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COLLEGE OF DEVELOPMENT STUDIES

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SOLID WASTE MANAGEMENT THROUGH COMPOSTING APPROACH AND ITS CONTRIBUTION ON HOUSEHOLDS' INCOME AND FOOD SECURITY SITUATIONS,- IN BISOFTU CITY, GARA BERU VILLAGE

BY: ROBEL AYALEW TEFERA

THESIS ADVISER

AMARE BANTIDER (Ph.D.)

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APPROVAL SHEET

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As supervisors of the Thesis, we certify that we have read and evaluated the Thesis prepared by Robel Ayalew Entitled 'Solid Waste Management Though Composting Approach and Its Contribution on Households' Income and Food Security Situations in Bishoftu City, Gara Beru Village.' and recommend for Open Defense as fulfilling the requirement for the degree of Master of Science Degree in Food Security and Developmental Studies

Major Advisor Signature & Date

……..…….

As members of the Examining Board of the Thesis Open Defense, we certify that we have read and evaluated the Thesis Entitled 'Solid Waste Management Though Composting Approach and Its Contribution on Urban Households' Income and Food Security Situations in Bishoftu City, Gara Beru Village.' and recommend that it is acceptable as a thesis for the degree of Master of Science Degree in Food Security and Development Studies.

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Name, Chairman Signature & Date

……..…….

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DECLARATION

I, Robel Ayalew Tefera, do hereby declare to Addis Ababa University School of Graduate Studies that this Thesis is a product of my original research work, and it has not been submitted to any other university for any academic degree. Materials and information other than my own are dually acknowledged.

Name:	Robel Ayalew Tefera
Signature:	
Date of Submission:	December, 2023

Supervisor's approval

This is to certify that the above declaration made by the candidate is correct to the best of my knowledge as an advisor.

Approved by: Amare Bantider (PhD)

Thesis Advisor: Name _____ Signature _____Date

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ABBREVIATIONS
AND ACRONYMS

MSW	Municipal Solid Waste Management
SDG	Sustainable Development Goal
UNCCD	United Nations for Conventions to Combat Desertification
UNDP	United Nation Development Program
SOM	Soil Organic Matter
UK	United Kingdom
WTP	Willingness to Pay
SWM	Solid Waste Management
FS	Food Security
HHI	Household Income
HH	Household
SPSS	Statistical Package for the Social Sciences
VIF	Variance Inflation Factor
FGD	Focus Group Discussion
KII	Key Informant Interview
HFAIS	Household Food Insecurity Access Scale

Abstract

A developing country like Ethiopia does not begin to see the economic benefits of solid waste yet; they even dump the solid waste in unauthorized sites. Effective management of household solid waste through composting mechanisms can have paramount significance for agricultural crop production. The objective of this research work was to assess the contribution of solid waste management through composting approach to urban households' income and food security situations in Gara Beru village of BIshoftu City. Data from 102 households that were chosen using the purposive sample method were gathered using a cross-sectional survey design. In order to gather the necessary information for addressing the required research objectives, questionnaires, personal observation, interviews, and focus group discussions were used. Data gathered through surveys, and interviews were examined using IBM SPSS version 20. The research findings showed that households refuse to pay for waste collection services and a lack of services led to rubbish being thrown on streets, in open areas, and near lakes. Some of the actions seen in the community of the research region to reduce solid waste disposed from the households were preparing the compost pit, sorting household solid waste, and putting the waste in the compost pit. Farmers in the hamlet employed compost to grow flowers, fruits, and other garden commodities because composting has a substantial impact on agricultural production. Using descriptive statics, the impact of composting on household income and food security was calculated and its impact on composting as solid waste management approach found to be the most important determinant factor for the production of cereal/crops for ongoing community food security challenges. The findings from the HFAIS model indicate that a majority of the participants who used compost had a higher level of food security (91.1%) compared to those who did not use compost (79.1%). This suggests that utilizing compost in an organic manner is an effective and promising strategy to improve household food security in the study area. At the same time, there is a strong relation evidence that support use of organic compost versus food security, with chi-square result of (87.100^{a}), df=1, $p<.005$, which is 0.00. Hence, the result can best describe using compost organically was greatly acceptable and is a good start up approach to households' food security situations in the study area. A suggested solution is to creating an enabling environment to address constraints hindering increased compost production via integrated MSW management practices in the study area.

Keywords: Household, solid waste, compost, Multiple logistic regression, Bishoftu City

CHAPTER ONE

INTRODUCTION

1.1. Background of the study

Municipal solid waste (MSW) is the assorted mixture of solid discards generated by urban societies. Although highly diverse, the common constituents of this household waste include kitchen scraps, garden litter, and packaging (Nanda and Berruti, 2021).

Globally, about 1.3 billion tons of urban solid waste produces per year and also expected to rise by 2.2 billion tons per year by 2025. This shows a significant change in per assets urban solid waste generation rates, from 1.2 to 1.42 kg per individual per day in the coming fifteen years (Igbinomwanhia, 2011a; Igbinomwanhia et al., 2011b; Hoornweg et al., 2013).

In African cities, the per capita waste generation rate is range of 0.45 to 1.3 kg/capita/ day. The waste generation rate in developed countries varies from 0.8 to 2.0 kg/capita/day. Similarly, in developing countries, the volume of waste generated varies from day to day and season to season (Jayarama, 2011). In sub- Saharan Africa the rate of generation urban solid wastes are estimated to 62 million tons per year and it predicts wide range of 0.09 to 3.0 kg per head per day with an average of 0.65 kg/capital/day (Hoornweg et al., 2014).

Solid waste generation and management are major problems facing Africa countries like Nigeria, Ghana, Cameroon, etc. Most cities and towns in this region spend 20-50% of their environmental budget on solid waste management and only 20-80% of the waste is collected (Orhorhoro and Oghoghorie, 2019). Generation of solid waste increases in line with developmental rate of any country. Africa is known to be the least developed region in the world with 38% urbanization (Yukalang, 2017). Although, this is low compared to many other countries in the world, African countries are experiencing rapid development with growth rate of 4% per annum and are now faced with huge amount of SW which has direct effect on the human health, safety and environment (Adebayo Bello and bin Ismail 2016).

Nowadays, In Ethiopia urban solid waste management practices are currently becoming a widely major concerning to public health and environment. Most developing countries like Ethiopia, As result of rapid expansion of urbanization and high population huge amount of urban solid waste is produced. “The average urban solid waste production rate is about 0.221kg per head per day and it is also

expected that only 2% of the population established urban solid waste collection services" (Hailu, 2019). And also the current daily waste production of Addis Ababa city is estimated to be 1,220 ton solid waste is generated per day (Wondimu, 2015). The waste production rate per person is about 0.45 kg/day. According to Ababa (2019), still Ethiopia is under pressure to deal with the difficulty of proper management systems of urban solid wastes. With the recent rate of urbanization urban solid waste collection, transportation and removal have been a main challenge of municipalities in most of the Ethiopian cities.

Composting as a solid waste management approach is quietly relevant in highly populated urban areas of low-income countries, which are characterized by limited waste handling facilities (Toxicol et al., 2017). Together with, the increasing rates of urbanization, expansion of urban crop farming, high disposal costs related to land filling, and incineration have reignited interest in the adoption of composting as a strategy for managing municipal solid wastes in urban areas (Toxicol et al., 2017).

These performances of composting empower the capacity of urban households to produce more food variety and safety relating to increase income and food availability. Although, the use of household solid waste for making compost is a growing form of recycling organic wastes and as an alternative to artificial fertilizers, there is paucity of information regarding the adoption of this practice and the factors that might encourage urban households to adopt it.

This research aims to investigate how organic compost contributes to food security of small landholders. Focus was made in Gara Beru village of Bishoftu City, where small landholders experienced the performances of organic compost and accepted by Bishoftu municipality, Oromia state, that their practices helped them to improve their agricultural products, household economy, and natural resources in cropping areas.

In this research, the framework will focus on performing organic compost that is related to contribute urban food security using solid waste as composting approaches. In addition, the study helps to improve those urban agriculturists' quality of life in the study area, based on self-food production, sufficient income to supply additional food, and food sustainability or ensuring to have sufficient food for present and further generation.

1.2. Problem of statement

Ethiopia established laws in 2007 related to urban solid waste management, and the proclamation has incorporated; i.e. mandating safe, designated waste sanitation sites for society and the urban environment, as well as household sorting or separation of recyclables and community-level waste management plans (FDRE, 2007).

Bishoftu city administration has practiced rapid industrialization, urbanization and these leads to increased generation of urban solid waste, has chance for economic sources for people which is beyond the existing infrastructure in place. Improper urban solid waste collection and inappropriate disposal of solid waste has caused in water, land and air pollution, posing risks to human health and the environment in Bishoftu city (Caravani et al., 2017).

In Bishoftu City, Gara Beru Village, solid waste management system faces challenges such as inefficient solid waste collection, poor public education, a lack of solid waste sorting, and improper use of recycling choices, leading to urban environmental pollution and a health risk. These issues are exacerbated by rising waste generation due to the city's population growth rate.

Urban solid waste management through a composting approach in improving productivities of urban agriculture needs to address the urban solid waste disposal mechanisms, with the effective services of disposals of solid waste, awareness creation and recycling choices such as composting. As these, are either sparse or ineffective, the wastes are often simply disposed to lakes, rivers, or near to villagers.

Despite the choice of recycling methods such as composting can have a paramount contribution in maintaining income and the food security statuses' of households in the study area, the rate of its adoption is still very low. With this scenario, the researcher needs to address the problem to identify whether the solid waste management is significant for urban dwellers though a composting approach.

1.3. Objective

1.3.1. General Objective

To assess the contribution of solid waste management through composting approach on households' income and food security situations in Gara Beru village, Bishoftu City.

1.3.2. Specific Objective

- To assess the current household solid waste disposal and management practices through composting in the study area.
- To assess the effects of organic compost preparation on urban households' income in the study area.
- To measure the food security status of households in the study area.
- To assess the challenges of urban solid waste management through compositing in the study area

1.4. Research Questions

- What are the existing methods used in household solid waste management in the study area.
- How do the communities in the study village perceive and utilize compost application for generating income?
- Are there notable disparities in the food security status between households that incorporate compost application in their agricultural practices and those that do not?
- Are there any obstacles to managing urban solid waste through composting in the study area?

1.5. Significance of the Study

This study is very important to understand the determinants of composting as solid waste management approach and its sustainability that depends on numerous factors and its impact on the society. It uncovers and examines the productivities of compost via urban households in Bishoftu City, making Gara Beru village the main area of focus. The experience of these people is essential, as it is more or less the same for all segments of the society. The research will produce information on the better ways of addressing the issue of food security aided by the improved understanding and the vision to see it from different perspectives. However, the most important is the will and commitment of the people to change the existing system and develop something better. The people of Gara Beru village, Bishoftu City, Oromia, Ethiopia, could be an example to participate in compost project management systems and contribute positively towards the development of the livelihood outcomes of small urban households' income. So long as the approach will set the people free from bondage of waste

congestion and It is this way among the many alternatives that can handle environmental pollution and enhance food security.

1.6. Scope of the Study

The study focuses on composting as solid waste management approach in urban households' level in Bishoftu City, Gara Beru's Village of 2021/2022 cropping season. The study envisions the current household solid waste disposal and management practices through composting and intends to measure the maximum number of benefits of compost among households in Gara Beru village.

1.7. Limitations of the Study

This study has the following limitations. Statistics relating to the Municipal Waste Management system are dispersed and inadequate. Municipalities did not keep adequate data and quantifiable treatment of the environmental issue is hardly possible. Within these constraints, tools that are popular to analyze environmental issues are used based on a sample study. The limitations applicable to any sample study will be applicable to the present study also. It is hard to imagine for a study of this kind could possibly be without limitations.

1.8. Organization of the Thesis

This study was organized in to five chapters. Chapter one was dedicated for introduction. Under this chapter, background of the study, statement of the problem, objective of the study, research questions, significance of study, scope of the study, limitation of the study are discussed.

Chapter two was dedicated for review of related literature. This chapter embarks on reviewing conceptual, theoretical and empirical literatures. Under conceptual review the study reviewed on such topics that show a conceptual framework of a sustainable model of utilizing and managing organic waste through composting.

Furthermore, research design and methodology was embedded in chapter three. Chapter four consists of data presentation, analysis and discussion. Lastly chapter five embraces conclusion and recommendation.

CHPTER TWO

2. LITRETURE REVIEW

2.1. Theoretical Foundations

What is Solid Waste? Waste can be defined as useless, unwanted, defective or semi-used products produced by humans and animals (Purohit et al., 2006). Similarly, solid waste means garbage, rubbish, sludge and other waste products, including waste products produced by industry, commerce and agriculture, horticulture and community activities, but does not include materials used or dissolved in domestic sewage or other drinking water. Significant contaminants in water resources such as sludge, dissolved or suspended solids in wastewater, dissolved substances in return water, or other water pollutants (CFR 1995:243).

In Ethiopia, according to Proclamation No. 1 of the Government of the Democratic Republic of Ethiopia. Solid Waste Management Communiqué 513/2007 "Waste" refers to unwanted things that are not liquid or gas and are thrown away. These can be waste such as garbage from homes, businesses or schools, food waste, ashes and debris, sawdust, paper, glass, metal, batteries, plastic, grass and vegetables, animal bones, animals and other materials. It creates a bad environment.

Gedefaw (2015) stated that more than 15 cities in Ethiopia such as Addis Ababa, Gondar, Asela, Jimma, Desi, Ambo, Hosaniya, Woleta Sodo, Bishoftu, Bahir Dar and Dehradava are characterized by rapid population growth. Increasing birth rates and increasing migration from rural to urban areas. Rapid population growth and rapid urban development create large amounts of urban waste, and urban waste management requires strong needs, good planning and social cooperation, energy (Regassa, Sundaraa and Seboka, 2011).

The recent assessment of solid waste management systems in the cities showed that in Adama, Bahir Dar, Bishoftu, Dire Dawa, Hawassa and Mekelle targeted by the UNDP-implemented and GEF-financed compost project. It is found that both the collection efficiency of urban solid waste management at the household level and the solid waste disposal rate at the landfill are, at most 75% and with a low disposal rate (70%), these rates give an overall system efficiency of 52% of USW being disposed of at landfills with little contribution of economic significance (UNDP, 2016).

Due to unskilled manpower, budget, facilities and producing high volume of urban solid waste in the city were the reasons for low performance of urban solid waste management, and require appropriate

urban solid waste management like education, formalizing the informal waste recovery system, establishing public-private partnership in all the waste management segments(Goa and Sota, 2017).

Solid waste can never and ever be separated to long human culture such as a household activity, from the beginning up to now. Throwing away of wastes carelessly into the roads, streams, lakes or near villagers has been a practice with little concern for the environment and thus, urban wastes have to be managed properly before it has come a disaster for human beings or to preserve the planet for the coming generations ahead.

The theories mentioned above primarily focused on various aspects of solid waste management in urban areas, including the importance of a well-functioning institutional setup, community participation, landfill projects, public-private partnerships, employment creation, strategic planning for environmental impact mitigation, and creating safer working conditions. However, these theories did not specifically address the reasons why solid waste management practices should include composting as an approach for urban dwellers. In contrast, this research aims to fill this gap by evaluating the current solid waste management practices in the study area, specifically through the use of composting, and examining its impact on urban households' income and food security.

In most developed countries, urban solid waste managers in collaboration with different stakeholders have means to use wastes in the form of organic compost. Improper management of waste led to contamination of environment, water, soil, and atmosphere and to a serious impact on humans and animals public health. Solid wastes can easily be converted to organic compost through a various steps that ultimately are up- taken and used by cereals and crops, those then producing food sustainably and contributing to food securities as well.

In Ethiopia the current waste management policy, rules and regulations are not enough supporting the issue with the required levels that the country deserves and hence problems regardless of waste treatments are still problematic. In fact, in some cities have still a general focus on waste minimization, and future probable waste and cleaner production systems. Regardless of this weak regulations plan, different kinds of wastes are still dumped in a continuous manner with potential hazardous waste that are seriously affecting the environment, and leads to death the health of humans at last.

Solid Waste Management in Ethiopia has been and still is behind a challenge, waste is abundant in nature and this has the potential for negatively affect the life of people and animals as well as damaging land and aquatic ecosystems and thus reducing the food production capacities, leading to

food insecurity at last. For most of the time urban sources of waste includes homes, experiments, teaching centers, hospitals, timber treatment, petrol storage, metal finishing, paint manufacture, vehicle servicing, tanneries, agriculture/horticulture, electricity distribution and dry cleaning (Liknaw, n.d.).

Organic compost is always a natural process and decomposition of waste materials and stabilizations of it takes place progressively (Hettiarachchi et al., 2020). The final nutrient- rich end product, which can be added to agricultural zones as soil enhancer or stabilizer usually offers paramount benefits to agree-business systems as it ensures environmental protection with sustainable agricultural production (Hettiarachchi et al., 2020).

After a use of municipal solid waste, the improvement of soil properties to the plants growth helps the plants not to be eroded easily by any of water flow that is a major benefit of compost application (Hettiarachchi et al., 2020). Composting is the up to date methods and procedures that has been recognized by most of developed countries through a gaining creditable attention as an alternative way of waste processing. On the top of the use of the decomposable organic materials, municipal solid waste (MSW) is adapting mechanisms or procedures for treatment and stabilizations of various other types of urban wastes such as farm manures, sewage sludge, and industrial sludge (Hettiarachchi et al., 2020).

One can be sure of the composting process that can have the definite ability to kill and minimize pathogenic microorganisms such as bacteria, viruses, and parasites in urban wastes, that otherwise, may significantly exacerbate a health risk on people. Despite the existence of a few microorganisms that may be pathogenic/free living and cannot be eliminated via composting completely, the presence of pathogens in compost is lower than in livestock manures (Zhao et al., 2023).

Literally, to the above context, solid waste management for composting approach benefits everyone to be more sustainable in how to manage the environmental resources. Recycling materials that are within the concept of composting supports the idea of transitioning to a circular economy that is widely accepted in many countries and continents across the globe.

Besides to the above discussion, organic waste production or composting addresses directly a few SDGs, additionally, partially supporting several others types. Even though how fascinating it provides the idea and the paramount potential it provides from the circular economic point of view to achieve the SDGs, Municipal solid waste composting is not popular enough yet. There are many reasons forwarded by intellectuals and stakeholders, but two of which is the researcher best choice to follow it

more prominently. One of which is the disconnect between the agricultural sector where compost is applied and the waste management sector where the bulk of raw material originates from. The policies, rules and regulations and/or institutional structures we have today in Ethiopia needs to be reformed as we do not necessarily provide any space for the integrated management of resources (Hettiarachchi et al., 2020).

2.2. Empirical studies

2.2.1. Definition of Composting

Municipal waste worldwide is managed by four main methods: cultivation, composting, recycling and reuse, and incineration. Approximately 40% of the world's waste is currently disposed of in landfills, approximately 19% is recovered through recycling and composting, 11% is converted to daily electricity use, and the remainder is managed through open landfill/incineration (Kaza et al., 2018). Relying on this disposal method is not a solution, as waste disposal requires more space and resources are severely limited in many urban/urban areas (Lu et al., 2020). Disposal of municipal waste in landfills also causes many hazards, such as air/soil/water pollution, fire/explosion, pollution/unpleasant substances damaging plants (Nannoni et al., 2015 ; Adamcova et al., 2017 ; Vaverková et al. , 2019). It can be said that composting is an easy method to improve food production, and some municipal waste is specially designed for this process. For example, in the United States, packaging and food solid waste (FSW) accounts for 30% by weight of all municipal solid waste. These products have now become an important target for environmental and economic sustainability, not only because they enter large quantities of municipal waste water, but also because they are often discarded after single use (UK Government, 2023). Product lifecycle is still under greater scrutiny in 2023, for example; A single-use plastic ban will be implemented in the UK (UK Government, 2023). These factors have stimulated the development of many containers/FSWs, particularly in relation to the life cycle of composting; this is due to the increasing use of biopolymers such as cellulose and plant fibers (Vendries et al., 2020). However, these advances are not universally implemented.

In North Africa, approximately 4% of municipal waste was managed through composting in 2016, and this number is still increasing. In the southern states of sub-Saharan Africa, less than 1% of municipal waste is deposited and the majority of 69% is disposed/burned openly (Kaza et al. 2018). This is worrying because African cities are the fastest growing cities in the world and perhaps experiencing the fastest urban change.

Improving recycling in low-income countries like Ethiopia is a significant challenge due to their large populations and the various obstacles they encounter, including waste generation, reliance on traditional plastics, and insufficient composting. To address these issues, it is crucial to establish effective and efficient municipal waste management systems. This is particularly important in achieving the United Nations Sustainable Development Goals, specifically Goals 1, 2, 11, 13, and 15.

2.2.2. Preparation of Solid Waste for Composting

Composting of municipal waste must control conditions to prevent contamination of some organic matter. The result is a rich product with benefits for farmland. The conditions required for the waste to be healthy are temperature (130-150°F), humidity (46-56%), oxygen (15-21%), and pH (6.0-7.5) level and carbon/nitrogen ratio (25: 1-30:1) raw material ratio (Mamo et al., 2002; Vesilind and Rimer, 1981). If conditions differ from these ideal levels, the composting process will slow down and unstable chemicals will be produced. When microorganisms decompose organic matter at high oxygen levels, the process is called aerobic composting. In contrast, another group of bacteria can degrade organic materials in low oxygen, a process called anaerobic composting (Bilitewski et al., 15, 1997). Aerobic composting is often preferred over anaerobic composting because it oxidizes faster and does not produce as much odor (e.g. ammonia, sulfur compounds, and organic acids).

2.2.3. Nature of Solid Waste Materials for Composting

Municipal solid waste is mixed waste from residential, commercial, institutional, and industrial sources. Municipal solid waste has a compostable potential of 60–90% (Holmes, 1981). For example, in Guadalajara- Mexico compostable waste is about 63.4% of the total solid wastes (Perez et al., 2001), where as in Guangzhou- China it constitutes 64.4% (Chung and Poon, 2001). It's typical composition includes paper, glass, wood, plastics, reusable goods, soils, chemicals, food waste, plant debris, metals, textiles, and rock, with the organic materials making up 50–70% of all municipal solid waste (Mamo et al., 2002). Ideally, the compost feedstock should only contain compostable materials such as food scraps, paper, cardboard, yard waste, and wood. Non-compostable waste (glass, metals, and plastics) contaminates the municipal solid waste to varying degrees. In general, the fewer non compostable materials in the feedstock, the better the finished compost will be for agricultural use (Holmes, 1981; Tcho banoglous et al., 1977).

2.2.4. Applications of Solid Waste for Composting

Municipal waste has great potential for use in agriculture and horticulture. In agriculture, MSW compost is often used as a feed additive or soil conditioner/improver. So far, most fertilizer trials have focused on nitrogen (Oladeji et al., 2020). For example, in Wisconsin (USA), MSW compost has been successfully used to replace nitrogenous fertilizers on different soils (silty loam and loamy sand) without affecting corn yields (Hargreaves et al., 2008). Municipal solid waste can also provide more phosphorus than some mineral sources if the material is adequately digested (Turrión et al., 2018). In field trials over 3 years, MSW composting has been shown to improve plant supply of potassium (K) and magnesium (Mg) while increasing phosphorus availability (Srivastava et al., 2016). In addition, municipal solid waste as a remedial tool has been useful in restoring salt-damaged soils by improving structure and permeability, which aids water flow and removes/eliminates excess cations (Meena et al., 2019). MSW compost can also reduce vegetation cover by neutralizing TEs in acidic soils (Farrell and Jones, 2009); more details on this will be discussed in Section 4.2. Composting municipal waste is beneficial to agriculture for many reasons, such as retaining water, reducing soil density, and providing essential nutrients (Pujara et al., 2019). However, if manure is not carefully monitored, harmful bacteria or organic pollution in municipal waste, especially roots and vegetables, can easily be affected (Farrell and Jones, 2009). This is because the roots are in direct contact with the soil and therefore have higher concentrations of elements than the corresponding one above the tissue space. Meanwhile, salad crops tend to be eaten raw, so avoid cooking stages such as boiling in water; this may result in the reduction of bacteria through destruction or lyses. Little information is available regarding the use of MSW compost in forests. However, some studies have shown positive effects of MSW composting on tree growth (height and biomass) (Rockwood et al., 2012).

2.3. Conceptual Framework

This section presents the conceptual framework of a sustainable model of utilizing and managing organic waste through composting (Figure 1). Globally, urbanization is increasing. High quantities of organic waste are generated along with MSW in the metropolitan regions. Organic waste material is taken away by being pooled into different waste streams in the sewage systems or dumped as household waste in landfills. Urban agriculture presents an opportunity to use organic waste through a recycling system such as composting. Many advantages are associated with resource recycling. For example, the amount of garbage to be discarded by the municipal waste management unit or authorities can be reduced. Besides, there is also a need to increase food production or food supply and

income of urban households. The chance of growing and acquiring food that is produced locally and improvements in financial conditions is a critical component for some urban dwellers. Therefore, utilizing a MSW composted farming near or in the city can contribute significantly to food productions and income situations of a household. Many urban communities across countries are turning to urban agriculture and gardening.

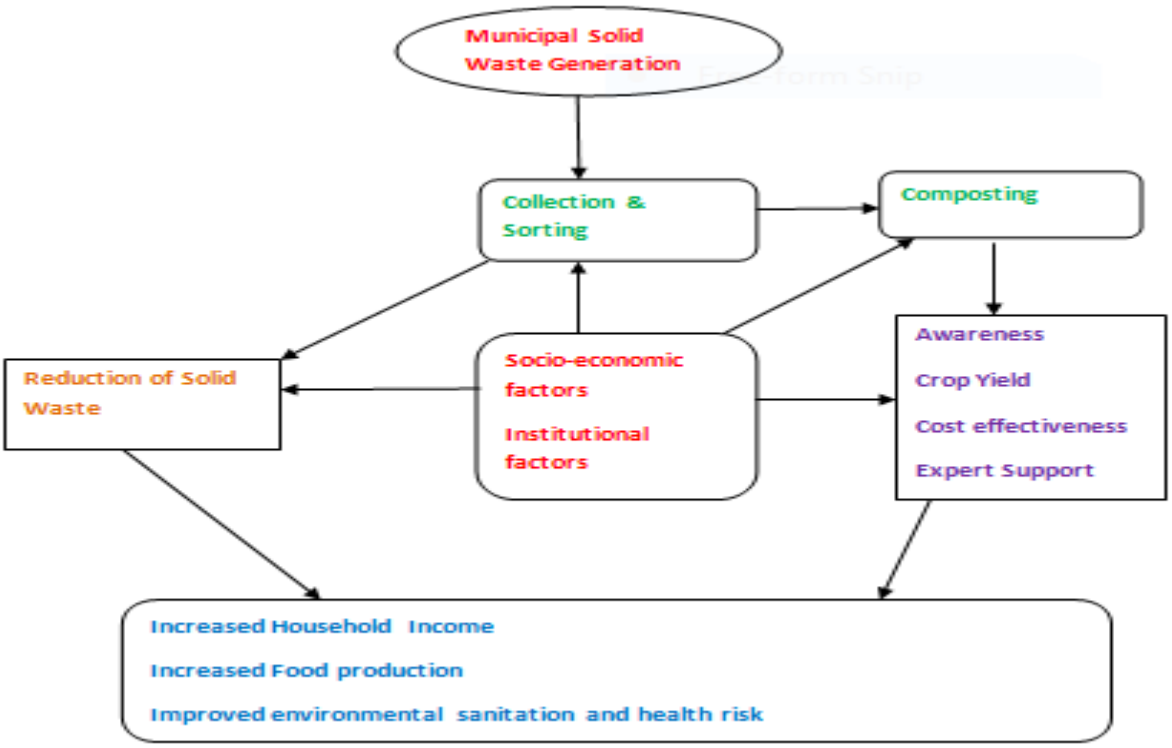

Figure 2-1: shows a conceptual framework of a sustainable model of utilizing and managing organic waste through composting and the associated benefits that can be derived from such practices

The motive behind this is to increase their ability to acquire a household income and healthy food. Utilizing urban wastes through composting and agriculture can also positively influence improving the urban environment and an overall benefit of a household. For example, urban waste management benefits the environment, through organic waste reduction, income of the household and food security situations through its utilization and enhancement of biodiversity. The compost derived from urban organics is incorporated into the soil to increase the amount of nutrients in the soil, which are essential

for plant growth. Therefore, nutrient recycling techniques that transmit waste to different urban cultivated areas play a vital role in improving the environment. Despite the potential benefits that urban waste management can offer through organic waste utilization, producing food in the city can have significant challenges and risks. These challenges may include, for example; Due to insufficient waste collection services and households' unwillingness to pay for such services , lack of a strong supporting policy from municipal authorities, ease of theft and, and risk of soil contamination that may need to be managed.

CHAPTER THREE

3. METHODOLOGY

3.1. Description of Study Area

This study was conducted in Gara Beru Village, Bishoftu City, Ada District, and Oromia State, Ethiopia. It is located 47 km south of Addis Ababa. The terrain is undulating, surrounded by flat lands to the north and east, several lakes, and hills to the south. The 2007 census put the total population of Bishoftu at 99,928; of these, 47,860 were men and 52,068 were women. The majority of residents say they practice Ethiopian Orthodox Christianity; 79.75% of the population says they practice this religion, 13.82% say they are Protestant and 4.98% say they are Muslim.

The geographical area of the city is approximately 15,273 hectares and its altitude is between 1900 and 1995 meters. The climate is temperate with temperatures ranging between 16°C and 24°C; the average rainfall is 860 mm. The main rainy season runs from July to September. Nearby attractions include Yerer Mountain and Green Crater Lakes. It is a holiday destination famous for its five crater lakes: Lake Bishoftu, Lake Hora, Lake Bishoftuguda, Lake Kriftu and Lake Cheleklaka seasonally. The rapid increase in the population in Bishoftu has also led to an increase in the amount of solid waste.

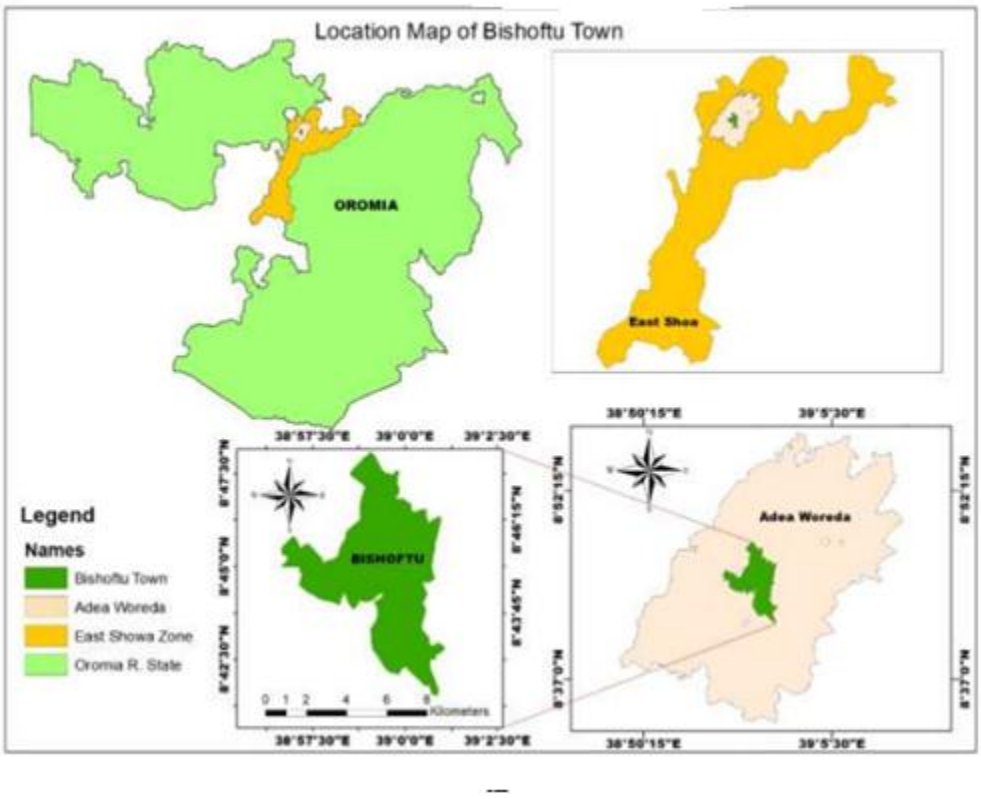

Figure 3-1: Map of Bishoftu town, East Shewa zone, Ethiopia. [Source: Bishoftu Municipal City Administration].

3.2. Research Design

The study was used cross sectional design and used descriptive research approach to describe the characteristics of a particular group where composting as their livelihood strategy. The research was also using both quantitative and qualitative research approaches which was utilized multiple methodologies to gather and analyze data.

This research was used three qualitative methods for data collection: in-depth interview, focus group, and personal observation. To measure the food security situations of a household, data were taken from the responses of households among compost users and non users, via households 'Food Insecurity Access Scale (HFIAS)

The study employed various research design and approaches, which can be summarized as follows: Two key informants, one from community leaders and the other from agency representatives, were selected based on their knowledge and experience in organic compost, financial incomes, and food

security. Individual interviews were conducted with the key informants using a semi-structured approach to cover all relevant topics while allowing for flexibility in the discussion.

In order to gather a more diverse set of responses compared to individual interviews, this study utilized Focus Group Discussions (FGDs). These discussions involved a group of 6-8 individuals with a mix of returnees, experts, representatives from various organizations, and farmers. The purpose of these discussions was to create a space for sharing experiences and engaging in collective discussions.

Interviews and focus group discussions were the primary data collection tools chosen for their ability to gather qualitative data and facilitate interactive discussions. The data collected from interviews and focus group discussions were analyzed to draw conclusions about the performances of organic compost in relation to financial incomes and food security. This research design and approach ensured a comprehensive understanding of the topic by considering the perspectives of different stakeholders and collecting rich qualitative data that can inform future decisions and policies.

3.3. Sampling Techniques and Sample Size Determination

The stratified sampling process involves multiple steps, which include defining the population and subgroups, dividing the population into strata, determining the sample size for each stratum, and randomly selecting samples from each stratum. In this specific study, the population consisted of 102 farmers, with compost users and non-compost users being the two subgroups. The sample size for each stratum was determined to include all the farmers in each subgroup, resulting in sample sizes of 49 and 53 for compost users and non-compost users, respectively.

To ensure adequate representation of each subgroup, the study employed stratified sampling, collecting data directly from the farmers themselves using a prepared questionnaire format and interview schedules during the 2021/2022 cropping season in Bishoftu. Compost users were identified through various methods, such as their questionnaire responses or participation in composting programs.

3.3.1. Techniques of data analysis

To achieve the stated objectives of the survey, data was first sorted out, edited and coded, organized, and analyzed using descriptive statistics, and legit model with a software known as SPSS version 20.

3.3.2. Types of Data and Instruments of Data Collection

3.3.3. Types of Data

Both primary and secondary data were used in this research. The primary data was collected from 102 respondents of the household who apply or not apply organic compost from the study area: in depth interview, focus group, questionnaire, and participatory observation.

Secondary data is also as important as the primary data was used from secondary sources. The secondary sources of data used different books, research papers (both published and non-published), internet sources, and articles from different magazines.

Questionnaire Design

A semi-structured questionnaire was used to collect data from the households, which included questions related to the determinants of composting in the study area, current household knowledge, perceptions and applications of compost for urban agriculture via food production systems. The awareness of the impact of composting on the environment can be an open-ended question, which allows respondents to answer based on their own understanding rather than influencing their decision by providing additional information.

3.3.4. Variable measurement and model specification

3.3.5. Variables of the study

The data collected from each farmer for the variable studies include community awareness, frequency of contact with extension agents/experts, cost effectiveness, compost preparation cost, and cultivation of crops.

The researcher utilized a Likert scale (agree-disagree) to assess the variables. The statements are unambiguous and directly pertain to the farming practices or concepts of interest. By employing the Likert scale, respondents are able to articulate their level of agreement or disagreement with each statement, thereby facilitating a more comprehensive comprehension of their awareness.

	Variables of the study	**Categories**
1	Community awareness	1=Strongly disagree

		2=Disagree 3=Neutral 4=Agree 5=Strongly Agree
2	Expert Support	1=Strongly disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree
3	cost effectiveness	1=Strongly disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree
4	compost preparation cost	1=Strongly disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly Agree
5	cultivation of crops	1=Strongly disagree 2=Disagree

		3=Neutral 4=Agree 5=Strongly Agree

3.3.6. Response variable

The food security status of sample households were investigated by the food security measuring instrument of the impact indicator for improved household nutrition that use to measure the improvement in household food consumption or food availability and food access (Swindale and Paula, 2006). For this research work the questionnaire was designed to measure food access, availability and utilization through the use of HFIAS food security models in 'lean season'. To that end, urban households' food security situations in utilizing compost have been measured. The tools to assess household food security status are described below.

The HFIAS is a tool to assess whether households have experienced problems in food access in the preceding 30 days. The tool is composed of nine questions that ask about modifications households made in their diet or food consumption patterns due to limited resources to acquire food. Three themes are covered by the tool:

1) Experiencing anxiety and uncertainty about the household food supply;
2) Altering quality of the diet; and
3) Reducing quantity of food consumed.

The respondent is ideally the person in charge of food preparation or the head of household who answers on behalf of all household members. Based on the response to the nine questions and frequency of occurrence over the past 30 days, households are assigned a score that ranges from 0 to 27. A higher HFIAS score is indicative of poorer access to food and greater household food insecurity. The HFIAS consists of a set of nine occurrence questions that represent a generally Increasing level of severity of food insecurity (access) during the past four weeks (30 days). The respondent is asked whether the condition in the question happened at all in the past four weeks.

The process for measuring data in the HFAIS tool involves the following steps:

1. Data Collection: The data is collected through a survey where the questions are asked to the household head or any adult responsible for food preparation.
2. Scoring: Each question has a frequency-of-occurrence component, where the respondent who affirms the condition in the corresponding occurrence question is asked how often the condition happened. The frequency-of-occurrence question is coded as follows: 0 = never, 1 = rarely (once or twice in the past four weeks), 2 = sometimes (three to ten times in the past four weeks), 3 = often (more than ten times in the past four weeks).
3. Calculation of HFIAS Score: The HFIAS score for each household is calculated by summing the codes for each frequency-of-occurrence question[2]. The maximum score is 27, reflecting a higher frequency of occurrence of food insecurity conditions.
4. Classification of Households: Based on the HFIAS score, households can be classified into four levels of household food insecurity (access): food secure, and mildly, moderately, and severely food insecure.
5. Analysis: The information generated by the HFIAS can be used to assess the prevalence of household food insecurity and to detect changes in the food insecurity situation of a population over time.

3.4. Validity and Reliability of instruments

The concept of validity refers to the degree to which differences observed through a measuring tool accurately reflect true differences among the individuals being tested. In research, the goal of establishing validity is to gather evidence that supports the accuracy of the results obtained through the measuring device. To ensure the validity of the instruments used, it is important to seek feedback from an experienced project supervisor who can provide constructive criticism and suggest improvements to the questionnaire items. Additionally, the questions should align with the study objectives and be evaluated by quality experts to ensure clarity and relevance.

Achieving validity also involves ensuring that the operationalzed variables are consistent with the theoretical constructs identified in the literature review. This can be done by operational zing the variables in a way that reflects the underlying assumptions of the study's conceptual framework. To further enhance the validity of the study, researchers can draw on instruments and concepts from related studies and appropriate literature.

In addition to validity, reliability is also an important consideration in research. One way to ensure reliability is to use the Cronbach's alpha coefficient of internal consistency, which provides a

quantitative estimate of the scale's internal consistency. By establishing both validity and reliability, researchers can have confidence in the accuracy and consistency of their results.

3.5. Ethical consideration

The researcher requested for explicit consent if the data collection involves images of the human elements of respondents. Consent was signed by the respondents wherever images are involved in the research process. The research process was guided by informed consent, do no harm, confidentiality and respect for privacy principles. The nature of the study was fully explained to respondents to obtain consent Information that would collect after securing consent from study participant. Data obtained from each study participant can be kept confidential.

CHAPTER FOUR:

4. RESULT AND DISCUSSION

4.1. Socio-demographic characteristics of the respondent

It is well recognized that composting solid waste may significantly improve the community's circumstances for sustaining a way of life. As a result, based on the socio-demographic characteristics of various respondents, it is required to examine the contribution of solid waste management through composting in the research region. The socio-demographic traits of the sampled households from the research region are shown in the table below as being either directly or indirectly related to the contribution of composting to solid waste management as well as income and food security situations of a household. Out of the total samples, 67.6% of the respondents are older than 40 years old, as shown in Table 3. Additionally, the survey's results show that men households make up the majority of the sample's households. According to table 3, the bulk of respondents (78.4% percent) come from a household with male heads of family, while just 21.6% come from households with female heads of household.

The table shows that the sample respondents' levels of education range from those who are illiterate to those who have completed their undergraduate degrees. In particular, of the 102 households who responded, 43.1% were illiterate, while 23.5% were in elementary school, 17.6% in secondary school, 9.8% at college, and 5.9% in universities. In terms of marital status, over 50% of the respondents were married, while just 21.6% were unmarried. Divorce and widowhood accounted for the remaining responses, with 16.7 percent and 11.8 percent respectively. Regarding the number of years spent there, (56) 29.2 percent of respondents stayed between 21 and 30 years, while (30) 29.4 percent of families stayed for longer than thirty years.

Less than ten years of residence was the median length of stay for respondents, with 12 (13.7 percent) of respondents falling into this category. The other socio-demographic factor that substantially influenced the circumstances of food security in the study region was the respondents' income level. To that end, the majority of respondents approximately 43.1% have monthly incomes of between 500 and 2000 birr. Respondents from both wealthy and low-income families are possible here. The remaining respondents, with monthly income levels ranging from 2000 to 3500, 3500 to 5000, and more than 5000 birr, had corresponding percentages of 17.7 percent, 15.5 percent, and 13.7 percent.

Table 4.1: Socio-demographic characteristics of the respondent household heads

Characteristics	Categories	Frequency	Percent	Cumulative Percent
Age	20-25	3	2.9	2.9
	25-30	9	8.8	11.8
	30-35	8	7.8	19.6
	35-40	13	12.7	32.4
	>40	69	67.6	100.0
	Total	102	100.0	
Sex	Male	80	78.4	78.4
	Female	22	21.6	100.0
	Total	102	100.0	
Education	Unable to read and write	44	43.1	43.1
	Primary	24	23.5	66.7
	Secondary	18	17.6	84.3
	Diploma (10+3)	10	9.8	94.1
	Degree	6	5.9	100.0
	Total	102	100.0	
Year of stay	<10	13	12.7	12.7
	10-15	14	13.7	26.5

	15-20	16	15.7	42.2
	20-30	29	28.4	70.6
	>30	30	29.4	100.0
	Total	102	100.0	
Marital Status	Married	51	50.0	50.0
	Single	22	21.6	71.6
	Divorced	17	16.7	88.2
	Widowed	12	11.8	100.0
	Total	102	100.0	
Income level	500-2000	44	43.1	43.1
	2001-3500	28	27.5	70.6
	3501-5000	14	13.7	84.3
	>5000	16	15.7	100.0
	Total	102	100.0	

Source: Survey result 2021

4.2. Study Household solid waste disposal and its management through composting

This section briefly examines and explains how solid waste management, namely the management of household garbage, is carried out in the village through composting. The best solid waste management (SWM) practices begin at the household level, and failures there could have an impact on the SWM system as a whole.

Due to insufficient waste collection services and households' unwillingness to pay for such services, wastes were dumped in nearby lakes, open spaces, and on streets, as shown by the results of this study and field observations. Such actions or failures in household solid waste management really contribute a lot to environmental pollution and human health issues. The use of temporary trash storage in the

houses, such as baskets, plastic bags, sacks, etc., is a practice of solid waste management in households. A common collection site outside the home is an option for people who don't store their waste there.

As it can be seen from Table 4 most of the households have a temporary solid waste storage in their house. The selected sample households were also asked whether they had waste collection material (temporary storage) at home. Most of the respondents replied that they have temporary storage in their home. With regard to the kind of storage they used, majority of the respondents (42.2%) used sack as waste storage, whereas, 23.5% and 16.7% of the respondent's used basket and plastic bags storage materials respectively. The rest of the respondents (17.6%) stated that they have no waste container of any kind, and mentioned that they throw the waste in open fields on the street and in the lake.

One of waste collection facilities, placing container in the village is very important for proper management, so the selected sample respondents were asked a question regarding the existence of communal container in the village. Most of the respondents said no container is available in most places of the study region. The key informants (head of beatification of the municipality) also stated the importance of container for waste management. But because of budget and related problem containers are not assigned in any parts of the town. There were about 43 containers but now they had been taken off from all parts of the village and instead it was preferred to establish door to door waste collection by the help of different non-governmental organization.

The other is the availability of collection service of garbage. Thus, 29.4% of the respondents had collection service of solid waste and 70.6% of them do not have collection services. Those respondents who do not receive the service also had their own reason that is 57.8% of them were not part of the service because of financial problem and 42.2% due to lack of interest. This is to mean that the collection service charge is not taking account the local community household income level. The low-income level households are subjected to drop the solid waste in street and road dishes. This resulted in different environmental and socioeconomic problems.

There are different strategies that households use to reduce the volume of waste. These include burning or incineration of waste, selling solid waste (plastic, metal etc.) In some cases, re-use of items such as bottles, plastic, metal occurs. This is known as a multibillion industry in the developed countries but in countries like Ethiopia re-using solid waste is not as much introduced. Reuse is an important factor to reduce the amount of waste to be dumped at the final disposal site. The study result indicates that there

is practice of waste reuse for different purposes like industrial waste, plant origin waste for fuel, animal source (meat and bone) waste for domestic animal's feed. However, the practice of reusing waste is varied among different income classes.

As it was indicated in Table 4 the respondents were asked whether they reuse the waste or not; thus, there were some proportions of the respondents who re use the waste (30.4%). From these plastic, cow dung and metal are amongst the common solid waste that are re used by most households. Most, 49%, of households do not re use the waste instead they use the waste to prepare compost. This is the best startup in the study region since composting different solid waste material benefits the community in terms of crop production. However, the solid wastes that are used for the compost are cow dung, food residues, and chicken dung. Thus, composting is the best mechanism of reducing such solid wastes but it didn't include all of the solid wastes collected from household.

Moreover, some households (20.6%) reduce their waste by burning the waste. The burning of solid waste needs proper management to reduce the risk that occurred during burning stage and after burning the waste. From the researcher field observation, household's burn solid waste near their house and the smokes that exerted from burnet material is not pleasing. This can cause environmental pollution such as noise smoke in the village.

Table 4.2: Household Solid Waste Management in Gara Beru village of Bishoftu City

S. N	Characteristics	Categories	Frequency	Percent
1	Types of SW container	Basket	24	23.5
		Plastic bags	17	16.7
		Sacks	43	42.2
		No container	18	17.6
2	SW collection service usage	Yes	30	29.4
		No	72	70.6
3	Reasons not to use SW	Financial problem	59	57.8

	collection service	Lack of interest	43	42.2
4	Types of SW treatment	Burning	21	20.6
		Compost	50	49.0
		Reuse	31	30.4
5	Household compost pit	Yes	38	37.3
		No	64	62.7
7	Compost pit preparation	Based on an expert's idea	49	48
		With local knowledge	17	16,7
		Not use	36	35.3
8	Compost application on farmland	Before cropping	48	47.1
		After cropping	26	25.5
		Not use	30	28.4
9	Types SW used as an input for the compost	Food residue	27	26.5
		Cattle residue	51	50
		Any waste	24	23.5

Source: Field survey 2022

4.2.1. Compost pit preparation and use to reduce solid waste disposed from households

According to Figure 3, out of the 102 households examined, 37.3% are using compost pits, while 62.7% are not. The reason that 62.7 percent of compost pit users stopped using them was because of insects and a bad smell that made it unsightly, produced leachate, and/or contaminated the water tank (46.1 percent). Additionally, the compost pit was too far away from their homes to make it easy to transport the compost to the farm area (40.2 percent). Nearly 13.7 percent of the respondents have no reason for not storing solid waste in a compost pit. HHs who didn't have enough space for composting

(45.1%), were too busy (13.7%), and were unconcerned since they either burnt all of their trash or fed it to animals (42.2%), respectively, were among the 62.7% who never used it (Figure 3).

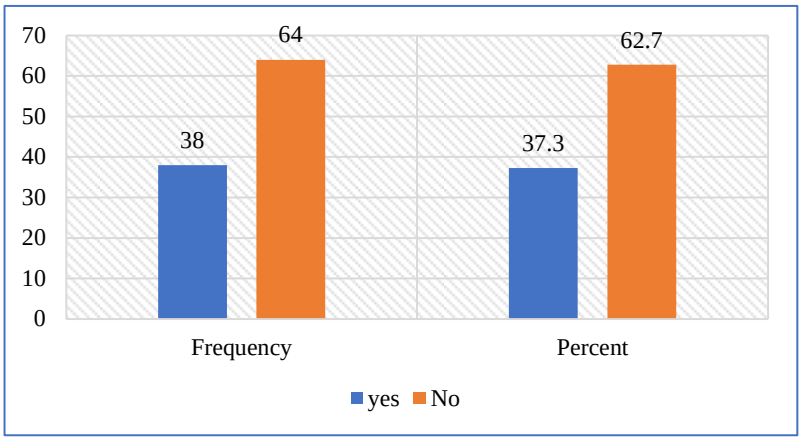

Figure 4-3: Households using compost pit

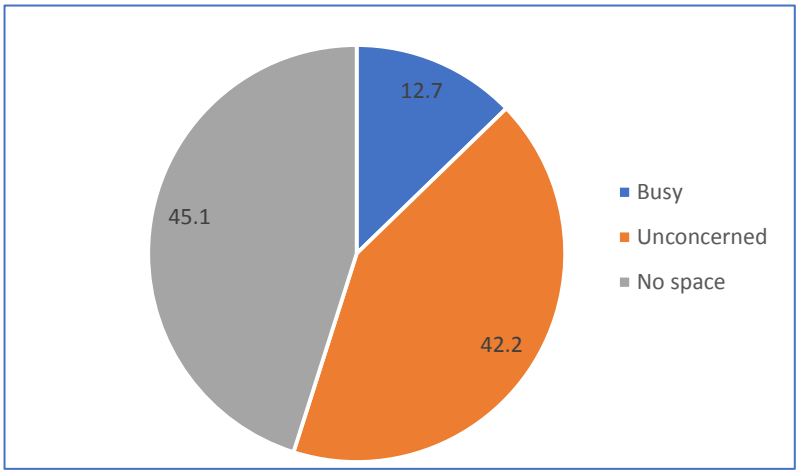

Figure 1-4: Reasons for not using compost pit

The HHs acquiring the pit but not using for composting have turned it into a dustbin, are using as a storage for vegetables such as potato or simply have given them away to friends or neighbors. This does not imply that those 37.3% who are using compost pit are free from complications. Some feel that they are not able to make quality compost because the end product turns out to be too wet and does not fall on the bottom section of the pit as it is supposed to. Some also admitted that other HH members do not take the job of segregating waste properly before being used as an input for composting. Insects such as flies, cockroaches, maggots, larvae, ants and scolopendrium; rodents; foul odor; damaging metal frame within the compost pit; time constraint; and limited capacity of pits are some of the problems current users are facing.

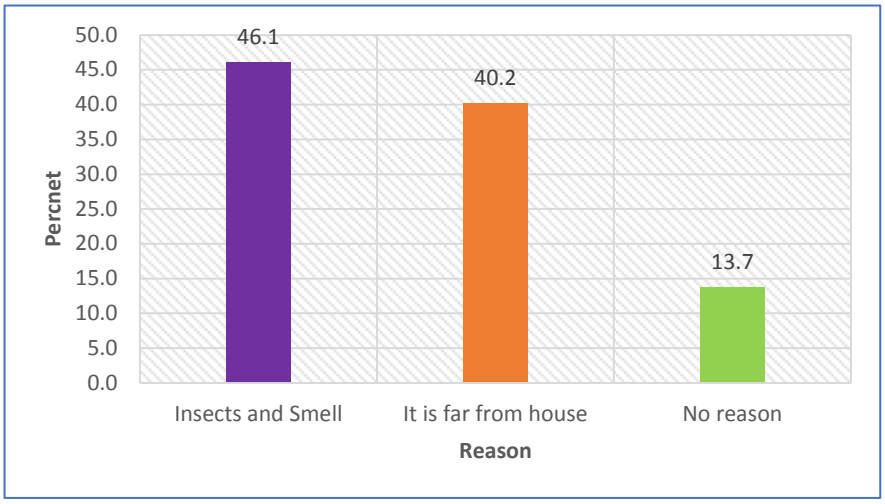

Figure 4-5: Reason to stop using compost pit to store solid waste

4.2.2. Compost preparation and harvesting as a mechanism of solid waste disposal

Prior to adding garbage to the compost pit, it must be sorted and ready for quick decomposition (Tuladhar&Spuhler, 2016). The total composting process can be sped up by adding mature compost. By preserving an appropriate level of temperature, moisture, and aeration, the deterioration process can be regulated. When the interior temperature has dropped to within 5 degrees of the ambient temperature, no solid matter is visible, and the material has a dark brown, powdery appearance, the composting process is said to be complete. The compost needs to be allowed to cure for about a month before being fine-screened (Tuladhar&Spuhler, 2016).

The compost pit should be situated in a practical area that is close to the kitchen and garden so that garbage can be readily disposed of there. Typically, food, garden trimmings, and other materials are used as inputs; however, meat products should be avoided to prevent the attraction of rats and other animals/insects. In order for the trash to disintegrate more quickly, it should be sliced into little pieces, typically one inch in length or diameter. Although it shouldn't be dripping, the waste should feel wet. If it is too dry, water should be added to maintain a 50 percent moisture content, and if it is too wet, sawdust or ash should be added. To balance the ratio in the waste, some brown waste, such as sawdust, should be put in addition to green waste like leaves and vegetables (which is typical for HH waste). It is also advisable to activate the degradation process with some old compost or garden soil. About once a week, the waste should be stirred to keep it aerated since, as it degrades, a lack of oxygen causes the garbage to smell bad. About two months should pass before the compost is ready. It will have a dark

brown color and an earthy scent. The compost should be screened to return the materials that weren't properly composted to the bin. The compost is subsequently prepared for use. It can also be kept in storage but should be carefully covered because if left out in the open, some of its nutrients may be lost (Tuladhar, 2003).

The most typical waste kinds that were used as an input for HH composting were kitchen and garden trash. Vegetable and fruit peelings and remnants, eggshells, food leftovers/stale and tainted food, tea leaves, and bones were all included in the category of kitchen waste. While garden waste included branches, leaves, grasses, weeds, plants, and flowers. Wastes produced by households were divided into five categories, including food waste, animal dung, garden trash, and chicken litter, to make data gathering easier. Animal dung is the major input to prepare compost and about 34.3% of the respondents used animal dung for the preparation of compost as an input. With a combined share of 21.6 percent from all input categories used, garden trash and chicken litter were employed as inputs. The remaining respondents (22.5%) used food waste as a component in compost preparation. The community's view that animal dung has a higher nutrient content than other types of waste is the primary driver behind the biggest percent share of animal dung being utilized as an input to create compost. Animal dungs were also simpler to find than other waste, like chicken litter. The majority of respondents report using a high percentage of animal dung, which is likely because local households used it in large quantities to produce enough compost.

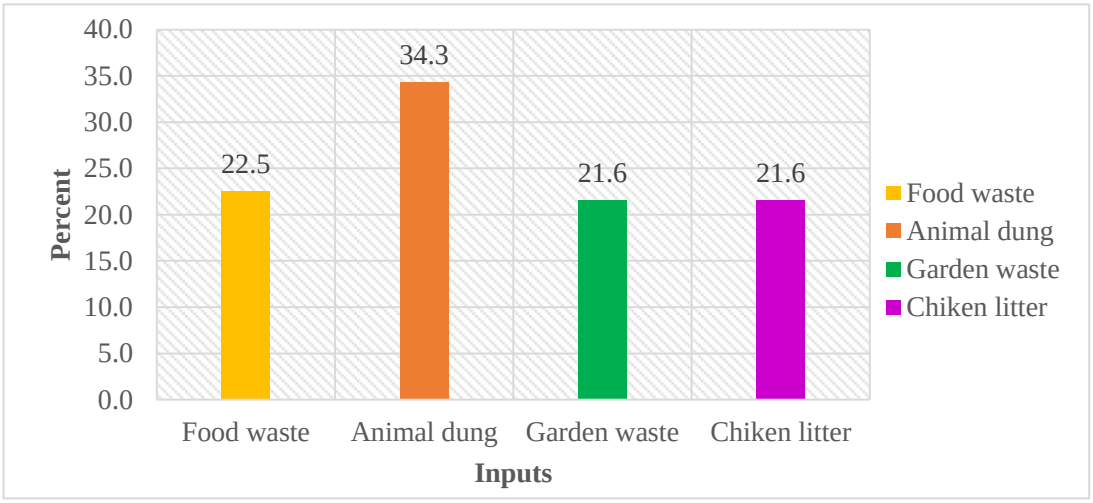

Figure 4-6: Inputs materials used to prepare compost

Some (15.79%) of the HH harvest compost two times a year, meaning they take out compost every 6 months (Figure 6). About 10%, 8.42%, 4.74%, 11.05%, 13.68%, 9.47%, and 7.89%, harvest 1, 3, 4, 5, 6, 7, 8 and 9 times a year, respectively. About 11.58% said they have not yet harvested, because they have just begun the practice of composting or do not use compost pit that often. About 14.71% use the compost on garden fruits (potato, cauliflower, spinach, garlic, onion, turmeric, and ginger), followed by flowers with 39.22. This is said to be low compost consumption compared to the amount of compost used for crop production at farmland level. To that end, 46.08% of respondents indicated the usage of compost for the crop production in particular of cash crop and cereal crops. Farmers produce cash crop and cereal crops for the sake of household income improvement and to sustain food security issue at household level. Figure 6 depicts the use of compost by the local households to their farm for the production of garden fruits, flowers, and crops.

Most of the respondents (85.10%) felt that composting has better impact on production (Figure 8). The size of vegetables is bigger and overall quantity of production is also higher. Only 22.5% and 32.3% said they didn't see any change and they cannot differentiate, respectively. This shows that the better the use of organic compost at farmland scale the better will be the fertility of the soil. It is known that fertile soil can hold any types of crops, vegetables, fruits, and other agricultural production in a good manner. At the beginning, compost preparation requires a lot of waste that is directly disposed from the individual household. The more solid waste taken for the compost preparation the less the waste disposed on streets, open space, and even in the water. The final ultimate of using compost for the agricultural production is to create clean and safe environment which is pleasant for the life of human beings.

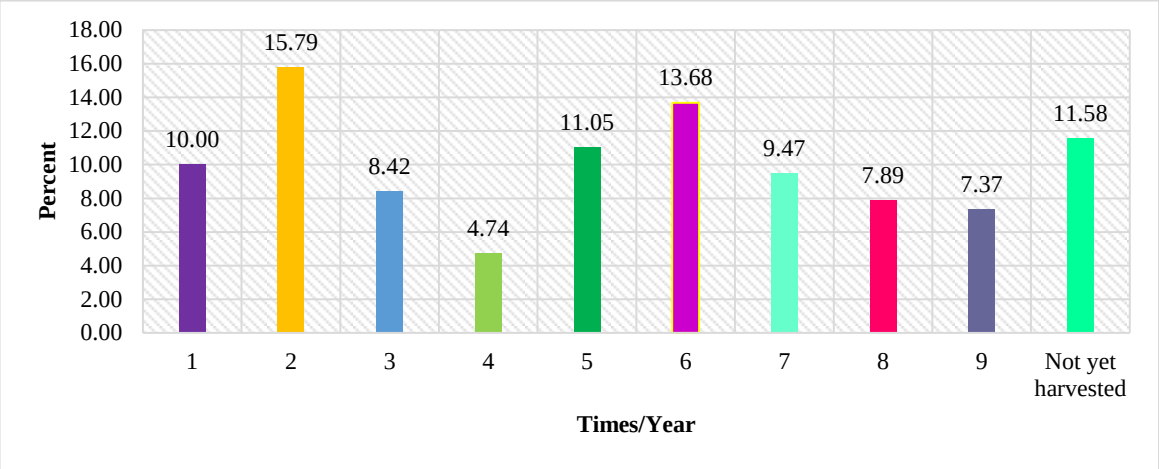

Figure 4-7: Frequency of compost harvesting per year

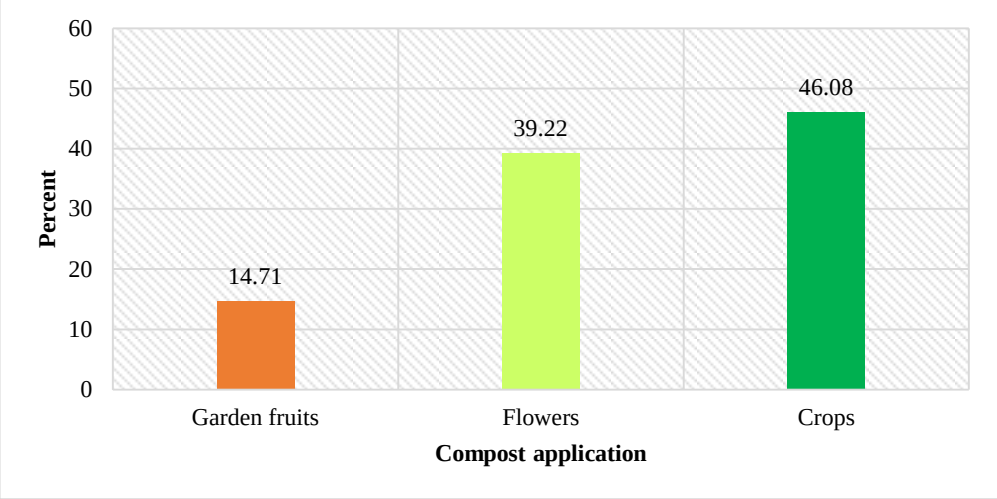

Figure 4-8: Compost usage

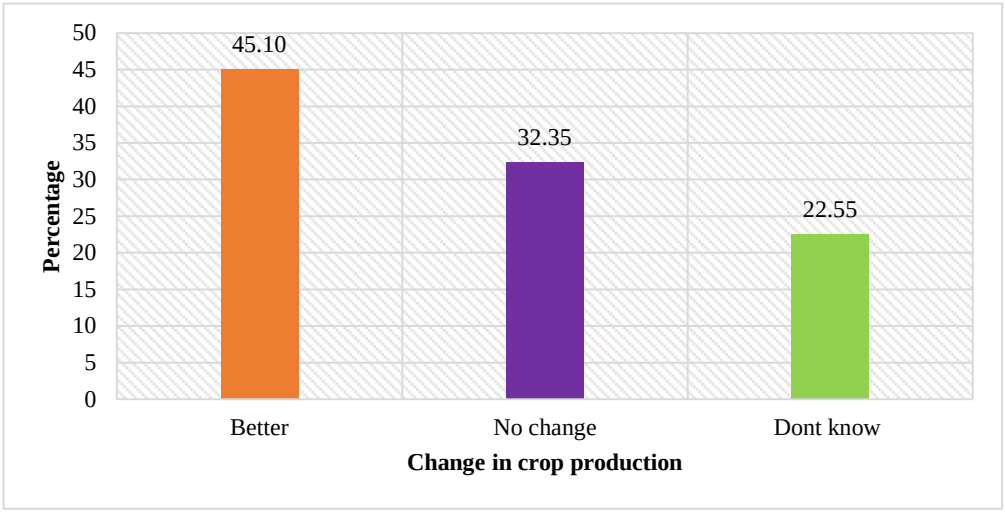

Figure 4-2: Perceived change in production

4.3. Effect of organic compost preparation on urban households' income

Farmers prioritize certain practices over others based on their specific household needs and farming goals. Various groups of farmers, such as men and women, wealthy and impoverished farming households, and those engaged in cash crop or subsistence farming, consistently recognize the importance of using organic compost and engaging in home gardening. These practices are highly valued because they contribute to increased income. By cultivating their primary cash crops and harvesting them multiple times throughout the year, farmers are able to sell these crops and generate income. The money earned from these sales can be utilized for various purposes, including educational expenses, clothing, and medical needs. In the study area, the impact of several variables on household income was measured, and it was discovered that certain indicators significantly influence income levels.

Community awareness: The level of community awareness regarding compost practices was assessed using a Likert scale, which ranged from "Strongly Disagree" to "Strongly Agree". The statements focused on the awareness, understanding, and perceived benefits of these practices or technologies. According to the survey results, it is evident that there is a high level of community awareness about compost farming practices or technologies. Here is a detailed breakdown of the findings:

Out of the 49 participants, 14.3% (7 individuals) disagreed with the notion of a high level of community awareness. On the other hand, 30.6% (15 individuals) agreed with the statement, indicating that they have observed some level of awareness within the community. The majority, comprising

55.1% (27 individuals), strongly agreed with the statement, demonstrating a strong belief in the existence of a high level of community awareness. These results indicate that a significant majority of the participants (85.7%) either agreed or strongly agreed with the concept of community awareness. This high level of awareness and understanding of farming practices or technologies can positively impact the income situation of households in various ways. Firstly, increased awareness can facilitate knowledge sharing among community members, enabling them to adopt more effective and efficient farming practices or technologies. This, in turn, can enhance productivity and subsequently increase income. Secondly, a high level of community awareness can foster collaboration among households. By pooling resources, they can invest in advanced farming technologies, share costs, and collectively reap the benefits. Furthermore, with greater awareness, households can make informed decisions regarding which farming practices or technologies to adopt. Factors such as cost, potential yield, and market demand can be considered, leading to increased income over time. Lastly, awareness and understanding of farming practices can help households anticipate and mitigate risks associated with farming, thereby safeguarding their income.

Expert Support: Out of the 49 participants, it is evident that a significant majority (61.2%) of farmers maintain regular communication with extension agents or experts, which experts support. This consistent support and guidance has the potential to positively influence their compost farming practices and enhance their understanding of soil fertility and composting techniques. By staying in touch with experts, farmers can stay updated on the latest advancements in agriculture and receive valuable advice on how to improve their crop yield. This regular communication also allows farmers to address any concerns or challenges they may be facing and seek expert guidance to overcome them. Overall, the data highlights the importance of maintaining a strong connection with extension agents or experts in order to enhance compost farming practices and achieve better results in terms of soil fertility and composting techniques**.**

Cost effectiveness: The survey results indicate a positive perception regarding the cost-effectiveness of organic compost preparation and its impact on household income. Let's break down the findings:

Out of the 49 participants, 5 individuals (10.2%) expressed disagreement with the idea that organic compost preparation is cost-effective and contributes to household income. On the other hand, 17 individuals (34.7%) agreed with the statement, suggesting some observed benefits. The majority, consisting of 27 individuals (55.1%), strongly agreed with the statement, showing a strong belief in the

significant contribution of organic compost preparation to household income. Based on these findings, it can be concluded that organic compost preparation is not only perceived as cost-effective but also as a practical way to generate income for households. This perception may arise from the lower costs associated with organic compost preparation compared to commercial fertilizers, as well as the potential income generated from selling excess compost. However, conducting further research to explore the specific reasons behind the high level of agreement and addressing the concerns of those who disagreed would be beneficial. This additional investigation could provide valuable insights for improving the process and maximizing its benefits.

Access to solid waste: Based on the provided data, it is evident that a significant majority of the respondents (77.6%) are in strong agreement with the concept of utilizing municipal solid waste for the creation of organic compost as a means to generate income for households. This indicates a high level of acceptance and potential success for this initiative. A smaller percentage of respondents (10.2%) express agreement with the idea, suggesting some level of support but with potential reservations or unspecified conditions. On the other hand, a minority of respondents (12.2%) disagree with the concept. This dissent could stem from various factors, including concerns about feasibility, potential odors, health risks, or other aspects associated with the handling and processing of municipal solid waste.

In summary, the data strongly indicates widespread support for the utilization of municipal solid waste in the production of organic compost as a means of income generation for households. However, it is crucial to address the concerns of those who disagree with the idea in order to ensure the success and sustainability of this initiative. Further research could be conducted to gain a deeper understanding of the specific concerns raised by dissenting respondents and to develop strategies to address them effectively. The Likert scale findings for the statement "Crop yield contributes to income generation of household in using organic compost" are as follows:

Crop Yield: Disagree: 3 respondents (6.1%), - Agree: 5 respondents (10.2%) - Strongly agree: 41 respondents (83.7%). These results indicate a significant level of agreement among the participants regarding the positive influence of organic compost on crop yield and, consequently, household income.

Within the context of a Likert scale, this data implies a strong consensus on the beneficial effects of organic compost on crop yield and, by extension, the financial well-being of households. The majority

of respondents (83.7%) strongly agree with the statement, demonstrating a firm belief in the advantages of using organic compost. However, it is important to acknowledge that a Likert scale primarily measures attitudes and perceptions, and although it can offer valuable insights, it does not establish a causal relationship. Therefore, while these findings suggest a positive perception of the impact of organic compost on crop yield and income, further research is necessary to definitively establish this connection. Additionally, it would be intriguing to delve into the reasons behind the disagreement or neutrality expressed by the remaining respondents (6.1% disagree, 10.2% agree). This exploration could provide further insights into potential obstacles or challenges related to the utilization of organic compost.

In conclusion, the results of the Likert scale survey indicate a strong positive perception regarding the influence of organic compost on crop yield and household income. Nonetheless, additional research is required to fully comprehend this relationship and address any potential challenges that may arise.

Table 4-3: Effect of organic compost preparation on urban households' income

S. N	Characteristics	Categories	Frequency	Percent
1	Community awareness	Disagree	7	14.3
		Agree	15	30.6
		Strongly agree	27	55.1
		Total	49	100.00
2	Expert Support	Disagree	4	8.2
		Agree	15	30.6
		Strongly agree	30	61.2
		Total	49	100.00
3	Cost effectiveness	Disagree	5	10.2
		Agree	17	34.7
		Strongly agree	27	55.1

		Total	49	100.00
4	Access to solid waste	Disagree	6	12.2
		Agree	5	10.2
		Strongly agree	38	77.6
		Total	49	100.00
5	Crop Yield	Disagree	3	6.1%
		Agree	5	10.2%
		Strongly agree	41	83.7%
		Total	49	100.00%

4.4. Food security situations of the household's

Similarly, the different groups of beneficiaries, as well as different categories of non-beneficiaries, commonly identified organic compos as a practice to ensured most of household's food security situation in the study area. Furthermore, farmers reported that in the area crop productions based organic composting improved household's food security, in that compost improves soil fertility and increase crop productivity. By using improved soil type, they indicated that farmers could get surplus production that can help them fulfill their households' food consumption.

Farmers' explanations of the importance of this natural compost for food security suggest that by mentioning home gardening as an example, home gardening serves household food security for two reasons. First, through, farmers produce cash crops, vegetables and fruits that can be sold and provide income. The financial incentives acquired through home gardening can be used to buy food items and crops which cannot be available from their own production. In this way, home gardening supports a household's food security. Secondly, vegetables produced through home gardening can be used for domestic/household food consumption and thus support household's food security. Similarly, fruits produced through home gardening contribute to household's food consumption.

According to the key informant interview, he added:

"Farmers indicated that when there is no cooked food at home, household members, particularly children satisfy their interim meals by eating fruits".[Interview 2021]

Thus, home gardening contributes to household's food security in multiple ways, thereby positively influencing farmers' decision-making and encouraging them to keep implementing this practice.

Table 4-4. Perceived results on household food security situations by using HFAIS model in the study area

	Food-secured Households	Non-Food-secured Households	Chi-square test
Compost users	91.8%	8.2%	87.100[a]
Non Compost users	79.3%	20.7%	

The findings from the HFAIS model indicate that a majority of the participants who used compost had a higher level of food security (91.1%) compared to those who did not use compost (79.1%). This suggests that utilizing compost in an organic manner is an effective and promising strategy to improve household food security in the study area.

Table 1-5: Food secured * Compost Users Cross tab

			Compost Users		
			No	Yes	Total
Food secured	No	Count	53	4	57
		Expected Count	29.6	27.4	57.0
	Yes	Count	0	45	45
		Expected Count	23.4	21.6	45.0
Total		Count	53	49	102
		Expected Count	53.0	49.0	102.0

Table 4-6: Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	87.100[a]	1	.000		
Continuity Correction	83.415	1	.000		
Likelihood Ratio	112.279	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	86.246	1	.000		
N of Valid Cases	102				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 21.62.

b. Computed only for a 2x2 table

Table 4-7: Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	.924	.000
	Cramer's V	.924	.000
N of Valid Cases		102	

Compost application of the farmers was important variable in the inferential statistics. The null hypothesis that compost application of the farmers cannot determine the food security situations of the community was tested. The statistical analysis revealed that compost application of the farmers' has significant impact on the food security situations of the community. Thus, the null hypothesis that compost application of the farmers cannot determine the food security situations of the community is rejected since the probability of respondents who said that compost application of the farmers has significant impact on the food security situations of community is less than the significance level

which is .000. Therefore, the alternative hypothesis that compost application of the farmers' has significant impact on the food security situations of the community is accepted.

4.5. Challenges of effective solid waste management through composting in the study region

The health concerns connected to improper solid waste management, including composting, were also mentioned by respondents as difficulties for effective measures and strategies to mitigate the impact of wastes. The main obstacles to effective solid waste management at the household level through a composting mechanism in Gara Beru hamlet in Bishoftu town were inefficient solid waste collection, poor public education, a lack of solid waste sorting, and improper use of recycling choices. The researcher was given measurements for disagree, agree, and strongly agree for each demanding issue in order to quantify the difficulties of successful solid waste management. This clarifies the respondents' level of agreement with relation to each issue posing a challenge to successful solid waste management.

The findings showed that the majority of respondents (40.2 percent) strongly agreed that improper collection of domestic solid waste poses the greatest obstacles to successful solid waste management at the household level through composting mechanisms. The remaining respondents, or about 34.3 percent, rate the scenario as agreeing and disagreeing, respectively. This demonstrates that the primary factor impeding successful management of solid waste by composting approach is the inadequate collection of solid waste generated from each individual dwelling. Lack of effective sorting of solid waste before it is dumped into the compost pit is another factor. The findings showed that the majority of respondents (40.2 percent) strongly agreed that improper collection of domestic solid waste poses the greatest obstacles to successful solid waste management at the household level through composting mechanisms. The remaining respondents, or about 34.3 percent, rate the scenario as agreeing and disagreeing, respectively. This demonstrates that the primary factor impeding successful management of solid waste by composting approach is the inadequate collection of solid waste generated from each individual dwelling. Lack of effective sorting of solid waste before it is dumped into the compost pit is another factor.

More importantly, creating public awareness regarding the collection, sorting, and recycling of solid waste generated from individual households' plays significant role for effective management of solid waste through composting. This can be associated with public education and was measured with agree, disagree, and strongly disagree rates respectively. As indicated in Table 2 most of the respondents

nearly 42.1% strongly agree that lack of public education is a series problem facing effective management of solid waste through composting. Lack of public education in the study region affects the way that solid waste collection, sorting, and recycling effectively with equal percentage nearly 29.4% from the total of 102 participants. Recycling of solid waste generated from household level reduces the waste that reside the street and is very important mechanism that helps the effective management of solid waste in the study region. About 51% of respondents strongly agree that public education strongly determines the effectiveness of solid waste management with composting approach. 27.5% of the respondents disagreed that public education and awareness are not the way to effectively manage household solid waste through composting. The rest of the respondents nearly 21.6% agreed that public education is important for the successful implementation of effective solid waste management through composting. In association with the above idea, environmental expert expressed in such a way that: -

"*Over the years the three most serious challenges faced in the solid waste management were lack of logistics, lack of budget, waste conversion into compost and recycle and re-use of wastes that impeded us not to deal with solid wastes. The municipality has done its best to solve these problems and has succeeded in converting waste in to re-usable materials and composting waste in traditional ways, but the municipality is planning to compost waste in modern means at an industrial level for the future*".

Table 4-8: Challenges of effective Solid Waste Management through composting

S. N	Characteristics	Categories	Frequency	Percent
1	Ineffective collection of solid waste	Disagree	26	25.5
		Agree	35	34.3
		Strongly agree	41	40.2
		Total	**102**	**100.0**
2	Lack of proper sorting of solid waste	Disagree	29	28.4
		Agree	54	52.9
		Strongly agree	19	18.6

		Total	**102**	**100.0**
3	Lack of public education	Disagree	30	29.4
		Agree	30	29.4
		Strongly agree	42	41.2
		Total	**102**	100.0
4	Not use of recycling option	Disagree	28	27.5
		Agree	22	21.6
		Strongly agree	52	51
		Total	**102**	**100.00**

CAPTER FIVE

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

The major household solid waste generation in Gara Beru village of Bishoftu City is mostly consisting of food waste, ash and plastic materials. This implies that, the type and rate of household solid waste production are varied depending on the living condition of each household.

The existing method of managing home solid waste through composting appears to be inadequate. Only a small percentage of the sample households used composting pits to collect and dispose of their solid waste; the majority preferred to dump their waste in unapproved locations. The main reasons given by the respondents for not using a compost pit were ignorance and disinterest. It was also recognized that the majority of homes do not have the habit of composting their waste. This is due to the fact that the majority of respondents thought solid trash was utterly useless.

Out of the 49 individuals surveyed, the majority, which is 55.1% or 27 individuals, strongly agreed with the statement, indicating a strong belief in the existence of a high level of community awareness. The data suggests that there is widespread support for the use of municipal solid waste in the production of organic compost as a means of generating income for households. However, further research is needed to fully understand the relationship between organic compost and crop yield and to address any potential challenges that may arise.

Additionally, expert support and guidance can positively influence farming practices and enhance understanding of soil fertility and composting techniques, leading to more cost-effective organic compost preparation and increased household income. The survey outcomes shed light on a positive perception surrounding the cost-effectiveness of organic compost preparation and its influence on household income. The results obtained from the Likert scale survey leave no room for doubt, as they clearly indicate a strong and affirmative perception regarding the positive impact of organic compost on crop yield and household income.

The findings from the HFAIS model indicate that a majority of the participants who used compost had a higher level of food security (91.1%) compared to those who did not use compost (79.1%). This

suggests that utilizing compost in an organic manner is an effective and promising strategy to improve household food security in the study area.

The main obstacles to good solid waste management using a composting technique in the study area were a lack of public education, a lack of solid waste sorting, unsafe solid waste disposal, and ineffective solid waste collection. This suggests that the village's current condition with regard to managing household solid waste through a composting strategy is subpar and requires additional development.

5.2. Recommendations

According to the study's findings, the researcher sent the following suggestions. Since waste is produced by everyone and its effects affect everyone, managing waste should not be the responsibility of a single organization or group of people. It is therefore advised to city authorities and other interested parties to:

- To lessen the amount of waste dumped from each household and encouraging using other options like reusing, recycling, and composting methods.
- Increase the number of opportunities for small micro businesses to enter the waste collection industry, which will improve waste management in the study region.
- The support for utilizing municipal solid waste for organic compost production as a means of income generation is encouraging, further research is necessary to fully comprehend the correlation between organic compost and crop yield, as well as to address any potential challenges.
- This valuable information can greatly benefit policy makers and stakeholders in the agricultural sector, potentially leading to the development of more sustainable and income-generating farming practices.
- The use of compost in an organic manner has been proven to be a successful and promising strategy for improving household food security in the study area. It is imperative for the government and other entities to give significant attention to this practice.
- The current state of managing household solid waste through composting in the village is below par and needs further improvement. This indicates that there are obstacles to achieving effective solid waste management using composting techniques.

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APPENDICES

Questionnaire and Interviews

ADDIS ABABA UNIVERSITY

COLLEGE OF DEVELOPMENT STUDIES

CENTER FOR FOOD SECURITY STUDIES

Dear Respondents,

I am graduating class of MSC student at Addis Ababa University. This questionnaire is prepared for research purpose entitled the ***contribution of solid waste management through composting approach on households food security situations, Bisoftu city, Gara Beru village urban agriculturist.),***your participation in this study will be valuable and greatly appreciated. Information gathered will be treated with utmost confidentiality and will not be used for any other purpose.

INSTRUCTIONS:

The questionnaires contain statements about ***contribution of solid waste management through composting approach on household's food security situations, Bisoftu city, Gara Beru village, urban agriculturist.*** Give your own opinion and feeling about each item. Please circle your response to each statement according to the following five-point scale in terms of your own agreement and disagreement of the statement.

5= Strongly Agree, 4= Agree, 3= Neutral, 2= Disagree, 1= Strongly Disagree

Example: If you strongly agree with any of the statements given in the questionnaire, you should circle on #5 and if you strongly disagree with any statements please circle on #1. For the statement, where you cannot make a decision, circle on #3 and rate others categories accordingly.

Name: Robel Ayalew

Phone No: 0911017297

Appendices 1

Part 1 . Demographic Information

1. **Age** : 20-30 ☐ 30-40 ☐ 40-50 ☐ above 50 ☐
2. **Sex :**Male ☐ Female ☐
3. Current size of farmer's household*(Current number of people living in your house)* persons
4. Educational level of the farmer:
   - ☐ Less than elementary level(*Illiterate*)
   - ☐ Elementary to less than high school
   - ☐ High school
   - ☐ Two years college
   - ☐ University or above
5. Farmer's experience in agriculture(*years*):
   a. Farmer's experience in farming in general: years
   b. Farmer's experience in crop cultivation years
6. Total land property of the farmer Donum
   a. Land area of crops so rented by farmer: ..... Donum
   b. Land area of crops rented by farmer:..... Donum
7. What is your annual income from organic crop cultivation in your farm land?
   - ☐ <50,000
   - ☐ 50,000-100,000
   - ☐ 100,000-160,000
8. To whom do sell your products?
   - ☐ Directly to consumers
   - ☐ Retailers

- ☐ Wholesalers
- ☐ Exporters
- ☐ Processors
- ☐ Governmentalcorporationforstorageandmarketingofagriculturalproducts
- ☐ Selling through Damman
- ☐ Other (specify):.....

Appendices 2

Part 2: study variables: contribution of solid waste management through composting approach on household's income and food security situations:

Please indicate the extent to which you agree/disagree with the following statements. Strongly disagree represents the least weight of 1 while strongly agrees is for the highest weight of 5. Please put (√) mark according to your choice

1=SDA, 2 =DA, 3=Neutral, 4= A and 5 = S

	Variables	Strongly disagree	Dis agree	Neutral	Agree	Strongly agree
A	Community Awareness	Rates				
		1	2	3	4	5
1	I am aware of organic farming practice.					
2	I understand how to use organic farming practice					
3	I believe that organic farming practice is beneficial for my farm.					
B	Cost effective-ness					
1	The cost of implementing organic farming practice or technology is reasonable.					
2	The benefits I get from organic farming practice or technology] outweigh its costs.					
3	I can recover the cost of organic farming practice or technology] within a reasonable time.					
C	Expert Support					

1	How often do you interact with extension agents or experts? Daily					
2	Weekly Monthly					
3	Rarely					
4	Never					
D	Access to Solid Waste					
1	I have easy access to solid waste for compost preparation					
2	The type of solid waste I have access to is suitable for compost preparation.					
3	I am able to collect this waste regularly.					
E	Crop Yield					
1	I am able to sell my crops at a higher price due to the improved quality from organic compost application.					
2	The income I generate from selling my crops has increased since I started using organic compost.					

3	The cost of applying organic compost is offset by the increase in my income.					

Appendices 3

Questionnaire Format for Food Security Responses

Household Food Insecurity Access Scale(HFIAS)Measurement Tool

No	Question	Response Options	CODE
1.	In the past four weeks, did you worry that your household would not have enough food?	0=No (skiptoQ2) 1=Yes	….|__|
1.a	How often did this happen?	1=Rarely(once or twice in the past four weeks) 2=Sometimes(three to ten times in the past four weeks) 3=Often(more than ten times in the past four weeks)	….|__|
2.	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	0=No(skiptoQ3) 1=Yes	….|__|
2.a	How often did this happen?	1=Rarely(once or twice in the past four weeks) 2=Sometimes(three to ten times in the past four weeks) 3=Often(more than ten times in the past four weeks)	….|__|

3.	In the past four weeks, did you or any household member have to eat limited variety of foods due to a lack of resources?	0=No(skiptoQ4) 1=Yes	….|__|
3.a	How often did this happen?	1=Rarely(once or twice in the past four weeks) 2=Sometimes(three to ten times in the past four weeks) 3=Often(more than ten times in the past four weeks)	….|__|
4.	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat Because of a lack of resources to obtain other types of food?	0=No (skiptoQ2) 1=Yes	….|__|
4.a	How often did this happen?	1=Rarely(once or twice in the past four weeks) 2=Sometimes(three to ten times in the past four weeks) 3=Often(more than ten times in the past four weeks)	….|__|

No	Question	Response Options	CODE
5.	In the past four weeks, did you or any house hold member have to eat a smaller meal than you felt you needed because there was not enough food?	0=No(skiptoQ6) 1=Yes	….|__|
5.a	How often did this happen?	1=Rarely(once or twice in the past four weeks) 2=Sometimes(three to ten times in the past four weeks) 3=Often(more than ten times in the past four weeks)	….|__|
6.	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	)	….|__|
6.a	How often did this happen?	1=Rarely(once or twice in the past four weeks) 2=Sometimes(three to ten times in the past four weeks) 3=Often(more than ten times in the past four weeks)	….|__|

7.	In the past four weeks, was the ever no food to eat of any kind in your household because of lack of resources to get food?	0=No(skiptoQ8) 1=Yes	….|__|
7.a	How often did this happen?	1=Rarely(once or twice in the past four weeks) 2=Sometimes(three to ten times in the past four weeks) 3=Often(more than ten times in the past four weeks)	….|__|
8.	In the past four weeks ,did you or any household member go to sleep at night hungry because there was no enough food?	0=No(skiptoQ9) 1=Yes	….|__|
8.a	How often did this happen?	1=Rarely(once or twice in the past four weeks) 2=Sometimes(three to ten times in the past four weeks) 3=Often(more than ten times in the past four weeks)	….|__|
9.	In the past four weeks, did you or any household member go a whole day and night without eating	0=No (questionnaires finished) 1=Yes	….|__|

	anything because there was not enough food?		
No	Question	Response Options	Code
9.a	How often did this happen?	1=Rarely(once or twice in the past four weeks) 2=Sometimes(three to ten times in the past four weeks) 3=Often(more than ten times in the past four weeks)	….| |

FGD

1.What is the trend of application of compost application in agricultural fields in your village?.....
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2. What are existing knowledge and perception of compost application among communities of your village? Would you elaborate?.....
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.....
...../

3. Which factors determine compost application in your village? How?.....
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.....
...../

4. Are there significant differences on the income and food security situation of households who adopts compost application in their agricultural practices with non-adopter households?

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……/

5. What are the possible recommendations towards the impacts of municipal solid wastes through composting approach towards urban agriculture and food security issues? Would you mention?

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Thank you so much for your feedback you have given me in this questioner!