons/year)		8170 tons
No	Category	Data/ Benchmark Indicator		Results
Key Waste-related data				
W1	Waste per capita	MSW per capita	Kg per year	156.95
			Kg per day	0.43
W2	Waste composition:	Summary composition of MSW for 3 key fractions – all as % wt. of total waste generated		
W2.1	Organic	Organics (food and green wastes) %		86.5
W2.2	Paper	Paper %		5
W2.3	Plastics	Plastics %		9
W2.4	Metals	Metals %		1
W2.5	Waste density	Solid waste density (kg/m^3)		340
W2.6	Moisture content	Moisture content		0
Physical Components (Scoring = % or out of 100)				
1	Waste collection	Full waste collection coverage %		47
		Basic waste collection coverage %		
		Waste Captured by the System %		
1C		Quality of waste collection service %		
2	Waste treatment and disposal	Controlled treatment and disposal %		0
		Semi-controlled treatment and disposal %		0
2E		Quality of environmental protection of waste treatment and disposal %		0
3	Resource	Recycling rate %		5

Background information on the Town			
Town		Lagatafo Lagadadhi town	
3R	Management– Reduce, Reuse,	Quality of 3Rs – Reduce, reuse, recycle %	12.5
Governance Factors (Scoring = % or out of 100)			
4U	Inclusivity	User inclusivity %	46
4P		Provider inclusivity %	40
5F	Financial sustainability	Financial sustainability %	42
6N	Institutions and policies	Adequacy of national solid waste management framework %	33
6L		Local institutional coherence %	50

Source: Lagatafo Lagadadhi town Sanitation and Greenery Core Work Process, 2018

CHAPTER FIVE

5. COMMUNITY PARTICIPATION IN INTEGRATED SOLID WASTE MANAGEMENT LAGATAFO

LAGADADHI TOWN

One of main objectives of this study was exploring community participation within the context of the integrated solid waste management system in Lagatafo Lagadadhi town. This necessitated assessing community participation in the town independently of the results and discussions provided in the preceding chapter, Chapter Four. This chapter thus provides the results of the study on the level of community involvement in terms of their financial, material, and labor contribution towards solid waste management.

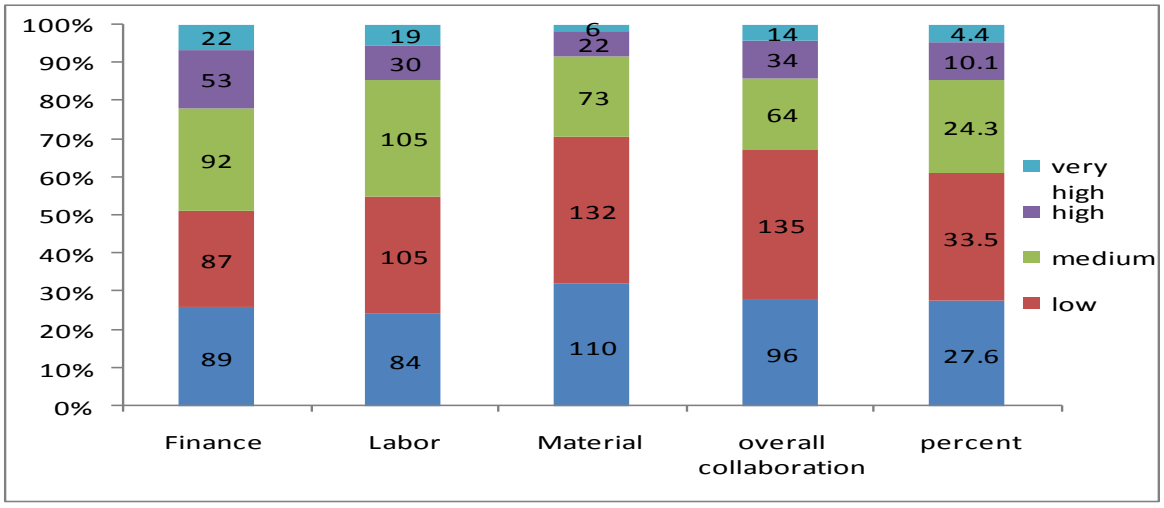
5.1. Community Involvement

Figure 5.1 shows the level of household involvement in financial, material and labor contribution in solid waste management in Lagatafo Lagadadhi town. About 27.6 percent (379) of the respondents said that their contribution was very low, 33.5 percent (459) stated that it was low, 24.3 percent (334) reacted that it was medium, 10.1 percent (139) responded that it was high, and only 4.4 percent (61) answered that it was very high. This indicates that the contribution of the society in finance, material, and labor is quite low. The very low to low status accounted for about 61.1 percent. The level of public involvement indicated on Table 4.19 also reveals that household contribution scored 10 out of 20, which is considered as medium according to the measurement scale of an integrated solid waste management system benchmark indicator score. Community participation was low in collective actions such as participating in

the campaigns with other waste actors who need cultural grounds and policy-oriented involvement (Ahmadi et al., 2016).

Although waste management responsibilities primarily lie within cities and municipalities, many of the successful cases in waste management involve a wide range of stakeholders in their implementation. The key to success is to do what each is good at and collaborate with other sectors in the society, such as the private sector, and communities (Modak, 2016). Another case study in Kaduna metropolis, in north-western Nigeria, revealed that 15.9 percent of the households did not engage in solid waste management system, 20.1 percent participated in paying solid waste management fees; whereas 46.9 percent participated in solid waste management (Yakubu & Mado, 2018). However, in the Lagatafo Lagadadhi town context, community engagement was low although the community is both the major stakeholder and beneficiary of the waste management activities.

Figure 5.1: Community Involvements in Financial, Materials and Labor Resources



Source: Own Survey Data, 2019

5.2. Capacity Building and Sensitization

Regarding capacity building and sensitization about community participation and involvement, 38.6 percent (662) of the respondents in Lagatafo Lagadadhi town confirmed that it was very low; 32.8 percent (563) said that it was low; 19.4 percent (334) reacted it was medium, 6.8 percent (117) reacted that it was high whereas 2.3 percent (39) argued that it was very high. The data indicated that capacity building and sensitization among the development team, the local authorities, and other stakeholders ranged from low to very low.

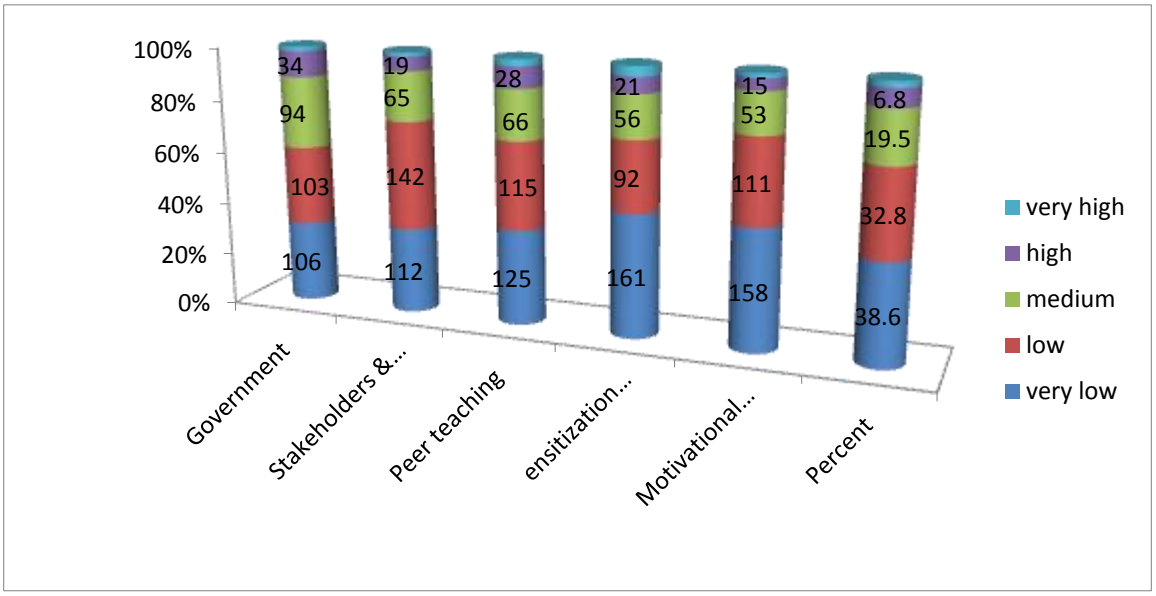
On the contrary, the focus group discussion held with the experts and heads of different sectors justified that the municipality has been conducting solid waste disposal campaigns with the employees of different sectors twice a year during the summer (Kiremt) and spring (Tsedey). In these campaigns, they alleged that the main activities were cleaning the drainages, main streets, market places, and erosion dumped areas as well as creating mobilization and society awareness. Even this information is taken at face value; it means that it is not having the intended result as far as creating awareness and increasing community participation. Besides, as per the integrated solid waste management system benchmark indicator the town scored 10 out 20 as shown in Table 4.19 which is considered to be a medium.

The key informants provided information that the sensitization and promotion of community participation efforts and the involvement of key stakeholders in the integrated solid waste management system remained unsatisfactory. This finding is in keeping with that from a previous study by Kebede and Tolossa (2019), which suggested that the municipality of Lagatafo Lagadadhi "ignored the residents and Community Based Organizations (CBOs) and adopted the customary top-down approach to waste management" (p. 115).

Muller and Hoffman (2001) argued that raising awareness and sensitization through instruction, education, promotion, and communication programs work best when the community is allowed to genuinely participate in the actual planning and implementation of waste management. Rather than cling to the traditional top-heavy approach, Muller and Hoffman (2001) continued to argue, local authorities, political or social leaders, religious leaders, and school teachers can play an important role in stimulating the desired behavior. Grassroots neighborhood and street committees create agreement not only among themselves about good practices but also in their homes and area. They argue and negotiate with one another and develop understanding at the end.

Apparently, this is not the practice in Lagatafo Lagadadhi town. Moreover, the society around the Ethiopian capital, which Lagatafo Lagadadhi a part, is accustomed to burning, collecting, disposing, and cleaning solid waste on November 22 (*Hidar 12)* yearly. There is an aphorism often called '*Hidarsitaten*', which relates to the story in Ethiopia's past in which deadly pandemic transmitted due to poor hygiene ravaged the country. That is why fumigation has been conducted in November (*Hidar)* throughout the country to suspend the spread of that waste-borne diseases and illnesses. Such fumigation is also practiced in Lagatafo Lagadadhi town. However, the municipality did not appear to have built on this veritable practice. According to Muller and Hoffman (2001), sensitivity and awareness campaigns in waste management need to take into account existing cultural practices about waste.

Figure 5.2: Status of Capacity Building and Sensitization in Lagatafo Lagadadhi Town



Source: Own Survey Data, 2019

5.3. Formal Organizational Structure

Asked about the existence of formal organizational structures and with clear roles and responsibilities on the participation of different stakeholders in solid waste management, 31.6 percent (325) rated very low, 33.7 percent (347) low, 22.6 percent (233) medium, 8.6 percent (88) high, and 3.5 percent (36) very high as shown in Table 5.1 below. Conversely, the secondary data on Table 4.22 item 6L, on local institutional coherence, displays that there was existing local institutional coherence from organizational structure to inter-municipal relation with rating value of 50 out of 100. In addition, field observation and secondary data by the researcher showed that there was indeed an organizational structure, as described in table 4.22 in the town Administration, but it was unfortunately non-functional. Besides, the focus group discussion and key informants provided that the formal organizational structure is there,

beginning from the community or neighborhood development team, Kebele, and Town Administration. The key informants underlined that the society may not clearly know the formal structure nor heard about the development team or that it is possible that the formal structure may not function at their level.

The data revealed that community participation is not where it is supposed to be. Urban managers are therefore encouraged to pursue the paths of Integrated Solid Waste Management (ISWM) and Reduce, Reuse and Recycle (3Rs) that place highest priority on waste prevention, waste reduction, and waste recycling instead of just trying to cope with ever-increasing amounts of waste through treatment and disposal. Such efforts will help cities to reduce the financial burden on city authorities for waste management, as well as reduce the pressure on landfill requirements (Modak, 2016).

Table 5.1: The Existence of Formal Structure

No	Items	Very low	Low	Medium	High	Very high	Total
1	There is a structure organized for ISWM within the society	114	126	74	18	11	343
2	The organized structure has roles and responsibilities for each individuals and households	118	124	72	19	10	343
3	There is an organization of capable SME for ISWM	93	97	87	51	15	343
	Total	**325**	**347**	**233**	**88**	**36**	**1029**
	Percent	**31.6**	**33.72**	**22.64334**	**8.55**	**3.499**	**100**

Source: Own Survey Data, 2019

5.4. Empowerment

The literature showed that society empowerment from problem identification to planning, implementation, decision-making, and evaluation is necessary for effective solid waste management. Table 5.2 sheds light on the level of community empowerment in solid waste management in the town of Lagatafo Lagadadhi town, where 31.9 percent rated it as very low, 35.6 percent low, 19.9 percent medium, 9.0 percent high and 3.6 percent very high. The results indicate that the town has a long way to go towards community empowerment in integrated solid waste management because 67.5 percent rated it from very low to low.

Table 5.2: Community Empowerment in an Integrated Solid Management

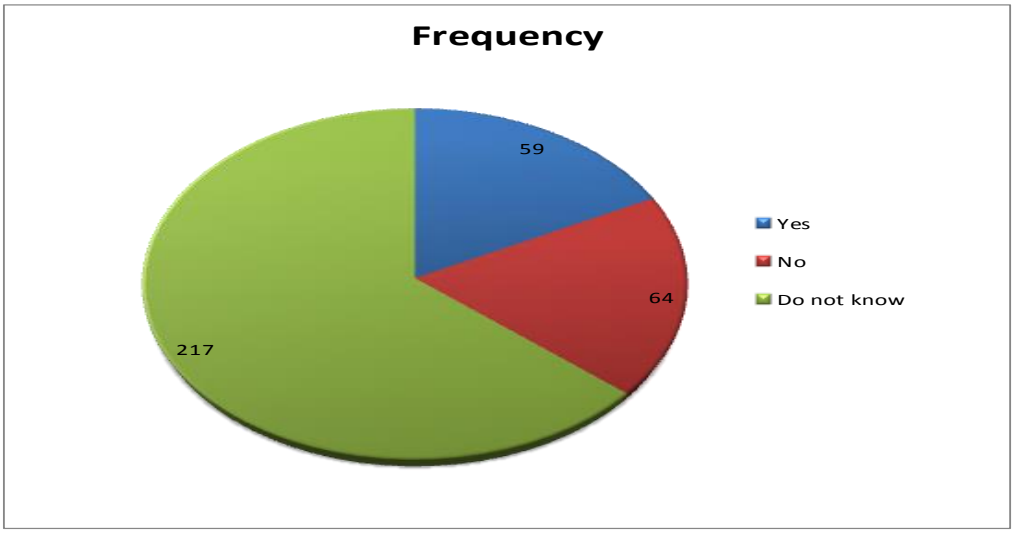
No	Items	Very low	Low	Medium	High	Very high	Total
1	The households participate the ISWM annual planning management	118	104	74	37	10	343
2	The households participate the ISWM in decision making	112	110	72	35	14	343
3	The society participate for ISWM of the town administration actively	102	131	66	31	13	343
4	The society empowered for the process of IWSM	111	135	62	27	8	343
5	The community participate in problem solving or trouble-shooting	89	122	85	30	17	343
6	The community monitors and evaluate the progress	124	130	50	26	13	343
	Total	**656**	**732**	**409**	**186**	**75**	**2058**
	Percent	**31.9**	**35.57**	**19.87366**	**9.04**	**3.644**	**100**

Source: Survey data, 2019

5.5. Awareness about the Laws Enacted

Figure 5.3 depicts that 17.4 percent (59) of the respondents reacted that they know the laws enacted, 18.8 percent (64) reacted that there are no laws enacted for municipal ISWM, surprisingly 63.8 percent (217) responded that they do not have any information about the laws. Regarding public awareness about laws and regulations of solid waste management, only 24 percent of respondents indicated they were aware about any laws and regulations dealing with waste management. Almost two thirds of respondents did not have awareness about this issue. Contrarily, the secondary data makes it clear that the council of the Lagatafo Lagadadhi town Administration has been reviewing and adapting its bye law solid waste and sanitary issues since 2013, in line with the integrated waste management plan for the Town. These bye laws address illegal dumping and sanitation-related problems and penalties for dumping in open places within residential, farm, and open spaces. The by-laws are indeed in line with national and international conventions, proclamations, and regulations.

Figure 5.3: Community Awareness about ISWM



Source: Survey data, 2019

5.6. Overall Status of the ISWM

Table 5.3 depicts how the respondents rated the overall status of community participation based on item: "How do you measure the overall status of SWM in an integrated manner with community participation?" Accordingly, 53 percent (194) rated it low, 23.5 percent (86) very low, 17.8 percent (65) medium, 3.0 percent (11) high and none of them said the status was very high. This indicates that over 75 percent of the respondents replied that the overall status of community participation in integrated solid waste management system at Lagatafo Lagadadhi town Administration ranged between low and very low. The secondary data from the team evaluation report presented in multiple Tables, from Table 4.20 to Table 6.2, also revealed that community participation and the overall integrated solid waste management in Lagatafo Lagadadhi town Administration was below 50 percent. Based on this information, it appears that the community in Lagatafo Lagadadhi town is not satisfied with the solid waste management service it is receiving and they don't feel that they are participating in the solid waste management system in an integrated manner.

Table 5.3: Overall Status of SWM in an Integrated Manner with Community Participation

	Frequency	Percent
Very low	86	23.5
Low	194	53.0
Medium	65	17.8
High	11	3.0
Total	356	97.3

Source: Survey data, 2019

5.7. Effects of Community Participation in Integrated Solid Waste Management in the Study Area

The study has examined the effects of community participation on integrated solid waste management in the study area. Accordingly, the study has measured community participation in four major variables namely; collaborative input of the community; community Development Activities, structural Organization and community Empowerment efforts. These four variables were measured using survey indictors and considered as explanatory variables of the study based on the literature reviewed in chapter two of the manuscript. As it is indicated in chapter two, the formulation of the research variables has been done based on pre-existing assumptions and scales found in the literature. To see the effects of these explanatory variables on the dependent variable (integrated solid waste management), an ordinal regression test was conducted.

In this regards, the following table 5.4 presents the regression model which indicates the effects of community participation on integrated solid waste management in the study area.

Table 5.4: Model Summary

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.504[a]	.254	.245	.644

a. Predictors: (Constant), Community Empowerment, Structural Organization, Collaboration Input, Community Development

As presented in the Table 5.4, the coefficient of determination R square is 0.254 and R is 0.504 at 0.00, significance level. The coefficient of determination indicates that 25.4% of the variation on integrated solid waste management is attributed to the effects of community participation as measured by those four variables community participation. This implies that there exists a significant relationship between community empowerment, structural organization, collaborative inputs, and community development and, integrated solid waste management in the study area.

In addition, the Analysis of Variance (ANOVA) results as shown in Table 5.5 confirms that the model is adequacy for this data since the p-value of 0.00 is less than 1% level of significance Statistically, to test the assumption, explanatory variables do have a significant effect up on the dependent variable of the study.

Table 5.5: Test of Model Adequacy (ANOVA) for Community Participation

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
	Regression	46.963	4	11.741	28.324	.000[b]
	Residual	138.034	333	.415		
	Total	184.997	337			

a. Dependent Variable: overall status of SWM in integrated solid waste management

b. Predictors: (Constant), Community Empowerment, Structural Organization, Collaboration Input, Community Development

It can be seen from ANOVA table that the p-values for explanatory variables is 0.00, which is less than both 0.05 and 0.01 level of significance. Thus, it can be concluded that community empowerment, structural organization, collaboration input, community development can affect

the status of integrated solid waste management of the town. From the signs of the estimated regression coefficients, it is seen that the direction of influence is linear. The coefficient of determination further indicates that variables of community participation have positive and significant effect on ISWM (Table 5.5).

Furthermore, the result indicates in the following table number 5.6, indicated that community collaboration input and community empowerment have significantly affect ISWM. This implies promotion of community input and efforts of empowering the community improves the performance of ISWM in the study area. On the other hand, the remaining two variables had no significant effects on the dependent variable.

Table 5.6: Test on Coefficient of Regression

Coefficients[a]

Model	Un standardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	.872	.115		7.563	.000
Collaboration Input	.064	.014	.290	4.559	.000
Community Development	.011	.014	.055	.766	.444
Structural Organization	.015	.018	.053	.858	.391
Community Empowerment	.026	.010	.183	2.479	.014

a. Dependent Variable: Status of SWM in integrated manner with community participation

CHAPTER SIX

6. CHALLENGES OF POOR SOLID WASTE MANAGEMENT IN LAGATAFO LAGADADHI TOWN

This chapter exclusively focuses on analyzing the results and discussions of the far-reaching consequences and challenges of the haphazard and poor handling of solid waste in Lagatafo Lagadadhi town. This is followed by an analysis and discussion of the challenges of solid waste around the open dumpsite and the environmental, economic, and health impacts arising from the haphazard and poor handling of solid waste.

6.1. Challenges of Solid Waste around Open Dumpsite in Lagatafo Lagadadhi Town

The absence of a properly engineered disposal site is one of the main agents causing environmental pollution and threats to public health in Lagatafo Lagadadhi town. Accordingly, 59 percent (216) of the respondents stated that open dumpsite posed public health risks; 18.9 percent (69) said that there was uncontrolled dumping even at the dumpsite, and 12.3 percent (45) argued that the open dumpsite contaminated groundwater (Table 6.1).

The main problem that the community is facing with respect to the open dumpsite is health-related. During the focus group discussion, experts and heads of different sectors with the municipality expressed that those around the open dumpsite are facing acute upper respiratory infections and fever and a host of illnesses such as typhoid and diarrhea. Improving environmental conditions in cities and towns helps in reducing poverty directly as well as indirectly. The open dumpsite is not only a nuisance but also, health hazard. Such unprotected and open dump sites put the health of residents in jeopardy as it is conducive for the breeding of

mosquitoes, rats, houseflies, and other vectors of infectious diseases (Sinthumule &Mkumbuzi, 2019). It is an environmental danger as well.

In many cities, as is the case in Lagatafo Lagadadhi town, the poor do not have access to formal solid waste collection services and live in unsafe, marginal, and environmentally hazardous areas such as polluted land-sites near the solid waste dump sites. These conditions lead to poor environmental health, which aggravates poverty and leads to impacts such as loss of income due to sickness and disease, inadequate medical treatment, and increased spending on healthcare which depletes household savings (Kaza, 2018).

The municipality's poor handling and monitoring of the dumpsite encourages the poor to make a living out of the tragedy. Modak (2016) argued that informal solid waste collectors, often operating without any protective equipment, are exposed to a wide range of health risks such as HIV, tetanus, respiratory problems, neural damage, injuries, premature drinking, stress, skin, and gastric problems. Similarly, while the exposure of communities closer to the dumpsites is higher, there are broader public risks associated with air pollution as well.

The poor service could also prompt households to resort to open-air burning of the waste they generate and those they stumble into in their neighborhoods. The inefficient local open-air burning of wastes could in turn produce air pollution. Let alone the spontaneous combustion of refuse at dumps, household levels or neighborhood levels, the incineration of waste can create pollution at plants if the latter lack effective treatment facilities (Bernstein, 2004).

A study in southeastern Turkey by Bernstein (2004) indicates that there may be a close relationship between proximity to dumpsites and community health, particularly for the poor. Residents routinely faced a lot of diseases and illnesses because they have to live close to the landfill. "Children are playing with syringes and bottles. They are dirty. Children are sick, and

there is no doctor." Residents of communities also added: "The wind spreads plastic bags from the landfill. Our cattle are ill because they eat these plastic bags."

The leachate from the dumpsite pollutes underground water, which is an important alternative water source for the residents and also loose papers and plastics blown by wind result in an aesthetic intrusion of the surrounding environment. A study conducted by Nibretu and Degefa (2019) also noted that poor and improper solid waste management at Lagatafo Lagadadhi imposed adverse effects on the community's economic wellbeing and health, not to mention the residents' loss of the aesthetic values of the environment.

Table 6.1: The Major Problems Encountered on the Open Dumpsite in Lagatafo Lagadadhi Town

Risks	Frequency	Percent
Public health risk	216	59.0
Groundwater contamination	45	12.3
Causing an eyesore with unpleasant odors	9	2.5
Uncontrolled dumping of wastes in the open dumpsite	69	18.9
Nothing is wrong with the dump site	13	3.6
Total	352	96.2

Source: Survey data, 2019

6.1.1. Environmental Challenges

Leaks from the waste may contaminate soils and water streams, and produce air pollution through emissions of e.g. heavy metals and persistent organic pollutants (POPs), ultimately creating health hazards. Other nuisances caused by uncontrolled or mismanaged waste disposal, which may affect citizens negatively, include impacts at local level, such as landscape deterioration, local water and air pollution, as well as littering (WHO, 2016).

According to focal group discussion and field observation, today Lagatafo Lagadadhi town is faced with poor solid waste management with the attendant short-term and long-term environmental problems. One of the main problems facing the Town is open and indiscriminate dumping of refuse. Moreover, piles of decaying garbage are found in strategic locations in the heart of the town. Leachates from refuse dumps are most certainly percolating into the soil and contaminating both underground and fresh water sources. Moreover, the Town's open landfill is located on the top slope of Lagatafo River. Run off from the landfill can easily pollute the river, especially during the rainy season.

Adding salt to the injury, scavengers and stray animals invade the roadside garbage and litter the waste over large areas causing much aesthetic damage to the atmosphere. In addition, the organic solid waste emits obnoxious odor upon decomposition. In addition, waste products like plastic and rubber easily pollute the atmosphere with noxious fumes. The fact is that due to the poor management of solid waste management, we can find solid waste in every corner of the Town becoming a source of air and water pollution, land contamination, and environmental degradation.

6.1.2. Economic Challenge

The classical economic mechanisms of supply and demand controlling the flow of goods and services do appear to fail when it comes to waste materials. Consequently, to protect the natural environment, government and society need to take appropriate measure. Among the proper measures to control waste are regulations prohibiting the uncontrolled disposal of waste and prescribing minimum standards for treatment and deposit. Controlled disposal or recycling involves costs, i.e. waste materials are assigned a negative economic value in the form of a

disposal fee. In exchange for the disposal fee, the economic value absence of pollution is created (Ludwig *et al.*, 2003).

The central economic problem is allocating the costs for a clean environment to all the stakeholders. Waste management used to be the responsibility of the public domain and financed by taxpayers, with little or no incentive for the consumer to reduce the rate of waste production. In order to incentivize waste reduction, the "polluter pays" principle has been introduced and increasingly used in many countries (Ludwig et al., 2003).

In high-income countries, operating costs for integrated waste management, including collection, transport, treatment, and disposal, generally exceed $100 per ton. Lower-income countries spend less on waste operations in absolute terms, with costs of about $35 per ton and sometimes higher, but these countries experience much more difficulty in recovering costs (Kaza et al., 2018).

From field observation in Lagatafo Lagadadhi town, there was evidence that the Town still loses a significant amount of potentially valuable recourses and “secondary raw materials” such as metals, wood, glass, paper, and plastics which can be recycled or reused. Even though each household in the Town currently generates on average 156.95kg of waste every year, only 5% of this waste is reused or recycled.

While waste can make a big contribution to economic growth and job creation, a study published by the EC in 2012 showed that full implementation of EU waste legislation saves €72 billion a year. The same study noted that the EU recycling sector valued at €42 billion and creates over 400, 000 jobs by 2020. However, even in the EU, illegal waste operations are causing missed opportunities for economic growth, a finding backed up by several case studies (BIO Intelligence Service, 2011; EC, 2012). Clearly, informal waste management activities can

provide income and support the livelihoods of the poor and marginalized, but the price in terms of direct health impact for those involved is likely to be very high (WHO, 2016). Unfortunately, Lagatafo Lagadadhi is experiencing not only lost opportunities for economic gain but also harvesting the ill-effects of poor solid waste management.

6.1.3. Health Challenge

That improper waste management can have negative impacts on both the environment and public health is well known. Negative impacts can be due to different handling and disposal activities resulting in health problems. Inadequately disposed or untreated waste may cause serious health problems for populations surrounding the area of disposal or elsewhere. Uncontrolled or mismanaged waste disposal practices are known to cause various diseases such as bacillary dysentery, diarrhea and amoebic dysentery, plague, salmonellosis, trichinosis, endemic typhus, cholera, jaundice, hepatitis, gastro enteric diseases etc (WHO, 2016).

In urban low-income neighborhoods such as Lagatafo Lagadadhi town, up to two-thirds of solid waste is not collected (Baker 2012). In areas with poor service coverage such as Lagatafo Lagadadhi town, the incidence of diarrhea can be twice as high and acute respiratory infections can be six times higher than in areas with frequent waste collection (UN-Habitat 2010). Waste is often dumped or burned, releasing toxic airborne chemicals and liquid runoff that contaminates vital water sources (Akinbile and Yusoff, 2011). And the Lagatafo Lagadadhi region is a vital water source.

During the focus group discussions with Health professionals and experts of the Town, they openly admit that improper management of solid waste could be causes for complication of health problems. They do understand that vectors like rats and insects invade refuse dumps and

breed potentially spreading various diseases in the Town. For instance, rats dwelling in the dumpsite could consume infectious solid wastes potentially spreading diseases like plague, salmonellosis, trichinosis, and endemic typhus. In addition to this, Water and food contamination through flies causes various diseases in humans as dysentery, diarrhea, and amoebic dysentery. The greatest danger is to the water supply, which if contaminated with pathogens present in solid wastes, may result in cholera, jaundice, hepatitis, and gastro enteric diseases.

The choking of drains and gully pits by the solid wastes, which were evident during the field visits, has resulted in water logging, which facilitates the breeding of mosquitoes enhancing the probability of diseases like malaria. Even if Lagatafo Lagadadhi is unknown as a malaria-prone region, it is difficult to be complacent in the age of disruptions and anomalies caused by climate change. Moreover, unsafe handling medical wastes could become conduits for disease transmission. The risk of body injury could not be ruled out due to the improper handling of sharp materials, which in turn could cause transmittable diseases like HIV/ADIS. The dismal health statistics compiled by the municipality as shown in Table 6.2 below cannot be unrelated to poor management of solid wastes.

Table 6.2: The Prevalence of Diseases Caused by Poor Management of Solid Wastes

Types of disease related to solid waste	From 41,823 total case treated in health centers in 2017	From 32,301 Total case treated in health centers in 2018	From 40,672 Total case treated in health centers in 2019
AURTI	8112	5675	5335
Typhoid Fever	221	956	651
Diarrhea	5868	2144	1545
Pneumonias	166	293	81
Total	**7067 (16.9%)**	**9050 (28%)**	**6222(15.2%)**

Source: Lagatafo Lagadadhi Town`s Health Office, 2019

CHAPTER SEVEN

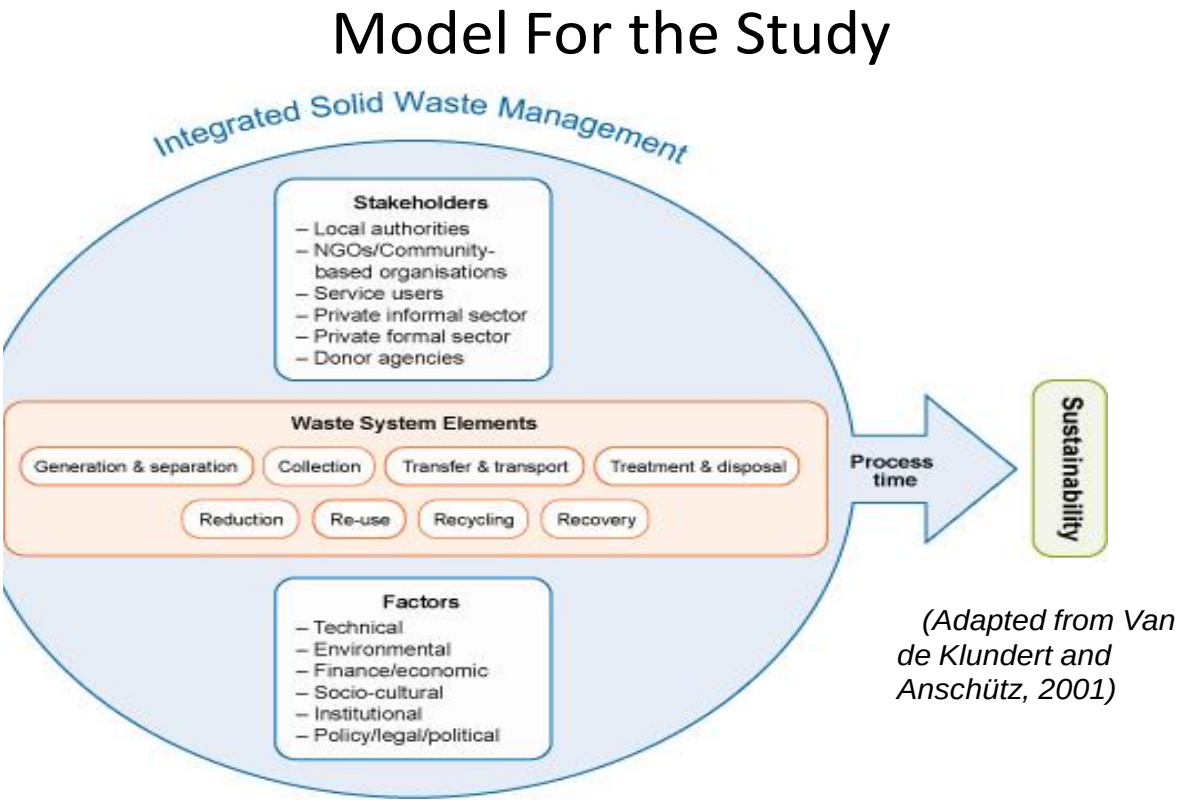
7. INTEGRATED SOLID WASTE MANAGEMENT MODEL DEVELOPMENT FOR LAGATAFO LAGADADHI TOWN

Integrated waste management planning is a dynamic tool including aspects that range from policy-making and institutional development to technical design of integrated solutions for the handling and disposal of waste. The concept of ISWM differs a lot from the conventional approach towards waste management by seeking stakeholder participation, covering waste prevention, and resource recovery, including interactions with other systems and promoting an integration of different habitat scales (town, neighborhood, and household). ISWM does not cope with waste management as just a technical issue, but also recognizes that political and social factors play a very important role in it (UNEP, 2009).

Planning and enforcing ISWM requires comprehensive data on present and anticipated waste situations, supportive policy frameworks, knowledge and capacity to develop plans/systems, proper use of environmentally-sound technologies, and appropriate financial instruments to support its implementation (UNEP, 2009). In an urban setting ensuring better human health and safety is impossible without an effective solid waste management system.

The system needs to be safe for workers and public health. Besides these requisites, the system must be environmentally sustainable and economically feasible. An economically and environmentally sustainable solid waste management system is effective if it follows an integrated approach (Saikia&Nath, 2015). The planning of integrated solid waste management system has been explained below in a study for Lagatafo Lagadadhi town.

Figure: 7.1: ISWM Model



(Adapted from Van de Klundert and Anschütz, 2001)

7.1. Legislative Framework

In Ethiopia, certain national policies are available to improve Solid Waste Management (SWM) with respect to local conditions. The Constitution of the Federal Democratic Republic of Ethiopia clearly provided the right to live in a clean and healthy environment. On the other hand, it imposes duty on government and citizens to keep and enforce this right. The Urban Development Policy of Ethiopia, Integrated Urban Infrastructure Provision Strategy, and Mechanism, Urban Solid Waste Management Strategy and health policy have relevance for the proper management of solid waste. In addition, Ethiopia has enshrined in its constitution a host of international treaties and agreements. Article 13 of the FDRE constitution commits the

country to comply with these international treaties and agreements. Furthermore, there are also local policies that need to be followed because SWM is a local issue where policies are translated into regulatory and economic instruments for their implementation.

Environmental protection laws and acts usually cover SWM at the national and the local levels along with a possibility of other laws, such as provision of public services, covering all or some aspects of it. The policies addressing various economic sectors, such as industry and agriculture, and the specific laws for healthcare facilities, construction, and demolition activities may, directly or indirectly contain specific clauses on SWM.

The primary law on waste management is the Solid Waste Management Proclamation No. 513/2007. Released in February of 2007, the proclamation's main goal is to increase community Participation. The Solid Waste Management Proclamation works hand in hand with the Environmental Pollution Control Proclamation No. 300/2002 which mandates that all urban governments to devise and implement safe and effective mechanisms to handle, transport, and store municipal waste. It also states that any transporting or treatment of municipal waste can only be done with a permit from the Ethiopian Environmental Protection Agency.

7.2. Gap Analysis

The existing state of SWM in Lagatafo Lagadadhi town and the Gaps were identified through descriptive survey, focus group discussion, observation, comparing secondary data with National urban solid waste management standard which are presented in detail in Chapter Four are the major gaps which pertinent solid waste management in the town. To sum up the main gaps:

- Lack of active community participation in integrated solid Waste management,

- Lack of specific SWM training, including, equipment operation and maintenance, dumping design and operation, route planning, recycling techniques, equipment requirements, etc,
- Lack of financial resources impeding the ability to plan, structure, and operate an integrated solid waste management system,
- Less attention given to enact and enforce local policies and initiatives at the local and regional level,
- The absence of a strong supervisory entity for SWM,
- Limited management information system to record and monitor SWM activities.
- Shortage of skilled manpower in key positions and vacant positions remain unfilled by competent professionals.
- At the Federal level, SWM activities are well defined and responsibilities apportioned through a number of legal instruments. However, there is limited capacity (institutional, financial, and technical) to implement and enforce Federal policies and initiatives at the local and regional levels.
- Cooperation and coordination at the regional level was weak again primarily due to resource constraints. No sufficient amount of financial resources is allocated at the local level to better implement Federal laws, policies, and standards.
- No standardized, competent national SWM education and training mechanism is in place to disseminate information about Federal policies and capacity building.
- The absence of an appropriate national database on existing systems, practices, and patterns of SWM, which is a key challenge preventing the opportunity for efficient planning and monitoring.

7.3. Needs Assessment for ISWM of the Town

Prioritized needs were formulated based on the gaps identified and include:

- Active community participation activities of ISWM
- Community access to waste collection services, equality of waste management services, and effective communication.
- The need to waste reduce, reuse, and recover through sorting and segregate at home, transfer sites and final deposal sites
- The need for additional IWM infrastructure to effectively treat and dispose waste
- The need for reliable data and information from industry, businesses, and households (on general and hazardous wastes) that will assist in waste diversion and valorization
- The need for institutional strengthening and capacity building to enforce laws governing waste management. The involvement of the private sector is required for cost effectiveness, improved quality, and better coverage of service areas.
- Capacity building there is a great need for disseminating information on new technologies for waste management and the promotion of public awareness.
- User and provider inclusivity involving all stakeholders from planning to implementation and monitoring of changes ensures effective communication between users and providers and help raise public awareness.
- The need for the financial sustainability of services and the challenge of finding sustainable sources of revenue and investment finance
- The need to produce compost at home and at town level
- The need to have material recycling society

- The need to apply circular economy to generate income and job creating opportunity

7.4. SWOT and Stakeholders Analysis

This section analyzes the full scope of the situation of waste management in Lagatafo Lagadadhi town by identifying the strengths, weaknesses, opportunities, and threats (SWOT) to form a basis for planning the way forward. This is followed by a stakeholder analysis.

Table 7.1: SWOT Analysis for Lagatafo Lagadadhi Town

STRENGTHS:	**WEAKNESSES**
• The Municipality is aware of the obligations on waste management. • The Municipality has established waste management units at all levels. • There are strategies and standards for waste management. • The public is increasingly becoming aware of their rights. • There is a growing public-private partnership in waste management.	• Waste management is allotted a low priority as shown by the very low budgetary allocation. • Inadequate political good-will. • Poor public perceptions/attitude on individual responsibility towards waste management • High tolerance for living in a dirty environment • Poor infrastructure in the city; There are many informal settlements hindering proper waste collection.
OPPORTUNITIES:	THREATS:
• Increasing pressure for the involvement of the private sector • Employment opportunities in waste management-based enterprises • Availability of potential financial support from development partners • Investment potential and opportunities in waste recycling, energy recovery, and composting	• Land use claim and conflicts between land owner and municipal authorities of the town. • Lack of regulation and law which govern solid waste at the town level. • Political interference against private investment in waste management service

Source: Organized by researcher, 2019

Table 7.2: Stakeholders Analysis

Stakeholders	Desired behavior	Their needs	Resistance issues	Their influence	Institutional response
The municipality	•Plan implementation • Ownership of the waste management process.	• Cost recovery • Transfer of funds and Consultations from the Federal government.	• Priority setting and commitment. •Financial sector of the Town	High	Community mobilization, participation. and Public Private Partnerships
Community	Ownership	• Empowerment, • Information • Access and improved waste management service	•Dissatisfaction •Low willingness to pay/ cost recovery	High	Community mobilization
Town/town council	• Ratification of legislations	• Implementation of legislation • Equity & quality • Plans & Reports	Giving priority	High	Put in place a strong M&E system and Comprehensive capacity building mechanisms
Line sectors (Environment, Education Water, Finance, Labor, and Women's	• Coordination • Inter-sectoral collaboration	• Evidence-based plans; Reports •Effective and efficient use of resources and coordination •Technical Support.	• Considering waste management as low priority	Medium	•Collaboration • Transparency • Advocacy
Development Partners, NGOs	•Harmonization and Alignment	•Accountability • Participation	•Giving priority for SWM	Medium	• Transparency • Advocacy • Capacity building
Private sectors	Quality	Partnership, rules and Regulations	Low quality	Medium	• Transparency •Collaboration • Advocacy
Civil servants	• Commitment • Participation	•Conducive environment • Transparency	•Dissatisfaction • Unproductive	Medium	• Motivation • Involvement

Source: analyzed by researcher, 2019

7.5. Integrated Solid Waste Management Model Plan for Lagatafo Lagadadhi Town

The main aim of ISWM model development Plan of Lagatafo Lagadadhi town is to significantly transform service delivery of MSW that in turn prevents and mitigates its impact on public health and the environment. Three core intervention areas have been identified for the ISWM Plan based on the findings of the study to address the main identified challenges in the study. These intervention mechanisms in ISWM for study area are provided as follows;

7.5.1. Strengthened Education, Capacity and Advocacy towards Integrated Waste Management for the Community and Municipal Administration

The finding of the study indicated that the Town's community awareness creation program for the public at large to address waste management issues such as illegal dumping and littering, and activities to promote waste reduction and recycling measures is weak. Since waste is a result of human activities, education and awareness creation is an important component to promote better waste management practices. Therefore, this intervention helps to ensure that the ISWMP succeeds in the town by ensuring behavioral change and increasing public participation. Additionally, capacity building and skills development within the municipality is also one of the key interventions needed to achieve the goal ISWM in the town. Thus, the main aims of this intervention mechanism are provided as follows:

- Induce behavioral change in the community to refuse using extra products and consumer goods, which become waste due to excessiveness.
- Create awareness in the community to use durable materials, for instance refusing using single-use plastic and instead using textile or leather packet.
- Build and strengthen waste management capacity in the Town.

7.5.2. Ensure Material Recycling and Promote Circular Economy

This mechanism aims to maximize opportunities of waste monetization by facilitating recycling, recovery, and creating job opportunities in the Town. This has a number of benefits including minimizing the extraction of virgin materials, minimizing climate change impact and the creation of jobs in the waste sector. The mechanism also promotes a shift in the economy from a linear model to a circular one, encompassing the superior design of materials, products, systems, and business models in order to eliminate waste. Thus, the main objectives this mechanism are enumerated as follows:

- Minimize the consumption of natural resources.
- Encourage job creation in waste management.
- Increase waste diversion through reuse, recovery, and recycling.
- Create public awareness on source separation as an essential component of waste management.
- Achieve a three-way source segregation process.
- Create awareness among the general public about the "3Rs" principles.
- Attain material recycling from 5% to 20%.
- Increase coverage of waste collection from below 50% to 100%.
- Promote extended producer responsibility in the Town.

7.5.3. Develop Composting Plan, which Helps to Reduce Organic Waste through Promoting Active Community Participation in the Town.

This aim can be achieved through the following ways;

- Create awareness among entire community of the town about composting at the household level.

- Reduce organic waste by 50% through composting at home and the municipal level.
- Enhance job creation opportunities and look for market for compost.
- Reduce emission of greenhouse gases such as CH4.
- Promote urban agriculture and urban greenery using compost made in the town.

7.6. Intervention Activities to develop ISWMP for the Town

The findings of the study have disclosed the key challenges and where interventions are most required. The roadmaps which hold detail key interventions and activities that should be undertaken to overcome the key challenges and gaps identified to ensure compliance with the NUSWMS (2014). Proper Implementation of the ISWM plan would foster transition from the present poor to medium levels of SWM services to good and great levels of SWM services at Lagatafo Legadadhi Town via the provision of appropriate, affordable, and sustainable ISWM services.

7.7. Planned Actions and Activities at the Municipal Level (Bottom-up)

The main purpose of this ISWM plan intervention roadmap is to present projects and activities that can be implemented at the local level in a “bottom-up” approach to bring Lagatafo Legadadhi Town into compliance with the NUSWMS and in turn enhance the quality of the environment of the town and the health of the residents.

The ISWM intervention plan presented here complements the critical components of the proposed National Solid Waste Management Program, which also incorporates a national “top-down” assistance approach. As revealed by the scoring in the ISWM Benchmark summary in Chapter Four of the study, both the physical components and the governance factors of the urban

SWM sector within Lagatafo Legadadhi town require assistance and development. It also demands the involvement of all stakeholders and active community participation. Without such assistance, the health and livelihood of the residents and local environment will be compromised.

This ISWM plan recommends that, the town Administration Devise Capacity Development Plan, involving service providers and the private sector, followed by a draft Capital Investment Plan, which detail potential equipment and infrastructure projects that would be needed to establish a reliable service level.

The town capacity plan is detailed in the national document and is summarized here with specific areas relevant to Lagatafo-Lagadadhi town highlighted

7.8. Town Capacity Development Model in ISWM Plan

Nine key Town Capacity Development Activities have been identified as core program requirements to develop the capacity of the SWM within Ethiopian cities. These include:

1. Strengthen and enhance SWM administrative structure.
2. Implement interrelated financial measures (as articulated within Section 15 of the NUSWMS (2014), to ensure the financial sustainability of existing and planned waste management services.
3. Establish and deliver a structured continuous professional development programme for sector stakeholders based on curriculum developed by the National Programme.
4. Improve management and operational procedures to increase efficiency and effectiveness of service delivery.
5. Design a tariff, cost recovery mechanism and service level that address and ensures “inclusivity” for both the residents and the SMEs providing waste services.

6. Enhance local private sector capabilities and capacity to operate within the sector.
7. Develop and implement a comprehensive and appropriate public education and awareness-raising programme (PEARP).
8. Establish dedicated monitoring and enforcement capabilities and capacity within the Towns.
9. Improve SWM sector health and safety and in particular the use of personal protective equipment (PPE) such as boots, overalls, and gloves.

Town Capacity Development Plan for an integrated SWM system to improve the existing situation and improve compliance with the NUSWMS (2014). The "Soft items" activities, such as institutional capacity building, training, service planning etc. are based upon average international and regional standard.

7.9. Town Investment Plan for an integrated SWM plan system

Lagatafo-Lagadadhi Municipality's SWM assets are presently extremely limited comprising six tractors & trailers, with no skip-bins compatible with collection vehicles and a small non-compliant dump-site. Accordingly, the town requires investment in a number of SWM capital infrastructure and equipment initiatives. Extending the geographical range of and quality of service for waste collection and establishing an improved waste disposal site are clear priorities for the municipality of Lagatafo-Lagadadhi Town.

7.10. Dumping Development

The town should establish an appropriate waste disposal facility, provide operating equipment, sustainable operating capacity, and rehabilitate the two small-unauthorized dumpsites throughout the Town.

- Develop an Action Plan detailing how the municipality intends to comply with the national standards (Section 13.3).
- Properly map and geo-reference the existing disposal-site and have an Environmental Impact Assessment (EIA) undertaken in compliance with the relevant Federal or Regional law (Section 13.4).
- Review options for upgrading the existing disposal-site into a controlled dumping site at least for an operational life of 10 years while planning, funding and doing detailed designs for a new sanitary dumping site in the future.
- Develop an operational plan for the existing disposal-site to address all of the issues identified through the completion of the Environmental Impact Assessment.
- To be in a Class 3 dumping (as a minimum) in compliance with Section 13 of the national Standards, the operational plan should cater to all of the following which can be achieved in the short-term (say 6 – 12 months):
    - Establishment of site boundary in order to distinguish the dumping site
    - Increased use and size of machinery to manage waste loads and layer daily waste deliveries within defined working cell.
    - Application of sufficient cover for waste disposal area
    - Defined separate unloading area and working space.
    - Establishment of drainage system to divert storm water and seepage from surrounding areas and to reduce leachate
    - Introduction of environmental protection measures such as buffer zones, litter control, passive gas venting.

- Introduction of amenities for staff
- Minimum area requirement shall be area required for fill volume plus 20% for additional facilities and site activities.
- Approximate waste acceptance capacity will be 51 – 130 tons / day
- Whole medical and other hazardous wastes, industrial wastes, demolition and construction wastes (except where utilized as cover and site engineering purposes) shall be prohibited from being disposed at such sites.
- Suitable training in dumping operations and plant and equipment shall be provided to those individuals designated to work at the disposal site.

In addition to establishing improved waste disposal facility, a plan is required with appropriate engineering estimates to rehabilitate the numerous informal dumpsites throughout the town, and in particular rehabilitate and clean-out surface water canals and gullies as a priority of ISWM plan development.

7.10.1. Collection and Transport

Procure appropriate equipment to increase the capacity and efficiency of waste collection and transport is one of major issue of ISWM plan development.

Due to the relatively close proximity of the disposal site to the town center, there is no need to construct waste transfer stations. Further, the existing disposal site is sufficiently close to use a tractor trailer combination for secondary waste collection. A series of large wheeled trailers ($8m^3$) should be located around the town and fed by the improved primary collection service.

Eventually, a new waste disposal site will be established within 5km of the town center which is still in range for a tractor and trailer waste collection service.

To support this proposed integrated solid waste management plan development strategy, the following key tasks should be undertaken:

- Purchase two (2) more locally-fabricated/manufactured 4x4 agricultural tractors.
- Purchase ten (10) locally-fabricated/manufactured large wheeled trailers (8 ton).

Finally, as a new disposal site is established, possibly fur away from town, a more mechanized approach may be developed, and this could include purchase of Hook Loader container lift trucks and compatible 40m 3 containers placed at strategically located dedicated transfer sites throughout the town to which the primary collection service connects.

7.10.2. 3R's

The Town should provide equipment for material recycling and recovery at the designated waste disposal site.

Recycling activities are driven by the informal sector within Lagatafo Legadadhi, but are still very much in their infancy or at non-existence level. With additional equipment the existing informal sector, plus the SMEs, can improve efficiencies, allowing new markets to be accessed and increase recovery rates and encourage sustainable job prospects within the sector. Investment might include:

- PET plastic chipper (plastics chipper to shred PET plastic to reduce bulk and increase economies of transporting material to market).

7.10.3. Monitoring and Supervision

Strict monitoring and supervisors through dividing the town in to four kebles and a number of operational zones are helpful to ground the ISWM model in the town

7.11. Sector Operation and Maintenance Enhancement in Integrated Solid Waste Management of the Town

Initial external financial assistance is required to establish improved solid waste management system and related financial flows. Once it is in place and local institutional capacity for planning and sustaining the physical components are established, the Town can sustain it itself. In order to raise community perception of the service and improve the reliability, effectiveness, and efficiency of the service (at all levels, from primary waste collection to final disposal), there is a need for external funding to temporarily subsidies service provision. Subsidized assistance establishing a reliable ISWM system designed to be locally affordable improves public confidence in the system and is anticipated to improve willingness to pay. Service cost recovery and sustainability would then begin to follow allowing subsidization to be gradually removed. Subsidization should only assist operation and maintenance improvements beyond what is currently being provided. In Lagatafo-Lagadadhi town, it is possible that a service coverage improvement of 80% collection rate is achievable within 5 years through applying ISWM.

Subsidization should cover 40% of such system operation and maintenance costs during programme year 1 to assist in the coverage of the operational and maintenance costs of the capital investment projects. In year two, subsidization shall remain at 40% of operation and maintenance costs to cover expansion of service provision to additional areas. In year 3, the subsidy shall be reduced to 20% to provide incentive for the Town to increase cost recovery and reduce reliance on external assistance.

7.12. Combined Implementation Proposal for Integrated Solid Waste Management Model in Lagatafo Lagadadhi Town

The investigation of Lagatafo Lagadadhi Solid Waste Management sector has identified several challenges and gaps that need to be addressed in order to become compliant with the National Urban Solid Waste Management Standards and improve performance against the internationally accepted ISWM benchmark indicators. The Municipal roadmap intervention recommendations presented within this chapter form part of the National Solid Waste Management Programme proposal. This does hold three core components:

1. Capacity building, including the establishment of functioning SWM entities at the town level and professional training of assigned personnel, and establishment of a Programme Management Unit at the national level ;
2. Investments in SWM infrastructure and equipment necessary to extend and improve collection services, deliver 3Rs improvements, and establish regulated disposal sites in compliance with national standards.
3. Town waste management system operational budget subsidization to increase service reliability leading to increased user satisfaction, willingness to pay and, in turn, cost recovery and service sustainability.

7.13. Compost Production as the Integral part of Integrated Solid Waste Management Plan Model of Lagatafo Lagadadhi Town

The compost production Plan in ISWM is very important to reduce solid waste and its pertinent effect in Lagatafo Lagadadhi town. The detail procedure of the plan and its benefits are provided as follows. With the expansion of urbanization in Ethiopia, waste management has become one of the most significant problems of our time. Most of the waste from human

activities ends up in landfills emitting dangerous greenhouse gases such as Carbon dioxide (CO_2) and Methane (CH_4). It also has health risk to people such as landslides and pollution from chemicals in landfills seeping into surrounding soil and water. Rather than dumping everything at a landfill, composting is a more environmentally friendly option in ISWM.

Compost may be used as mulch. Mulch can be an amendment to the soil or a source of additional nutrient. With mulch, soil increases pore space allowing increased water permeability and aeration, as incorporated material continues to undergo further decomposition; they have the advantage of releasing nutrients slowly enhancing the fertility of the soil. Moreover, it suppresses common plant diseases such as Fusarium and Phytophthera, not to mention its environmental and social uses.

Compost produced from solid waste is more advantage than synthetic fertilizers. Physically, it is far better in terms of water and air permeability and water retention. Chemically, all primary, secondary, and microelements exist in locally produced compost, but not in synthetic fertilizer. Organically, microbes increase in variety and quantity and soil animals like earthworms congregated. As microbes consume the feces and food remains of soil animals, microbes become activated facilitating soil aggregation. It is more likely that the proliferation of specific microbes (e.g. disease-causing pathogens) will be kept in check if microbes are present in more varieties and larger quantities (K. Tekakura, 2017).

Since Ethiopia is a developing country, between 70 to 80 percent of the municipal solid waste is biodegradable and this organic matter could easily be converted into natural fertilizer. The same is true for Lagatafo Lagadadhi town; out of the current waste generated from this town 76% is organic (Assefa & Mohammed, 2017). This fraction of the solid waste can therefore be

converted into compost and hence change into something useful than something that harms people and the environment.

Composting Municipal Solid Waste has advantage over other means of waste management practices especially for cities and towns with larger portions of organic waste such as Lagatafo Lagadadhi town.

- It reduces emission of greenhouse gases such as CH4.
- Can be linked with urban greenery such as for plant nursery and greening the city.
- Can be used as means of job creation.
- Can be linked with urban agriculture and hence contribute to poverty reduction.
- Helps to cure farming land degraded by use of chemical fertilizer over a long period of time.
- Can replenish nutrients of land degraded for various reasons.

This composting Plan in ISWM is developed for Lagatafo Lagadadhi taking the current waste generating potential of the town into consideration. The plan considers two cases, the first one is home composting in order to decrease waste from the source and the second one is central composting at the town level. Home composting can be easily implemented within a limited resource and time, but it needs high public awareness. Whereas, central composting needs large investment for building compost shed, purchasing machineries, large space and a skilled work force. For central composting, there is experience taken from the NAMA COMPOST project in composting municipal solid waste, which has been under implementation in six towns of the country (Adama, Bahirdar, Bishoftu, Diredawa, Hawassa, and Mekele) since 2017 (MoUDC, 2019).

Home composting can be prepared by using composting boxes or pits. For central composting, the composting methodology recommended is Controlled Microbial Composting (CMC) Windrow Method. Both Composting methods are selected because of the following reasons:

- Both of them have already been proven to work well in Ethiopia as well as other countries.
- Both are aerobic so decomposition is fast.
- The final product is rich in micro flora and free of sulphites, nitrites, potential pathogens, toxins, weeds etc.
- They reduce the amount of greenhouse gases released to the atmosphere.
- Home compost is highly labour intensive while central composting is less labour-intensive and still quicker than the pit method of composting.
- Compost nutrients are stable and have low ammonium.

The plan is developed assuming that the Lagatafo Lagadadhi municipality will aggressively encourage public awareness programs and distribute sample-composting boxes for home composting. In addition, for central composting, engage Micro and Small Enterprises in transporting waste and composting while the role of the town administration is limited to supporting them in starting the businesses and finding market for their product. Based on this assumption, this planning document has an objective of giving a step by step guidance for Lagatafo Lagadadhi municipality in starting composting as a solution to the existing as well as future solid waste related challenge of the town.

7.13.1. Composting Potential of Lagatafo Lagadadhi Town

Several factors have facilitated increase in the volume of solid waste generated. One of the factors that have led to increased solid waste generation is rapid urbanization (UNEP, 2007). An increased population automatically means increased demand for not only social services but also consumables that potentially present a larger base for waste generation in most cases solid waste. The waste generation potential is estimated for the next five years in Lagatafo Lagadadhi Town as indicated in the Table 7.6 below.

Table 7.3: Waste Generation Capacity of Lagatafo Lagadadhi over Five Years (Taking 10% Increase) (Assefa & Mohammed, 2017)

Waste Type	Annual Generation of Waste in tone				
	2020	2021	2022	2023	2024
All type of Waste	11006.04	12,106.64	13,317.3	14,649.03	16,113.93
Non-organic	26,41.18	2,905.14	3,196.15	3,515.77	3,867.34
Organic	8,364.86	9,201.5	10,121.15	11,133.26	12.246.59

Source: Assefa & Mohammed, 2017

From the above Table 7.6, we can understand that compost production has a huge potential to benefit the Town of Lagatafo Lagadadhi as indicated also in Table 7.7 below.

Table 7.4: Annual Compost Production Projection of Lagatafo Lagadadhi (With Rate of 3.33)

Waste Type	Annual Organic Waste Generation and Compost Production in tone				
	2020	2021	2022	2023	2024
Organic	8,364.86	9,201.5	10,121.15	11,133.26	12,246.59
Compost	2,511.97	2,763.213	3,039.3844	3,343.3213	3,677.65465

Source: Assefa & Mohammed, 2017

7.13.2. Composting Municipal Solid Waste Using Home Compost and CMC Windrow Methods a Step by Step Plan

Development of ISWM Strategy based on the success of model community participation under the strong political support of the town administration is needed to implement this plan. About ¾ of the waste generated from this town is organic. Therefore, prioritizing the reduction of organic for the next five years will be the future direction. The main activities should be promoting separated waste collection at home or neighborhood level, composting at household and at centers, and promoting recycled products and integrating the informal sector.

7.13.3. Home composting

Home composting is usually prepared by box, bin or any locally available materials at household level in small scale. The box or bin type composting system is comparatively more efficient than the conventional windrow system of composting. Experience shows that the box system requires less space and labor, and provides convenience for an operator to monitor the compost process. It requires less turning compared to the windrow system, and as a result the amount of labor required to handle that same amount of waste is greater than a wind row system.

Another positive side of the box system is that waste water from the compost box is drained out to a collection tank or sewerage system in a controlled way, making housekeeping easier and, aesthetically, this system is more attractive to an operator.

The community should be encouraged to commit to a household based solid waste management town wide to reduce MSW generation at its source. The organic waste can be converted into compost at individual households, while the recyclable waste can be sold to other trash collectors. Normally micro-organisms take about three months using existing composters to decompose organic waste into conventional composts. To improve their performance in terms of time efficiency, we can use locally available effective microorganisms.

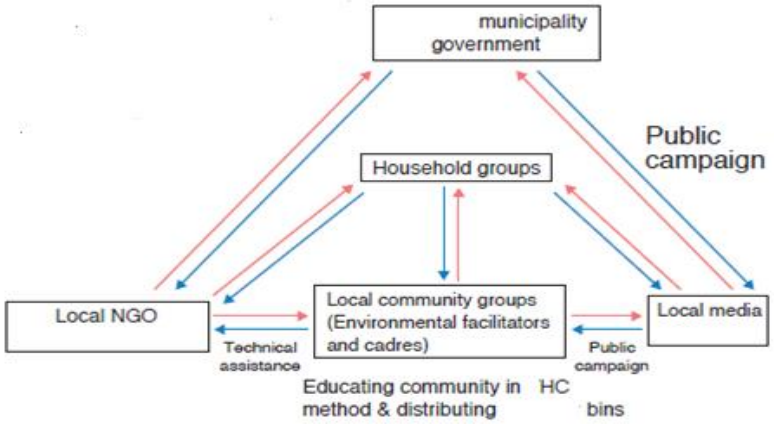
Activities in Home composting:

To start home composting the following steps are necessary.

- The first one is Recruitment of Facilitators and training of Environmental Leaders for community mobilization and
- Secondly, introduce a public awareness campaign covering all sectors and stakeholders in the town.

  The following Figure 7.1 below more elaborates some examples like; Counseling activities, students, businesses, community, Environmental campaign, Socialization in schools, public meetings, etc.

Figure 7.1: Relation among Stakeholders in Home Composting Implementation



Source: Researcher own sketch, 2019

I. Thirdly, establishing a supportive system for promoting composting programmes like distribution of compost bins (see sample bins in Figure 7. 2 below), to attend to training and willing to do residence is necessary.

Figure 7.2: Sample of Home Composting Bins.

Source: *adopted from Institute for Global Environmental Strategies (IGES), D.G.J.Premakumara, 2012*

Composting with bins is ideal for households that consist of one to ten people depending on the amount of waste. The method could be applied for composting not only kitchen waste but also refuse from markets. It possesses key characteristics such as simple methodology, low energy consumption, indoor use, portability, rapid waste decomposition, no odors, and low-cost production (Kurniawan, 2014).

Although organic waste composting is not a new idea regarding environmental sustainability, generally it will encounter public resistance due to bad odors if the composting process is not managed properly. Therefore, the bins should possess some modifications to remove the bad odors and attract insects and rodents. Figure 7.3 below presents successful models of community home composting at the household level that have produced tangible results.

Figure 7.3: Models of Community Home Composting at H/H Level

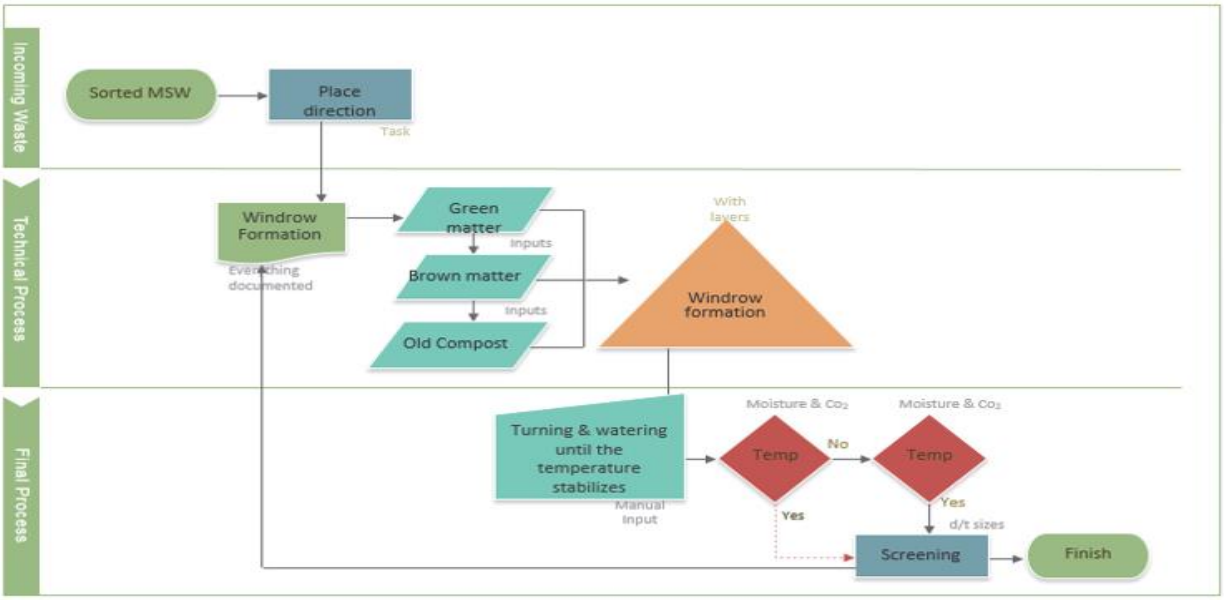
Source: *Adopted from Institute for Global Environmental Strategies (IGES), D.G.J. Premakumara, 2012*

7.13.4. Controlled Microbial Compost Windrow

The success of the Controlled Microbial Compost (CMC) Windrow, which is an aerobic composting method, hinges on carefully controlled moisture, temperature, oxygen, pH, and C to N ratio in the composting material as it decomposes. Controlled Microbial Compost also known as "Luebke compost" produces premium grade, well humidified compost that has been microbial inoculated. The waste is stacked methodically in rows called “windrows”. The windrows are aerated by turning the pile periodically (either manually or mechanically). This process allows for the control of oxygen, moisture, and temperature inside the compost heap that in turn provides the ideal environments for the aerobic organisms causing the decomposition to thrive.

Composting Municipal Solid Waste using a CMC Windrow method passes through a process as depicted in the diagram below (Figure 7.4).

Figure 7.4: Windrow Composting Flow Chart



Source: Organized by researcher; 2019

Planning for Input

Before starting composting, ensuring availability of the raw material which is the organic waste is very important. There are various sources of waste in Lagatafo Lagadadhi town; factories, market, hotels, households etc. that produce more than 11,000 tons of waste a year of which 76% is organic which is significantly higher than the African average of 56% percent (Couth et al., 2010). The challenge is therefore not with finding the source of waste but an organic waste that is not mixed and contaminated. Encouraging segregation of waste at source has to be the major concern when thinking of inputs. Major components of compost mixture can be categorized under the following groups.

a) Brown input material group (dry carbon rich waste), b) Green input material group (wet nitrogen rich waste) and c) Manure input material group.

Since imparting the culture of sorting takes long time, the administration has to first map part of the town that generate more organic waste. These include vegetable markets, hotels, 2-3 villages of residential areas, urban farming areas etc. This will be expanded later on. The selected villages can be incentivized by distributing sorting bags with different colors, awareness raising programs and using social entities such as *Idir*.

7.13.5. Organizing Micro and Small Enterprises

In order to sustain the composting business, it has to be linked with the market and market-driven. The role of the town administration should not be producing compost which is not feasible. In this regard, there is good experience from the NAMA COMPOST project. The role of the municipality is limited to creating favorable conditions for the MSEs and capacitating them to start composting.

Lagatafo Lagadadhi can therefore support those to be engaged in composting and transportation of waste to organize themselves into MSEs by linking them with the market. There is an existing experience in the town of Adama (see Box 7.1 below for details) where waste is transported by MSEs. It is expanding such experience that can ensure sustainability. Since compost may not have market at the beginning, the MSEs have to be supported with a variety of incentives especially at the start. These MSEs are going to assist the municipality in managing solid waste of the town. Therefore, the expenses incurred to support them should not be considered as extra cost.

Here are some of the ways Lagatafo Lagadadhi town can support these MSEs

1. In getting access to loan,
2. Availing infrastructure that requires big capital investment such as composting sheds,
3. Giving them land for composting and sales.
4. Arranging training in composting, entrepreneurship, business management, occupational health etc,
5. Procuring the necessary equipment for the MSEs
6. Arranging initial business relationship with the municipality such as transporting waste and compost sales (please see case study on box 7.1).
7. Help them overcome bureaucratic hurdles

Box 7.1. Good Practice on Capacitating SMEs the Case of Adama Town

Capacitating MSEs
Good Practice form Adama
Adama has organized MSEs who are engaged in Solid Waste Transportation and Composting. The city administration took collateral responsibility and supported the MSEs to get 7 tractors from Adama Agricultural Machineries Manufacturing on loan bases. Then the administration contracted the MSEs to collect waste and supply compost for city greening activities. The city administration then deducts from each payment made to the MSEs to repay the loan. The MSEs are now using the tractors to transport the organic waste separately and their loan is almost paid back. This has made easier for the MSEs to get loan because the city administration took collateral responsibility.

The administration avoided potential failure to pay back the loan by the MSEs by giving them income

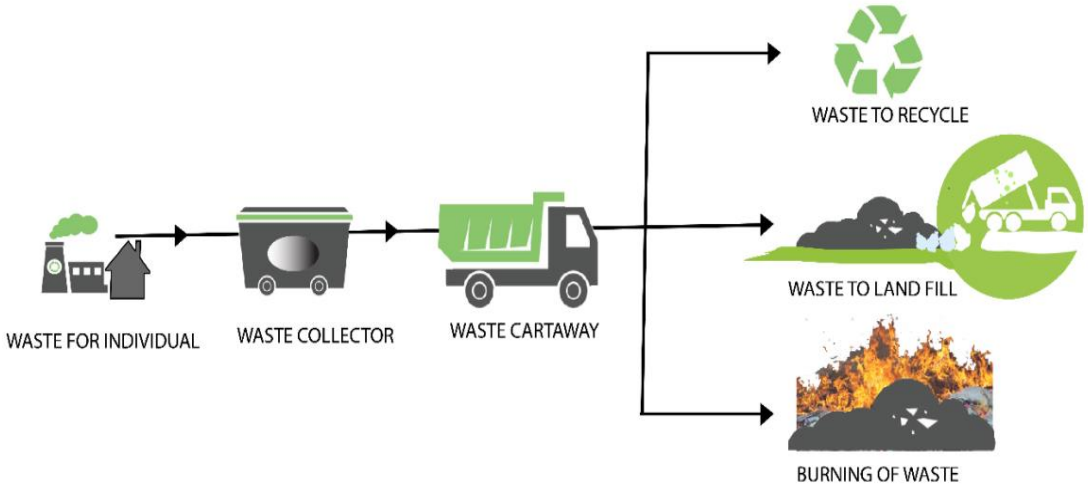
Source: NAMA Compost, MoUDC, 2019

7.13.6. Planning for Separate Transportation

As shown in Figure 7.5 below, all municipal waste does not end up in one place. Care should be taken during door-to-door collection of waste to avoid mixing of the organic waste with hazardous waste and other impurities. Moreover, the organic waste has to be collected frequently while it is fresh to avoid rotting that cause bad smell and compromise quality of the final product. Similarly, the organic waste has to be transported separately.

The green waste is what can be used for composting, while other materials can be recycled or disposed of by combustion or being buried in landfills. The green waste has to be transported separately directly to the composting areas either by SMEs organized for this purpose or by the municipality's existing transportation system. If the existing system is used, the municipality can either arrange a separate vehicle for organic waste transportation or design a separate program such as two days a week dedicated for transporting only organic waste.

Figure 7.5: Fate of Municipal Solid Waste



Source: Organized by researcher; 2019

Arranging Composting Area

Windrow composting method requires a much larger space. Ideally, the land should be far from settlement and have a slight slope of 3 – 5% in the direction of the windrow to prevent pooling of moisture and should have impermeable leachate collection pond. It should be fenced to protect entrance of animals such as scavengers and sheltered from drying winds and excessive sun. The proximity to water and sources of biodegradable waste should be considered to minimize transport costs. Having Compost pad/ stable ground**,** especially if working in the wet season, is mandatory. Moreover, storage space for equipment, stockpiling biodegradable waste, packaging etc. has to be thought of before starting composting business.

Compost Pad: is the surface where the windrows are stacked. It should be stable, durable, and preferably water proof. Normally, it is constructed using a combination of reinforced cement concrete (RCC) and plain cement concrete (PCC).

Leachate Pond: is placed in the lowest corner of the compost pad area. This leachate should be reused for recirculation of nutrients and for maintaining the moisture content of windrows.

One should note that composting can be under taken inside a shed or outside. The first gives advantage of undertaking composting regardless of the weather but it is costlier than the later. Having composting shed is recommended for Lagatafo Lagadadhi so that production can be undertaken throughout the year.

Planning for Market

Market is the major driving factor for composting to sustain so that it can meet its objective: reducing waste that goes to the land fill, protecting the environment and reducing emission. If there is no market that enables the MSEs to generate income enough to motivate them, they will definitely quit the business. The municipality therefore has to support the MSEs in finding

market. One good experience from the NAMA COMPOST Project in six towns of Ethiopia is that the municipalities are the first buyers of the compost which is used for urban greenery. At the beginning, purchase of the compost by the municipality is very important because of the following reasons:

1. The MSEs will have income just from the start hence will see hope in the future and therefore are unlikely to quit early.
2. Despite the fact that the compost will not have market at the beginning due to lack of awareness and the tendency of people to usually not buy new products to avoid risk, the MSEs will not suffer from lack of market.
3. At the beginning the compost may not have the required quality because of lack of experience and therefore selling to outsiders might create bad image.

However, it has to be clear that the municipality cannot create enough market for the compost forever. Assessment of potential markets and customers is therefore key factor to sustain the businesses. A market demand study aiming at identifying compost customers, usages and their demands in terms of both quality and quantity is necessary. Flower farms, urban agriculture schemes, rural farmers, MSEs engaged in plant nursery, organizations who would like to green their compounds and forest projects can be potential market for compost. Since Lagatafo Lagadadhi is close to Addis Ababa, which has a big potential market for compost, this can be taken as an advantage.

The MSEs have to be supported in promoting their compost and maintaining quality. The means of promotion at the beginning can be directly approaching potential customers such as the flower farms, urban agriculture owners, nursery business owners etc. NGOs who promote environmental protection and who are engaged in afforestation programs can also be directly

contacted. Through time, as amount of production increases and quality is maintained, radio, television, online, print media etc. can be used as a means of promotion.

7.14. Monitoring and Support

The municipality can be benefited only if the composting sustains itself as a business that depends on how much income the MSEs are generating. The initial investment made by the municipality can only be justified as long as compost production continues. This requires continuous monitoring and supporting the MSEs to ensure they are producing the required quality of compost and they have a market that absorb what they produce. As a result, there must be a bureau or department well trained and dedicated to monitor and support these and other MSEs. This has to be a regular activity of the municipality like any other government tasks.

Table: 7. 5: Objectives, Indicators, and Activities for the Compost Model Plan of ISWM of the Town

Objective	Indicator	Activities
1. To map major source of organic waste and promote source sorting	1.1 Source of organic waste are mapped 1.2 Source sorting started by waste generators	Conducting research on major source of organic waste
		Identifying incentive mechanisms for source sorting
		Promoting source sorting
		Awareness raising
		Engaging Iddir and development team
2. To Engage MSEs in waste transportation and composting	2.1 MSEs are engaged in waste transporting and composting business	Organizing MSEs
		Training MSEs
		Facilitating for loan access to the MSEs
		Procuring the necessary equipment and OHS
3.To Ensure the organic waste is transported separately	3.1 Organic waste collected and transported separately	Supporting the MSEs to procure transportation facility or organizing transportation program
4.To arrange area for composting	4.1 composting area is developed according to the standard	Identifying area suitable for composting
		Constructing the shed and required facilities
5.To find market for compost	5.1 Sustainable market is created for compost	Compost production started
		Procuring compost by the municipality
		Promoting compost through different means
6.To identify gaps and support the MSEs sustain in the business	6.1 The MSEs are continuously monitored and supported	Monitoring and supporting the MSEs

Source: Organized by researcher; 2019

CHAPTER EIGHT

8. CONCLUSION AND RECOMMENDATIONS

This chapter presents general conclusions drawn based on the findings of the study in line with the research objectives. It, then, presents what the researcher thought to be the major contributions of research. This section also forwards major propositions that help to improve and enhance community participation in an integrated solid waste management system. Finally, further research issues were forwarded depending on the gaps identified throughout the research undertaking.

8.1. Conclusion

Based on the study findings the followings conclusions can be made;

- In previous studies, it is indicated that the higher the level of education, the better the awareness and the understanding of the proper methods of waste disposal (Bernstein, 2004; Machio, 2017). And married couples are also presumed to have high levels of participation in solid waste management (Mlozi, 2011; Phillip &Abdillahi, 2003). However, neither was corroborated in this study. It is inferred from the finding of this study that what matters most in proper solid waste management is attitudinal change towards solid waste management rather than educational and marriage status.

- The literature predicted that daily household solid waste generation rate per person increases as the economic status of households and living standard rises (Beyene, 2005; DerejeDiriba, 2009; LemaAsfaw, 2007; Gebre, 2013). This was

borne out by this study where waste generation by households from the relatively well-off Ropak real-estate was found to be 12% higher than that for other less well-off households.

- Food and biodegradable wastes made up 76.5% of household wastes in Lagatafo Lagadadhi town, which is significantly higher than that for developing countries which was found to range between 53%and 56% (World Bank, 2018) as well as towns like Adama (Lemma Asfaw, 2007) and Hawasa (Dereje Diriba, 2009).

- Normally an integrated solid waste management system follows solid waste generation, sorting, collection, transportation, segregation, treatment, and finally culminates in safe disposal. However, the field observation and focus group discussion revealed that the Lagatafo Lagadadhi town Administration tracks only solid waste generation, collection, transportation, and disposal to the dumping site which means the Town is neglecting to sort, segregate, and treat its solid waste. In addition, the municipality lacked waste collection materials for collection from door to door, like plastic bags and segregation bins. Contrarily, informal waste collectors, most of who were women, separated and segregated the recyclable materials at the dumping site without personal protective equipment and thus putting their health in jeopardy. To wit, these informal pickers were reportedly afflicted with acute upper respiratory infections, fever, typhoid, diarrhea, and other maladies. Lacking any transfer sites and waste collection containers for the temporary duration, solid waste stayed at each household or neighborhood or

thrown to the open spaces, which was where residents lived until the vehicles, came to take away the solid waste.

- The study also showed that waste collection by the municipality was not uniform throughout the Town. There are areas or places where solid wastes were transported daily throughout the week, particularly around the main asphalt road which was done daily. Although this might not be unique to the Town as studies show up to two-thirds of solid waste is not collected (e.g., Baker 2012), the breadth and depth of the problem beg for the need for an integrated solid waste management system enjoying high community participation. The caveat is that the Town lacks sufficient garbage vehicles compatible with the health and safety standards set by the National Solid Waste Management Standard. More disconcertingly, the existing dumpsite fails to meet the basic criteria and requirements of the latter.

- Corroborating the findings by Bernstein (2004) and Adum (2013), this study revealed that women tended to be more actively involved in waste management than their male counterparts. As discussed above, their elevated participation in waste management also meant elevated risks to their health.

- The study revealed that most of the solid wastes (49.6%) were burned at the household level and at the dumpsite, which is in keeping with the practice of most developing countries (Modak, 2016). Moreover, the study showed that the

municipality's haphazard handling of wastes is polluting the city environment as well as important water bodies.

- When it came to "user" inclusivity and "provider" inclusivity, the Lagatafo-Lagadadhi town scored 46 percent, equating with poor to medium level of service, and 40% equating with a poor level of service, respectively.

- The Town has a waste management budget that is woefully inadequate to cover all but a small minority of operational costs related to SWM, which explains why it has a collection rate of only 42 percent reliant as the municipality is on a single aging agricultural tractor and one trailer in the form of equipment. The SWM budget accounts for a mere 11% of the municipality's budget nearly less than half of the average for low-income countries (Ndum, 2013). To make matters, even this meager budget is split with the Town's beautification program. Worse still, the work is financially unsustainable. On a financial sustainability scale, the Town scored 42 percent, which means a poor performance level.

- Based on self-reports and measured by their financial, material, and labor contributions, a whopping 61.1 percent of the respondents rated community participation in Lagatafo-Lagadadhi town's between very low to low. This is very low compared to even sub-Saharan standards. For example, close to 46.9 percent of households participated in solid waste management of the Nigerian town of Kaduna metropolis (Yakubu & Mado, 2018). This is worrisome especially given the high percentage of households headed by relatively the well-educated contrary

to what is suggested by the literature. This suggests that social capital, based on the depth of trust and interactions between households and the municipality, aimed at building strong communities with close-knit social fabric and with shared sets of values, is not well-built (Field, 2003). In addition, based on the levels of mutual trust, mutual obligations and expectations, and the presence or absence of effective channels of communication, social capital appears to be in short supply in Lagatafo Lagadadhi town. Short of giving the community a sense of ownership in the waste management system (Norman, 2000), which is currently lacking, the Town is likely to face further and more serious environmental and health impacts.

- The rationale for effective public participation in SWM has been based on the idea that everyone generates waste and can be affected directly and indirectly if waste is not well managed (Squires, 2006). However, the finding of this study reveals the financial, material, and labor contribution of the society towards SWM was low. The Town does have the organizational structures necessary and customarily supposed to facilitate community involvement. Municipal officials pointed out that they have been conducting concerted campaigns to sensitize the community and create awareness. However, a large proportion of the households, actually 71.4%, rated these efforts from very low-to-low. That is not all: Two-thirds (67.5%) of the households did not believe they have been empowered to actively and genuinely take part in the Town's solid waste management endeavors. Even worse, surprisingly 63.8 percent indicated that they do not have

any information about the laws and regulations about solid waste management. These have perhaps a lot to do with the state of social capital between the municipality administration and the community at large. This finding is in keeping with that from a previous study by Kebede and Tolossa (2019), which suggested that the municipality of Lagatafo Lagadadhi "ignored the residents and Community Based Organizations (CBOs) and adopted the customary top-down approach to waste management". The further hypothesis is that perhaps the community did not believe that efforts by the municipality were aimed at their genuine participation (Muller & Hoffman, 2001). It is also possible that this gap has something to do with the rapid and exponential growth of the Town's population. The doubling of the latter in less than a decade means that households are yet to forge with their neighbors the deep web of interactions and bonds necessary to build, maintain, or nurture social capital.

- The study revealed that today Lagatafo-Lagadadhi town is faced with poor solid waste management with the attendant short-term and long-term environmental problems. Consequently, not only is Lagatafo-Lagadadhi experiencing lost opportunities for economic gain but also harvesting the ill-effects of poor solid waste management. The town still loses a significant amount of potentially valuable recourses and secondary raw materials, such as metals, wood, glass, paper, and plastics which can be recycled or reused. Even though each household in the town currently generates on average 156.95kg of waste every year, only 5% of the solid waste generated by the town is reused or recycled. The research

revealed that one of the main problems facing the town is the open and indiscriminate dumping of refuse. Piles of decaying garbage are found in strategic locations in the heart of the Town. On top of being open and unprotected, the Town's waste disposal site is not properly engineered becoming a source of significant environmental pollution and posing serious threats to public health. Health experts and heads of different sectors with the municipality expressed that those around the open dumpsite are facing acute upper respiratory infections and a host of illnesses such as typhoid and diarrhea. There is a growing impression that the dumpsite has become a breeding ground for mosquitos, rats, houseflies, and other vectors of infectious diseases, which is a common result of open and unfenced dumpsites (Sinthumule & Mkumbuzi, 2019). The cost of this disaster is not proportionally shared throughout the Town. The brunt of the impact falls on the poor, particularly women, who are encouraged and forced to attempt to make a living from the tragedy. Modak (2016) argued that informal solid waste collectors, often operating without any protective equipment, are exposed to a wide range of health risks such as tetanus, respiratory problems, neural damage, injuries, premature drinking, stress, skin, and gastric problems. Next to the poor and marginal, the other victims are those unfortunate to live close to the waste disposal site. A study in south-eastern Turkey by Bernstein (2004) demonstrated a close relationship between proximity to dumpsites and community health.

- Lack of proper management of solid waste is causing environmental pollution and posing threats to public health in Legetafo-Legedadhi town. According to a

survey of the study, 59 percent (216) of the respondents stated that the open dumpsite posed public health risks; 18.9 percent (69) said that there was uncontrolled dumping even at the dumpsite, and 12.3 percent (45) argued that the open dumpsite contaminated groundwater. During the Focus Group Discussion, experts and heads of different sectors with the municipality expressed that uncontrolled open dumpsite causes for health risk in the town those who live around the open dumpsite are facing acute upper respiratory infections and fever and a host of illnesses such as typhoid and diarrhea. The data from the Health office of the town shows that from those who came to health centers for treatment the prevalence rate of diseases caused pertinent to poor solid waste management were16.9% in 2017, 28%in 2018, and 15.2%in 2019.

- The greatest danger of mishandling waste in Lagatafo-Lagadadhi is to the water supply, which is contaminated with pathogens present in solid wastes, may result in cholera, jaundice, hepatitis, and gastro enteric diseases. The choking of drains and gully pits by solid wastes has been shown to result in water logging, which facilitates the breeding of mosquitoes enhancing the probability of diseases like malaria. Even if Lagatafo-Lagadadhi is unknown as a malaria-prone region, it is difficult to be complacent in the age of disruptions and anomalies caused by climate change. Improper dumping of solid waste, for example, 82% in Asella (Lemma et al., 2019) and 76% in Debre Berhan (Tyagi, Fantaw, & Sharma, 2014), appears fairly common in Ethiopian cities. Vital water sources, both fresh and ground sources, remain unprotected to this menace (Cheever, 2011), raising

the risk of water contamination. This study has made it abundantly clear that the same is true in Lagatafo Lagadadhi town. However, the dire consequences of the failure to protect vital water sources through appropriate and modern solid waste management won't be bored by the Town and residents of Lagatafo-Lagadadhi alone. It poses a serious threat and presents danger to Ethiopia's capital, Addis Ababa itself since it is over 5 million inhabitants receive a portion of their potable water supply from Lagatafo Lagadadhi and its surroundings

- In general, factors such as lack of leadership commitment; institutional, socio-cultural, and financial limitations; poor infrastructure and equipment; faulty management arrangements; lack of institutional capacity; ; income; and awareness and attitude are found to be among the key factors to address to improve the solid waste management in Lagatafo-Lagadadhi town

8.2. Recommendations

Today, the emerging town of LegeTafo-Legedadi of Oromia Region, experiencing fast population growth and urbanization, face poor solid waste management that has become one of the most intractable environmental problems. One of the main problems facing the town is open and indiscriminate dumping of refuses. Piles of decaying garbage are found in strategic locations in the heart of the town. Wastes in such places could become a source of air and water pollution, land contamination, environmental degradation, and health problems. The following recommendations are forwarded to curtail the critical problems and the impact of poor solid waste management in Legetafo-Legedadi town:

- The research strongly recommends an integrated solid waste management system which is a holistic and comprehensive system of waste management which enables the town to uses a range of inter-related collection and treatment options. The town administration should follow inclusivity such as involvement of all stakeholders, governmental or non-governmental organs, the formal or informal sectors, for-profit or nonprofit schemes, and take into account to creating linkage between the waste management systems with other systems. In other words, accommodating the aspirations of all stakeholders; from waste generators to waste management and service providers and encouraging local ownership and responsibilities/participation through a consultative approach.

- Constant awareness creation programs in the community to improve their involvement and participation in the solid waste management system should be given. Communities and organizations should be involved starting from identifying solid waste-related problems through planning and implementation phases in the budget year of the Municipality. This makes the community and organizations develop a sense of ownership, sharing the financial burden of the Municipality, provision of facilities and equipment needed for solid waste collection services. Community participation is very crucial for effective and efficient solid waste management. Therefore, a consistent and ongoing educational program is necessary for the success of the waste management system in Lagatafo Lagadadhi town.

- The Town Administration should deal with all types of waste materials, as opposed to focusing on specific materials which means give due attention to sources of municipal solid waste and include such steps as waste collection and sorting followed by one or

more of recycling, composting, landfill or at least controlled dumpsite. It should integrate different response functions such as legal, technical, managerial, financial, and policy.

- Since Ethiopia is a developing country, between 70 to 80 percent of the municipal solid waste is biodegradable and this organic matter could easily be converted into natural fertilizer. The same is true for Legetafo-Legedadhi town; out of the current waste generated from this town, 76.5% is organic (Assefa & Mohammed, 2017). This fraction of the solid waste can, therefore, be converted into compost and hence changed into something useful than something that harms people and the environment. Therefore, the research strongly recommends that the town administration should work on compost production and introducing integrated urban agriculture. The compost or natural fertilizer can be used to produce organic vegetables, ornamental plants, or in nurseries at household and town level. This can easily be linked or integrated with urban agriculture practices or urban greening activities in Lagatafo-Lagadadhi town.

- Applying the concept of a circular economy by establishing a household waste sorting program and encouraging informal waste dwellers in town. This helps to recover materials that can be recycled. Moreover, it reduces the number of wastes requiring collection and disposal. Based on the assessment, household waste can be categorized into three major components i.e. organic decomposable or putrescible, fines, and recyclables. In the short, to middle term, the town can start a pilot household solid waste sorting program into three categories namely putrescible, fines, and recyclables. Efforts should also be made to recover recyclable components of the household waste stream as the assessment result reveal significant amounts of recyclables. The process can be

initiated by conducting a feasibility study on recyclable materials including market, costs, and operational issues.

- Solid Waste Management law should be enacted at the regional level. To minimize illegal dumping, the town should formulate regulations regarding littering and improper disposal of solid waste and these should be strictly enforced. These efforts will not be effective without a strict law enforcement mechanism applied consistently.

- Private sector involvement in solid waste management should be encouraged and establishing and strengthening MSEs for SW management should be a priority issue for the town. Strengthening the capacity of MSEs with waste collection bags, wheelbarrow, pushcarts, shovels, forks, and PPEs may motivate MSEs and help them to reach their ambition. Moreover, it would be helpful to provide them in-depth training on composting, urban greening/ agriculture practices, business planning, financial management, and product marketing.

- Landfill is one essential component of municipal solid waste management. The waste that remains behind or unmanaged through reuse, recycle, refuse and compost initiative should be disposed of safely. In this regard, it is important to establish a sanitary landfill system with due consideration of the experiences with such measures in the country.

- The town municipality/the regional state government should strengthen the institutional set-up and allocate adequate budget to upgrade the existing solid waste management system.

- Solid waste management requires huge resource commitments and should have reliable financing mechanisms. Hence, the town administration should adopt efficient a user-pay financing mechanism like aligning payment of solid waste service with other services like water service, or other options to cover the costs of waste management in the town.

- Waste Collection and Transportation should be improved by using two types of plastic drums to segregate and collect the waste. The plastic drums may have two colors i.e. green and Black/ Blue. Hence the organic decomposable wastes will first be source segregated/ separated using the green drums/buckets whereas the other wastes can be sorted in the black/blue container. The waste should be collected every other day and transported to a pre-identified resource recovery site. The waste can be transported to this site using appropriate transportation mechanisms.

8.3. Recommendation for Further Research

This study investigated community participation in an Integrated Solid Waste Management system especially, focusing on non-hazardous municipal solid waste. However, the issue of liquid waste management and hazardous waste due to the expansion of industrial activities are very critical for towns like Lagatafo-Lagadadhi which were not covered by this study. Therefore, Community participation in the proper management of liquid and hazardous waste needs further research investigation. In addition, farther in-depth reaches are needs that in thematic area helps to create waste material recycling society in the study area in particular in the country in general.

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Appendices

Appendix I: Questionnaire to be filled by Community

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

Ethiopian Institute of Architecture, Building Construction, and City Development (EiABC)

Ph.D. Program in Urban and Regional Planning

Questionnaire to be filled by Community

General Direction

The main purpose of this questionnaire is to collect data from community, for the research conducted on *"Community Participation in Integrated Urban Solid Waste Management in LagatafoLagadadi town administration".* By this questionnaire; you'll be able to identify those aspects of community participation in solid waste management. The results will help you town administration, community, stakeholders and others to show the status and expected roles and involvements of the society in SWM. To obtain the reliable and valid information for the research your open and genuine information is highly appreciated. There is no right and wrong answers and what is needed from you is to show the level of your personal opinion in each item.

This questionnaire has two parts. Part one about respondent's background information, part two close ended questions, with open ended question. Each part has its own instruction. Please read each item carefully and give your response accordingly. If you overlook, respond twice or more for each item it will invalidate the tool, and also lower the response rate. **Thank you for your cooperation!**

Part I: Background information about the respondents

Instruction: In order to answer the following questions, circle the best answer of your choice.

1. Kebele: 1) Lagatafo 2) EekkaDalle3) Dambal4) Lagadadi
2. Gender: 1) Male2) Female
3. Age in years: 1) 15-182)19-25 3)26-30 4)31-40 5) above 40
4. Educational status: 1) No formal education 2) primary school3) secondary school 3) Certificate 4) diploma 5) level graduates 6) First degree 7) Second degree and above
5. Family size: 1) 1-2 2) 3-4 3)4-6 4) above 6
6. Household Occupation: 1) Trading2) Farming3) civil service4) Daily laborer 5) others
7. Marital status of the households: 1) Single 2) Married 3) Divorced 4) Separated 5) Widowed
8. Average monthly income (in birr):

1) Less than 10002)1001-20003)2001-3000 4) Greater than 3000

9. Length of year of the respondent lives in the town:

1) Less than 1 2)1-2 3) 3-4 4)4-6 5) above 6

Part II. The followings are questions presented to community, households, and stakeholders on solid waste management. Answer the followings accordingly and circle the best answer of your choice.

1. Who is handling the solid waste most probably at the household level?
   1) Father 2) mother 3) children 4) housemaid 5) other relatives
2. How do you discard the waste that is no value to your household?
   1) burn it 2) leave it on the street 3) throw it in the river 4) discard it in the communal containers 5) bury it in the backyard 6) bury it on the seashore 7) bury it near the riverbank 8) bring it to the dump site 10) leave it to be collected from the house 11) don't know
3. Is there any door to door waste pickers from house to temporary transfer sites or garbage containers 1) yes 2) No
4. If your answer for question number 3 is 'yes'

   4.1. Who would conduct a payment for them?1) households 2) stakeholders 3) local governments

   4.2. How much would you pay for them per round?

   1) up to 5 birr 2) 5-10 birr 3) 10 to 20 birr 4) more than 20 birr 5) unlimited or as they request us

5. Is there any communal solid waste containers/transfer sites near the residents/houses
   1) Yes 2) No
6. If your answer for question number 5 is 'Yes' the current communal containers/transfer sites in your neighborhood are
   6.1. Distance related 1) too far away from the houses or generation areas 2) with appropriate distant from the generation areas
   6.2. Size related 1) too small to contain the nearby solid wastes 2) with sufficient size
   6.3. Health and safety related 1) produce unpleasant odors 2) having proper treatment
7. Is the solid waste collected from transfer sites? 1. Yes 2. No
8. How many times per week is your solid waste collected from transfer sites?
   1) Daily 2) twice 3) once a week 4) there is no collection schedule 5) don't know
7. Is there any solid waste open landfills in the town administration 1) Yes 2) No
8. If your answer for question number 7is 'Yes' the current open landfills is/are
   8.1. Distance related 1) too far away from the houses or generation areas 2) with appropriate distant from the generation areas
   8.2. Size related 1) too small to contain the nearby solid wastes 2) with sufficient size
   8.3. Health and safety related 1) produce unpleasant odors 2) having proper treatment
9. What do you consider the most urgent problem related to the present site in your neighborhood where you dump your waste? a. public health risk b. groundwater contamination c. it becomes an eyesore with unpleasant odors d. uncontrolled dumping at the area e. nothing is wrong with the dump site
10. Is there any clear role distribution between the community, stakeholders and government in ISWM 1) yes 2) No
11. If your answer for question number 9 is yes how it is exercise in the town _____

12. Rate the following activities of a community in ISWM as: *1) very low 2) low 3) medium 4) high 5) very high*

	Collaboration input: The society	
1	Contribute finance for ISWM	
2	Participate with labor force like annual cleaning program etc	
3	Participate with different material contribution including transportation vehicles, loading	
4	The community are working with the government and stakeholders in collaborative	
	Community Development	
1	The government capacitate the community with skill gaps	
2	There are stake holders and NGO that capacitate the community skill gaps	
3	There is community peer teaching for ISWM (1:5)	
4	The development team of the society has sensitization program like tea ceremonial discussion upon ISWM	
5	There is motivational incentives for the community who manage their solid wastes properly in an integrated manner	
	Organization/Gurnmaa'ina	
1	There is a structure organized for ISWM within the society	
2	The organized structure has roles and responsibilities for each individuals and households	
3	There is an organization of capable SME for ISWM	
	Empowering	
1	The households participate the ISWM annual planning management	
2	The households participate the ISWM in decision making	
3	The society participate for ISWM of the town administration actively	
4	The society empowered for the process of IWSM	
5	The community participate in problem solving or trouble-shooting	
6	The community monitors and evaluate the progress	

13. Is there any proclamation, rule, regulation and directives enacted for ISWM
    1) Yes 2) No 3) I don't know it
14. If your answer for question number 14 is 'yes'. Write the number, article and magazine
    1) Proclamation/s _____
    2) Regulation/s _____
    3) Directive/s_____
15. How do you measure the overall status of SWM in integrated manner with community participation 1) very low 2) low 3) medium 4) high 5) very high

Appendix II: Health Care Facilities Questionnaire

1. General

1.1 Name of the health facility _____-

1.2 Address: Region_____ Town _____Woreda___

1.3 Number of in patients _____ Number of outpatients _____

2. Solid waste management trainings

2.1 Is training of staff available regarding HCWM? ___Yes ____No ___Don't know

2.2 If yes what kind of training is given? _____ in service _____pre-service __other

3. HCWM responsibility

3.1 Who is responsible of HCWM in your facilities? _____Sanitarian Administrator ___Head of health facility _____other specify

3.2 Is there supervision/monitoring? _____ Yes _____No

4. HCWM legislation & enforcement

4.1 Do you have HCWM regulation? ____Yes _____No _____Don't know

4.2 Do you have HCWM guideline? _____Yes _____No _____ Don't know

4.3 Do you have HCWM operational manual? _____Yes _____ NO ____ Don't know

5. Waste segregation practice

5.1 Is there waste segregation practice? Yes _____No

5.2 If yes, what system do you have? Two bin _____ Three _____Four _____ Other specify

5.3 Is there specific container for infectious wastes? Yes _____No

5.4 Is there specific container for sharp wastes? _Yes _____No

5.5 If specific container is available, what kind of container is used for infectious waste?

___Plastic ___ Metallic ___ Cardboard ___Bag

Other

6. Are the following categories of waste handled separately?

6.1 Sharps _____ Yes _____ No _____ Mixed

6.2 Non-share infectious waste _____ Yes _____ No ___ Mixed

6.3 Non-infectious waste _____Yes _____ No _____ Mixed

6.4 Anatomical waste _____ Yes _____ No _____ Mixed

6.5 Pharmaceutical waste ____Yes _____ No ___Mixed

6.6 Chemical waste _____ Yes _____ No _____ Mixed

6.7 Radioactive waste _____ Yes _____No _____ Mixed

6.8 Other specify _____

6.9 Is there secure temporary HCW storage in HF? Yes ___ No

7. What type of container is used for sharp waste? Puncture-proof _ Non-puncture-

8. Waste receptacles location

8.1 Are waste receptacles placed in the HCF building at convenient site? Yes ___ No

8.2 Are there waste receptacles in each ward? Yes _____ No

8.3 Is there sharps containers at each place injection are given? Yes ___No

8.4 Is there a safety box properly assembled? Yes _____ No

9. Waste generation

9.1 What is the overall average quantity of waste generated at your facility? Kg/day

9.2 What is the average quantity of garbage generated? Kg/day

9.3 What is the average quantity of sharps generated? Kg/day

9.4 What is the average quantity of infectious waste generated? Kg/day

10. Health care waste (HCW) transport

10.1 Who transport the HCW? HCF _____Municipal service _____ Private company/SME

10.2 How often they collect from storage and transport? _____ Once a week twice a week _____ other specify _____

10.3 Is there trolleys/carts for HCW transport in HF? _____Yes _____ No

10.4 What type of HCW on-site transport do you have? ____ Open device _____ Closed device

10.5 Where do they transport? _____ Disposal site _____Treatment facility other specify _____

11. HCW disposal method

11.1 Which type HCW final disposal site do you have? _____ On-site _____ Off-site Both

11.2 What type of disposal method do you use for HCW? _____ Open dumping Sanitary land fill _____ Small burial _____ Shallow pit burning ____ Protected pit Open pit _____ Other specify

11.3 Is disposal area fenced to prevent community access? _____ Yes _____ NO

12. HCW treatment

1 Is incinerator used for HCW treatment? _____ Yes _____ No

2 Is incinerator area fenced to prevent community access? Yes_____ No _

3 Is incinerator clean and good working condition? _____ Yes _____ No

4 Is yard area of the incinerator neat and free of sharps? _____ Yes ____ No

5 Does incinerator operator wear protective closing? _____ Yes _____ No

6 Are incinerator operation instructions posted at the site? _____ Yes _____ No

7 Is ash removed regularly and buried properly? _____ Yes___ No

8 Are only infectious wastes incinerated? _____ Yes _____ No

9 How frequently containers are taken for treatment? _____ once a week Every two weeks _____ other specify _____

13. **What other type of HCW treatment method do you use before disposal?**

1. Open burning _____ Yes _____ No
2. Chemical disinfectant _____ Yes _____ Nio
3. Autoclave _____ Yes _____ No
4. Other specify _____
5. Do animals scavenge burn or burial pile? _____ Yes _____ No
6. Is the health unit compound clean? _____ Yes _____ No

14. **Vaccination and budget**

14.1Do you vaccinate your staff against hepatitis B and tetanus? _____ Yes _____ No

14.2 Do you think sufficient budgets are allocated for HCWM? _____ Yes _____ No

Enumerators Name _____ Date _____ Signature

Appendix III: Interview Guide for Integrated Solid Waste Management

ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

Ethiopian Institute of Architecture, Building Construction, and City Development (EiABC)

Ph.D. Program in Urban and Regional Planning

Focus Group Discussion

The focus group discussion is conducted among different sectors expertise of municipality, health, environmental protection, agriculture, and investment with purposive sampling.

Purpose:for triangulation of questionnaire items, to harmonize views of different experts and judges the level of community participation in town SWM. The result of this instrument is to show their views and others to give attention for the problems.

1. Is there any proclamation, rule, regulation and directives enacted for ISWM
   1) yes 2) No 3) I don't know it
2. If your answer for question number 1 is 'yes'. Write the number, article and magazine
   1) Proclamation/s _____
   2) Regulation/s _____
   3) Directive/s_____
3. Is there any clearly defined roles and responsibilities given for community, stakeholders
4. List some of the roles and responsibilities
5. How do you measure the status of SWM in an integrated manner with
   5.1. Community participation 1) very low 2) low 3) medium 4) high 5) very high
   Describe the level of your choice_____
   _____
   _____
   5.2. Innovative technology 1) very low 2) low 3) medium 4) high 5) very high
   Describe the level of your choice_____
   _____
   _____
6. What are the major negative impacts of solid wastes in the town administration?
7. What are the challenges that you encounter in ISWM?

Appendix IV: Solid Waste Generation Collection Data Sheet for Health Centers

Days of data collection	Types of solid waste generated	Health Center name: _____		
Day 1		Kg/day	%	
	Infectious			
	Sharp			
	Municipal			
	Total			
Day 2	Infectious			
	Sharp			
	Municipal			
	Total			
Day 3	Infectious			
	Sharp			
	Municipal			
	Total			
Day 4	Infectious			
	Sharp			
	Municipal			
	Total			
Day 5	Infectious			
	Sharp			
	Municipal			
	Total			

Appendix V: Data Sheet for Daily Waste Generation at Institutional Level in Lt/Kg/Day

Name of institution			Unit	Days							
	Employees	Average number Customers per day		1	2	3	4	5	6	7	

Appendix VI: Data Sheet for Daily Waste Generation at Household Level

Number	Household size	Unit	Days							
			1	2	3	4	5	6	7	

Appendix VII: Data Sheet for Daily Waste Composition

Number	Items	Unit	Days							
			1	2	3	4	5	6	7	
1	Food									
2	Bones									
3	Paper									
4	Textile									
5	Plastics									
6	Grass									
7	Leaves									
8	Wood									
9	Leather									
10	Rubber									
11	Metal									
12	Glass									
13	Ceramics									
14	Ashes/fines									
15	Miscellaneous									