ASSESSMENT OF LIVESTOCK WASTE RECYCLING PRACTICES AND CHALENGES IN ADDIS ABABA CITY ADIMINSTRATION: THE CASE OF LAMI KURA AND AKAKI KALITY SUBCITIES

MEBRATU PAULOS

A THESIS SUBMITTED TO COLLEGE OF DEVELOPMENT STUDIES OF ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN ENVIRONMENT AND DEVELOPMENT STUDIES

March, 2025
ADDIS ABABA, ETHIOPIA

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BY

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DECLARATION

Under the direction and recommendation of the research adviser, I, the undersigned, hereby certify that this thesis is my original work and that all resources used for the study have been officially acknowledged. It is available for the partial fulfillment of the requirements for the degree of Master of Arts in Development Studies.

Declared by

Name_____

Signature_____

Date_____

Certification

This is to certify that the thesis entitled: *"Assessment of Livestock Waste Recycling Practices and challenges in Addis Ababa City Administration: The case of Lami Kura and Akaki Kality Sub-cities"* submitted in partial fulfillment for the requirements for the Degree of Master of Arts in Development Studies (Environment and sustainable development) and is carried out by Mebratu Paulos under my supervision. Therefore, I recommend it to be accepted as fulfilling the thesis requirements.

Name of Advisor	Signature	Date
Assefa Siyoum (Ph.D.)	_____	_____

As members of the examining board for this Master of Arts thesis defense, we hereby certify that we have read and evaluated the thesis prepared by Mebratu Paulos. The thesis, titled "Assessment of Livestock Waste Recycling Practices and challenges in Addis Ababa City Administration: The case of Lami Kura and Akaki Kality Sub-cities meets the academic standards required for the degree of Master of Arts in Development Studies (Environment and sustainable development).

Internal examiner_____signature_____Date_____

External examiner_____signature_____Date_____

LIST OF ACRONYMS

UN	United Nation
CSA	Central Statistical Agency
GDP	Gross Domestic Product
UN-Habitat	United Nations Human Settlements Programme.
SPSS	Statistical Packages for Social Sciences
VIF	Variance Inflation Factor
KII	Key Informant Interview

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Abstract

Addis Ababa, Ethiopia's capital, is experiencing significant growth, and with it, challenges in managing waste from urban livestock farming. This study assesses the livestock manure recycling practices of urban farmers and associated challenges in Addis Ababa, focusing on the Lemi Kura and Akaki Kality sub-cities. The primary objectives are to assess the existing waste management practices, identify the challenges hindering recycling efforts, and assess the perceptions of stakeholders towards manure recycling. The study basically used Qualitative and quantitative approaches. 216 randomly selected livestock farmers and seven key informants were selected purposely from relevant government offices to collect primary data. Livestock farming plays a crucial role in urban livelihoods in Addis Ababa. However, the improper disposal of manure often dumped in open spaces or connected to drainage systems, poses serious environmental threats, including soil and water pollution, and public health risks. Despite the benefits of manure recycling such as composting and biogas production only a small percentage of urban livestock farmers adopt these sustainable practices. The study reveals that the primary methods of waste disposal include dumping in open spaces 60%, while only 32.5% of farmers engage in composting or biogas production. Furthermore, most respondents 77.5% indicated that they are not updated with advancements in recycling technologies, and over 60% expressed inability to apply modern waste recycling technologies due to various barriers, including limited space, lack of knowledge, and insufficient government support. However, monitoring of the environmental impact of waste management is limited, with 73% of respondents reporting no regular assessment of their practices. The study identifies several key challenges hindering effective manure recycling, including limited space 50%, regulatory barriers 27.5%, and a lack of market 12.5%. Although 80% of participants believe that recycling manure can mitigate environmental pollution, 73% do not regularly monitor the environmental impact of their waste management practices. The findings suggest that improved government support for livestock manure recycling, policy reforms, and training on modern technologies are essential to promote sustainable livestock waste management. The study concludes that there is a need for increased governmental and NGO support, better access to modern recycling technologies, and enhanced training and awareness programs to promote recycling livestock waste which is sustainable way of waste management practices.

Key words: sustainable waste management, recycling challenges, livestock farming, government support, technology,

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the study

The world is rapidly becoming more urbanized. By the end of 2050, 60% of the world's population is expected to be living in urban areas (Ezeadichie, 2023). The Global South will absorb 90% of future urban population growth, notably in Asia and Africa.

Annual rates of population increase of 5% are not an exception in the cities of these regions, meaning that the population doubles within approximately 14 years. To cope with these pressures would be an incredible challenge for any city, but it is overwhelming for many African and Asian cities where urban institutional capacities are mostly limited, governance mechanisms inefficient and urban growth is not accompanied by corresponding economic growth (Parnell & Walawege, 2011). Consequently, poverty levels are high and nearly 60% of the urban population in sub-Saharan Africa, and around 30% in Asia, are living in slums with poorly built homes and a scarcity of basic infrastructure such as electricity, water and sanitation (UN, 2018b). This will be very likely for Africa as well, in which Ethiopia too is going to be part of the process.

The population of Addis Ababa is expected to increase in the next 15 years at an average annual growth rate of approximately 4%, reaching almost 9 million people in 2035 (UN, 2018). However, not only is Addis Ababa expanding at a rapid pace, but growth is also taking place along the major outlets of the city into the surrounding region (Kassa, 2013). This growth is expected to translate into an expansion of settlements in the city and into the surrounding areas. Consequently, farmland will continue to decline in the city's surrounding area for urbanization and industrial development (UN Habitat, 2021). The amount of farmland lost and the impacts on food supply, local livelihoods and the environment will very much depend on the mode of future urban development.

Cities are dynamic and changes in available space, resources and assets are often rapid. Economic changes result in considerable variation in the number of underemployed or underpaid people who need to supplement their food sources or incomes through urban agriculture (Bakker et al., 2000). A number of studies support the importance of urban food production to the wellbeing of producers in connection with nutrition or consumption, health, cash saving and income generation and employment (Bakker et al., 2000).

Most of the food for urban people is imported from rural areas (Jones et al., 2013), but significant amounts are provided also by urban and peri-urban farms (Roessler et al., 2016). Urban and peri-urban agriculture contributes to the livelihood of urban dwellers, providing jobs, income and food security, especially in developing countries (Chihambakwe et al., 2018). Urban and peri urban farms mainly supply perishable vegetables and animal products to urban areas, due to the proximity to and high prices in urban markets (Djurfeldt, 2015).

Livestock are an important component of nearly all farming systems in Ethiopia and provide; power, milk, meat, manure, hides, skins and other products. In addition, livestock are important source of cash income and play an important role in ensuring food security and alleviating poverty (Holloway et al., 2002). The large increase in the livestock population is causing environmental concerns due to limited land areas for efficient disposal of animal excreta. When many animals are kept in small areas it is difficult to return their excreta and sewage at rates which the agricultural land can absorb (Cooke and Williams, 1973). Wrong handling of the manure, like improper storage or faulty spreading on agricultural land can cause environmental pollution problems (air pollution and water pollution) and may also give problems with flies and odors. The accumulation of manure in urban and peri-urban areas contributes to a range of unwanted human health and environmental effects (Herrero et al., 2018).

Livestock farms are important among urban and per urban farms in Ethiopia; these farms largely depend on animal feed scavenged from neighborhoods and feed imported from rural areas, as they have little or no land and the manure of the livestock, which contains 60% to 95% of the nutrients contained in the animal feed, are not used for manuring croplands, but are dumped into the urban environment, disregarded or used partly as biofuels (Tadesse et al., 2021). Urban manure recovery and recycling may have energy, economic and environmental benefits, the 3Es aspects (Rodionov and Nakata, 2011).

The ‘circular economy’ is a response to the inefficient use and management of resources in our current linear socio-economic systems. It aims at more sustainable development through increased recycling. Alike, nutrient recovery from animal manure and human waste in urban and peri-urban areas and recycling in rural areas has direct environmental benefits (Rao et al., 2017), and may replace synthetic fertilizers and thus reduce the costs, emissions and pollutions associated with the production and use of synthetic fertilizers (Buckwell and Nadeu, 2016). Also, recycled nutrients may reduce the dependency of countries on imports of

fertilizers (Smits and Woltjer, 2018) and are thought to have a vital role in achieving Sustainable Development Goals on food and nutrition security, clean water and sanitation, sustainable cities and life below water and on land (Zhu et al., 2017).

Manure management has risen to the fore of livestock production concerns in the developing world with implications to farming system design, function and profitability. As well as to environmental quality and human health Sustainable manure management that balances the production, economic and environmental concerns of manure generation, handling, processing and end use requires concerted investment of resources and time as well as a strategic approach to livestock production that often extends well beyond the farm gate (Potter et al., 2010)

As a result, the practice of urban livestock farming is introduced in an intensive manner within the city. Office of Farmers and Urban Agriculture Development and Addis Ababa Cleansing Management Agency, woreda, sub city and the city administration level is involved in promotion of urban livestock manure recycling. However, the practice of livestock manure recycling was not sufficiently addressed in the previous studies. Therefore, the purpose of this study will be assessing the practice of Addis Ababa farmers on livestock manure recycling.

1.2 Statement of Problem

Declining soil fertility in sub-Saharan Africa is a threat to future crop and livestock productivity (Faerge & Magid, 2004). Losses of nutrients is occurring continuously through harvesting of grains, grazed feed, animal products, volatilization or manure removal for other purposes. In an ecosystem, when natural resources are managed, nutrient recycling is an essential part of any strategy for sustainable agriculture (Jabbar et al., 2011). Livestock have a significant role in stabilizing farming systems by providing manure (Saleem, 1998) which is a valuable resource and can be used as a supplement, to replace inorganic fertilizers or for energy production. Inorganic fertilizers are expensive and applied mainly to high yielding varieties especially in irrigated conditions (Faerge & Magid, 2004).

The large increase in the livestock population is causing environmental concerns due to limited land areas for efficient disposal of animal excreta. When many animals are kept in small areas it is difficult to return their excreta and sewage at rates which the agricultural

land can absorb and wrong handling of the manure, like improper storage or faulty spreading on agricultural land can cause environmental pollution problem (Cooke and Williams, 1973).

According to Heubach (2012) cattle manure, especially when buried, improved the yields of elephant grass significantly. This was possibly due to reduced nitrogen volatilization. The lack of tools did hinder the recycling activities of manure in different ways. Without tools it takes a lot longer time to clean up in the animal houses and makes the transport of the manure more difficult. Some of the farmers poured the manure into a water stream and this can give rise of diseases and destroyed water sources for people downstream (Karin, 2007).

According to Feliciano et al., (2021) although the costs of manure and waste recycling will increase greatly, the cost of the resulting composts will be comparable to the cost of mineral fertilizers, per unit of Nitrogen and Phosphorus, which suggests that the composts would be economically compatible. Estimated fertilizers saving for Addis Ababa were in the range of 75 million to 300 million Ethiopian Birr.

There are several reasons for not collecting and recycling urban livestock manures and household wastes, even though there is a large need for essential nutrients in the rural areas, First, there are cultural barriers and a poor infrastructure, Second, there is lack of knowledge and urgency at the policy level, and thus absence of effective policies and incentives for facilitating urban manure and waste recycling. In particular, there is lack of knowledge in urban communities and waste management agencies about the quantity and quality of urban livestock manures and household wastes that may be collected and recycled (Tadese et al., 2018).

Tadesse et al., (2018) reported that landless commercial livestock farms with surplus livestock manure, simply dumped large quantity of into ditches and farm surroundings or left it unmanaged on the ground. Similarly, in Kampala city, many livestock farms discard and dumped livestock manure into drainage channels, where it is carried off by running water, because there is no comprehensive national urban policy and institutional framework to regulate the use of solid waste In addition to losses of nutrient resources, unmanaged wastes may contribute to pollution of the urban environment (Komakech, 2014).

The Ethiopian government has a policy and legal system for solid waste management, including the National Integrated Urban Sanitation and Hygiene Strategy (2017), and the Solid Waste Management Proclamation No 513/2007 and the country has goal of reducing, reusing, and recycling waste. Although the country has Environmental Pollution Control

Proclamation No. 300/2002, there are only a few initiatives that implement the 3R (reduce, reuse, recycle) and circular economy models are still evolving.

Even though livestock manure recycling has several contributions for soil fertility and environmental improvement, previous studies conducted in did not sufficiently address and asses the livestock manure recycling practices and challenges in Addis Ababa city administration. Therefore, the purpose of this research is to assess urban livestock manure recycling practices and challenges in Addis Ababa city administration. Specifically in Lemi Kura and Akaki Kality sub city.

1.3 Objectives of The Study

This study has both general and specific objectives.

1.3.1 General Objective

The general objective of the study was to assess livestock waste recycling practices and associated challenges in Addis Ababa city specifically the case of Lami Kura and Akaki Kality sub cities

1.3.2 Specific Objectives

i. To assess the existing livestock waste management practices in livestock farming to understand the extent of recycling in Addis Ababa city specifically the case of Lami Kura and Akaki Kality sub cities.
ii. To assess main challenges that hinder the recycling practices of farmers in Addis Ababa city specifically the case of Lami Kura and Akaki Kality sub-cities.
iii. To assess the perception of livestock farmers and government agencies towards livestock manure recycling practice and its contribution for environmental conservation in Addis Ababa city specifically the case of Lami Kura and Akaki Kality sub cities.

1.4 Basic Research Questions

1. What are the current livestock waste management practices employed and extent of recycling in livestock farmers in Addis Ababa specifically Lami Kura and Akaki Kality sub-cities?

2. What are main challenges that hinder the recycling practices of farmers in Addis Ababa specifically Lami Kura and Akaki Kality sub-cities?

3. How do livestock farmers and government agencies perceive and respond to livestock waste recycling practice and its contribution to environmental conservation in Addis Ababa specifically Lami Kura and Akaki Kality sub-cities?

1.5 Significance of the Study

Conducting study on the assessment of urban livestock manure recycling will have several significances. Study's significance lies in its potential to contribute to environmental protection, agricultural sustainability, climate change mitigation, policy development, and economic benefits through the promotion of sustainable manure recycling practices. It will help to understand the practice of urban livestock manure recycling in urban areas, which can inform policies related to urban agriculture and livestock manure management for policy makers.

Besides, the study will play a significant role in creating awareness in livestock manure management practices such as recycling. It will also raise awareness about the potential of urban livestock manure for environmental protection and soil fertility.

Moreover, the findings of the research will be used to educate policymakers and urban planners about the benefits of supporting urban livestock manure recycling, leading to informed decision making and the development of supportive policies.

The finding of this research will also contribute to understanding of the perception of stake holder and the farmers about recycling of livestock manure. In the meantime, the finding of this research will be an add on the existing literature about the contribution of urban livestock for waste management methods.

1.6 Scope and Limitations of the Study

The thematic scope of the study tries to assess Practices and challenges of recycling urban livestock waste and the perception of stakeholders about recycling practices. The primary source of data was individual livestock farmers, the data collected through questionnaire and key informants from stakeholders. Secondary data was collected from reports, articles and related studies. Geographically, the study concentrated in Lemi Kura and Akaki kality Sub-cities of Addis Ababa City Administration. In this research, livestock farmers except poultry farmers were the focus of the study. Besides, it is worth to assess the practice of urban livestock manure recycling in whole Ethiopia, but this study will focus on Addis Ababa City Administration due to some limitations.

In the process of conducting this research, the researcher encountered challenges like in accessibility of government official reports and minutes. In addition to this there is problem of inaccessissibilty to contact enumerators this makes data collection plan longer than planned. There is also lack of willingness on some sampled livestock farmers to tell real method of their livestock waste management. Even though urban livestock management is currently becoming serious issue the researcher had faced challenge in finding organized documents about livestock waste management and recycling practices in government offices.

1.7. Organization of The Study

The thesis is organized into five chapters. Part one is the introduction section which consists of the study‘s background, statement of the problem, objectives, significance, scope, limitations and ethical consideration of the study. The second section is the literature review where related concepts and literatures related with the study are reviewed. Theoretical, empirical and analytical frameworks of the study are also incorporated in this section. The third chapter of the thesis describes the research methodology of the study. It includes description of the study area, research design, sampling technique, sample size, source and type of data, data collection and data analysis methods. The fourth chapter presents the results and the discussion; whereas, the last chapter forwards conclusions and recommendations drawn from the findings of the study.

1.8. Operational Definition of Key Terms

- **Assessment** – is a systematic process of gathering data through various methods and analyzing to evaluate and improve understanding or knowledge of a particular issue. (Smith & Jones, 2020).
- **Livestock Waste** – is organic and inorganic waste materials generated from animal husbandry, including manure, urine, feed residues, and processing byproducts. Livestock waste is a major contributor to environmental pollution if not properly managed (Innes, R, 2000).
- **Recycling** – is process of converting waste into reusable products, for livestock waste such as compost, biogas, or other environmentally friendly materials. Recycling helps in reducing environmental impact and enhancing sustainability in agricultural systems (Zhang et al., 2019).
- **Practices** – The specific methods, techniques, and approaches used by farmers, and relevant stakeholders to manage and recycle livestock waste. These practices vary based on technology availability, economic feasibility, and policy frameworks (Kumar & Singh, 2021).
- **Challenges** – The difficulties, constraints, and barriers that hinder effective livestock waste recycling practices. (Nguyen et al., 2020).
- **Addis Ababa City Administration** – The governing body responsible for managing urban affairs, including waste management and environmental regulations. It includes eleven sub cities and plays a key role in implementing policies related to waste management (Addis Ababa City Government, 2019).
- **Lami Kura and Akaki Kality Subcities–** Administrative divisions within Addis Ababa City that serve as the specific study locations for analyzing livestock waste recycling practices and challenges.

CHAPTER TWO

2. LITERATURE REVIEW

This chapter presents general literature review of urban livestock production, urban agriculture, and manure recycling. The chapter discusses the interface of livestock production, the environment, and the waste management practice of urban farmers. Theories concerning the management of livestock waste, empirical evidence on recycling manure, and determinants of recycling behavior among urban livestock producers are covered in the chapter. Additionally, it highlights manure recycling as a key sustainable urban waste management approach, examining its benefits and challenges. Further, the chapter outlines the importance of livestock keeping in ensuring food security, employment, and environmental sustainability. It concludes by outlining the empirical evidence on manure recycling and a conceptual framework based on the literature discussed.

2.1 Definition of Terms and Concepts

2.1.1 Urban Agriculture

At the 1996 United Nations International Conference on Human Habitats in Istanbul, the term "urban agriculture" was first defined as an industry that uses a variety of land and water bodies located throughout intraurban and peri urban areas to produce, process, and market food, fuel, and other products, primarily in response to the daily demands of consumers within a town, city, or metropolis (Smit et al., 2006). According to Mougeot (2000), urban agriculture is “an industry located within (intra-urban) or on the border (peri-urban) of a town, a city or a metropolis, which grows or raises, processes and distributes a diversity of food and non-food products, (re)using largely human and material resources, products and services found in and around that urban area.” This definition highlights the economic, social, and environmental dimensions of urban agriculture.

Urban agriculture encompasses a variety of activities, including community gardening, rooftop farming, hydroponics, aquaponics, and vertical farming urban agriculture can contribute to urban resilience by increasing green spaces, improving air quality, and mitigating the urban heat island effect. Moreover, it provides economic opportunities for marginalized groups, including low-income families and unemployed individuals, by

creating jobs and entrepreneurial ventures in food production and distribution (Smit et al., 2001).

According to Yalew (2020), in Ethiopia urban agriculture will have a substantial role in fostering sustainable urban development agenda in the country. However, urban agriculture in Ethiopia has gained little attention from the scientific research community. The topic is both under researched and very recent. The tiny literature on urban agriculture in Ethiopia is dominated by gray literature and micro-level analysis, i.e., on a sample of households in a specific urban center. The existing body of literature, therefore, provides little information on the macroeconomic role of UA in both regional and national economies.

2.1.2 Urban Livestock Farming

The practice of raising and retaining livestock such as cattle, chickens, goats, or other nontraditional animals in urban or densely populated areas is known as urban livestock farming. It entails the management of livestock for a number of objectives, such as the creation of food items and revenue (RUAF, 2007). According to Lee-Smith (2010), urban livestock farming encompasses the keeping of animals in urban and peri-urban areas, often as part of informal economies, and plays a crucial role in meeting the nutritional and economic needs of urban populations. This practice is prevalent in both developed and developing countries, where urban farmers utilize small spaces, backyards, vacant lots, and even rooftops to raise animals.

The contributions of urban livestock production system to overall development include income and employment generation, poverty alleviation, and improving human nutrition and health. Urban livestock production system is complex with diverse activities including production, processing and marketing and several technologies at each level in the commodity chain that make up a system. Each activity of the system is affected by diverse biological and social factors and their interactions. In addition, the major technical and non-technical problems associated with these livestock production systems such as policy issues, land rights and ownership, availability and cost of inputs (genotype, feed resources, trained personnel, animal health) need to be addressed (Tadese et al., 2018).

2.1.3 Livestock Manure

Livestock manure is organic matter, mostly derived from animal faeces and urine, but normally also containing plant material (often straw), which has been used as bedding for

animals and has absorbed the faces and urine (Loss et al., 2022). When correctly handled, livestock manure is a beneficial fertilizer that can help improve soil quality and crop production, contributing to increased food security. On the other hand, poor handling, storage, and disposal of livestock manure can result in excessive greenhouse gas emissions and a hygienic concern (Rufino et al., 2006). Untreated livestock manure may harbor a variety of zoonotic infections that can infect people and spread mostly through contaminated food and water. Additional health problems may arise if manure containing antimicrobials or antimicrobial-resistant bacteria ends up in the environment, as they may contribute to the emergence of antimicrobial resistance (Heuer et al., 2011).

Implementation of proper management practices for livestock manure is often challenged by ineffective manure management policies and a lack of incentives for good management In addition, poor farmers may not have enough capital to invest in the equipment necessary for improvements, and there is often insufficient knowledge among farmers about the value of manure as a fertilizer, and about the biosecurity hazards arising from improper handling and use of manure (Teenstra et al., 2014).

2.1.4 Recycling

Recycling is the process of collecting and processing materials that would otherwise be thrown away as trash and turning them into new products. It is an important practice that benefits the environment, the economy, and communities. By recycling, we can conserve natural resources, reduce waste and pollution, save energy, and mitigate climate change (sommer et al., 2013).

Manure recycling, also known as nutrient recycling, focuses on returning the nutrients like nitrogen, phosphorus, and potassium from livestock manure back to the soil for crop production and it is in line with the FAO model for sustainable intensification of crop production “Save and grow”(Pergola et al., 2017). According to Food and Agriculture organization of United States waste is a human concept, it does not exist in natural ecosystems. By imitating natural ecosystems, agroecological practices support biological processes that drive the recycling of nutrients, biomass and water within production systems, thereby increasing resource use efficiency and minimizing waste and pollution.

Manure recycling delivers multiple benefits by closing cycles and reducing waste that translates into lower dependency on external resources or fertilizers, increasing the autonomy

of producers and reducing their vulnerability to market and climate shocks. Although recycling of animal manures and household wastes has several advantages, the willingness and incentives for recycling manures and wastes back to crop land are still limited in developing countries (van Beek et al., 2016). For instance, less than 10% of the animal manures and crop residues available to smallholder farmers in Ethiopia were applied to soils (Nigussie et al., 2015), despite net nutrient depletion due to nutrient withdrawal with harvested crops, erosion and leaching, and limited applications of inorganic and organic fertilizers (van Beek et al., 2016). There are a number of methods of livestock waste recycling which are biogas production, composting (aerobic composting, anaerobic composting and, vermicomposting, direct land application, dunk cakes for building and cooking, etc. (Tadesse et al., 2018).

2.2 Livestock Production and Economic Development

One of agriculture's fastest-growing subsectors is livestock; in developing nations, the need for animal feed is predicted to double, while globally, it will rise by 70%. Since environmentally friendly development is now a global concern, the livestock industry contributes significantly to both economic growth and the world's food supply, but it also uses a lot of natural resources and has an adverse effect on the environment (Osak et al., 2015).

According to Dorward et al. (2005), raising livestock can help keepers' economies in a number of ways, including as increasing farmers' revenue by supplying consistent cashing originate from the sale of goods (such as milk, eggs, meat, hide and horn, wool, and manure), services (such as labor, transportation, breeding sires, and ceremonial purposes), or live animals that farmers can use to purchase other household goods; by offering a supply of livestock to feed the household; by providing insurance and buffering to cover unforeseen expenses and absorb the shock of an unforeseen event; and by offering the keepers a higher social status and the community's respect. The role of livestock production systems in increasing food supply and ensuring adequate and nutritious food for populations is paramount (Beveridge et al., 2013).

2.3 Livestock Systems, Food Security and Household Income

Increased demand for foods derived from animals and intense competition for resources (such as land and water) are predicted to have a significant impact on food security (Brend et

al.,2017).

Furthermore, as poverty grows more urbanized, food production and food value chain systems are probably going to see major adjustment processes. At the same time, cities have a bigger impact on rural and peri-urban livelihoods and environments as the demand for urban food rises (Buhaug and Urdal, 2013). As a result, both domestically and internationally, the effects of urbanization on crop and livestock production systems and their consequences for food security are becoming more widely acknowledged as essential elements of sustainable development (Sonnino, 2016).

Food Livestock provide a number of direct and indirect sources of income for households. Firstly, livestock provide financial income or income in kind through the sale of animals and / or the sale and consumption of milk, meat, eggs and other animal products. Second, because the sale of animals generates quick cash to cover major or unforeseen expenses (like school or medical fees), livestock are a type of insurance and savings (capital growth through herd growth). Third, livestock offer draft power, manure, and transportation services that can be utilized on the home farm or traded on the market (e.g., renting a bull to plough). Fourth, being a source of wealth, livestock not only contribute to social status but may possibly facilitate access to financial services, both in formal and informal, (Moll et al., 2007).

2.4 Livestock Production and the Environment

According to (Delgado et al., 1999) the physical environment can be impacted by livestock in both beneficial and harmful ways. Problems with vast grazing systems typically include deforestation and soil deterioration. Problems with manure disposal and water pollution worsen as animal production techniques shift toward industrial and feedlot systems. Groundwater, surface water, and the atmosphere can all be impacted by pollution from cattle husbandry. Numerous economies have responded in a range of ways to the growing environmental damage brought on by increased animal production.

Uncollected garbage is a serious environmental hazard for all, especially in areas where the roads are not accessible for waste collection, deteriorating aesthetic quality of the city. Thus, the health situation of the community is under serious threat (Regasa et al., 2011). Improper waste disposal has resulted in poor hygiene and lack of access to clean water and sanitation in the city, particularly by the urban poor. Adopting Environmentally Sound Management of

wastes focused on the promotion of the “3Rs”, Reduce, Reuse and Recycle is needed. Moreover, Waste to Wealth Initiatives; Corporate Social

Responsibility by producers of consumer products; involvement of multiple stakeholders; Public Private Partnerships and Waste Exchange programs should be explored. Although waste management responsibilities primarily lie with cities and municipalities, the key to success is to collaborate with private sector, communities and in some cases with the informal sector (UNHABITAT, 2010).

2.5 Environmental Impact of Livestock Manure

The rapid development of global animal husbandry not only meets the needs of a high-quality diet but also produces a large amount of livestock manure. Livestock manure, as the focus of agricultural non-point source pollution prevention and control (Yang et al., 2019), will not only produce air pollution, soil destruction, water quality deterioration, and other environmental problems but also cause harm to human health. Studies have found that in low- and middle-income countries, livestock manure pollution is the main cause of gastrointestinal diseases in domestic farmers for many years (Delahoy et al., 2018).

However, livestock manure is not all bad. Relevant studies have shown that organic matter, nitrogen, phosphorus, potassium, and other components rich in livestock manure can not only provide nutrients needed for crop growth but also generate a large amount of electricity and gas energy through biogas and other projects (Holm-Nielsen et al., 2009). It can be seen that strengthening the resource utilization of livestock manure is of great significance to the high quality development of the ecological environment and the sustainable development of agriculture. Using organic solid waste in Urban agriculture reduces the public cost of waste management, reduce environmental and health problems and provides a better living environment, especially in areas where lacks waste management services and productive reuse of waste (wester et al., 2005).

Urban organic wastes provide nutrients and using organic solid waste in urban agriculture reduces methane emissions from landfills and can generate a good price and contributes for the urban farmer to use fewer chemical fertilizers and using fewer chemical fertilizers will prevent problems related to the contamination of groundwater and provide nutrients to soil. In addition, compost making create employment and provide income for the urban poor (Si et al., 20016)

2.6 Benefits and challenges of Livestock Manure Recycling

Anaerobic and aerobic digestions are the two types of systems that are available for on-farm digestion. Microorganisms break down or digest the manure in anaerobic digesters, which function similarly to an animal's digestive tract (Belete & Ayza, 2015). Methane-forming bacteria transform the manure into biogas as one of the final stages of digestion. Methane, carbon dioxide, nitrogen, hydrogen, carbon monoxide, oxygen, and hydrogen sulfide are all components of biogas (Raven 2004, 2005, 2007).

Between 55 percent up to 70 percent of the biogas is methane, while the remainder consists mostly of carbon dioxide. Usually, the nitrogen, hydrogen, carbon monoxide, oxygen, and hydrogen sulfide are found in trace amounts. Methane in biogas is similar to natural gas, and after scrubbing it can be used to fuel internal combustion engines that run generators and produce electricity (Yu et al., 2010).

Land application is a critical process in manure management. Pathogens from animal waste can threaten humans who are exposed to runoff, have direct contact with manure, or consume food or water contaminated with infectious manure. Therefore, application rate and seasonal conditions are important factors that contribute to the transfer of pathogens from lands where manure has recently been applied to nearby surface water. However, there is a higher risk of pathogen transfer to the food chain when fresh manure is land-applied than when stored manure is land-applied because there is no storage or treatment period to decrease pathogen numbers (Nicholson et al., 2005).

Livestock manure recycling, despite its environmental and agricultural benefits, has several disadvantages that can hinder its effectiveness. One major challenge is the high initial costs associated with setting up recycling facilities such as composting units, biogas digesters, and proper storage systems. Farmers and waste management agencies often struggle with limited financial resources, making it difficult to invest in the necessary infrastructure. Additionally, space constraints, especially in urban areas, make manure storage and composting impractical, leading to improper disposal (Raven, 2007).

The manure recycling process is also time consuming, requiring weeks or even months for composting and nutrient stabilization before it can be used in agriculture. Furthermore, poorly managed manure can produce strong odors and attract pests such as flies and rodents, creating health and environmental concerns for surrounding communities. Another

significant risk is the presence of pathogens and harmful bacteria in untreated manure, which can pose health hazards to humans and animals. Nutrient imbalances can also arise if manure is not properly processed and applied; potentially harming soil fertility and water sources (Heuer et al., 2011).

Transportation challenges further complicate manure recycling, as moving manure from urban farms to rural areas requires costly logistics and infrastructure. Moreover, market uncertainty affects the economic viability of manure-based fertilizers, as synthetic fertilizers are often preferred due to their consistency and ease of use. Strict environmental regulations on waste handling can also limit recycling opportunities or require expensive compliance measures. Additionally, improper manure recycling management can lead to water pollution, with excess nutrients causing issues like eutrophication in nearby water bodies (Tadesse, 2021).

2.7. Theories Related to Livestock waste Management

2.7.1. Theory of 3Rs

One of the most important methods for reducing environmental impact and advancing sustainability is the 3Rs idea of waste management: Reduce, Reuse, and Recycle. Reducing waste entails choosing sustainable products and using fewer resources to minimize the quantity of waste produced. By utilizing things repeatedly or reusing them for various purposes, the goal of reuse is to prolong their life cycle. Recycling reduces pollution and the need for raw materials by turning discarded materials into new products. These guidelines help create a cleaner environment, reduce greenhouse gas emissions, and conserve resources (Diaz et al., 2021). Around the world, governments and organizations enact laws to support the 3Rs, which encourage conscientious consumer behavior and effective trash management practices. By incorporating these ideas into their daily lives, people and businesses may drastically cut down on waste creation (Shahet et al., 2024).

2.7.2. The Waste Hierarchy Theory

One idea in waste management that gives priority to the most environmentally friendly waste management solutions is the waste Hierarchy Theory. By using a ranked sequence of tactics, with the most advantageous options at the top and the least advantageous at the bottom, the main goal is to minimize the impact on the environment. The hierarchy highlights the

significance of preventing waste in the first place and recommends that waste be managed to reduce environmental harm if it is produced (zhang et al.,2022).

A. Prevention (Waste Avoidance): The most preferred option is to prevent waste from being created in the first place.
B. Minimization: Focuses on reducing the amount of waste generated by optimizing processes, improving efficiency, or using fewer resources.
C. Reuse: Items or materials should be reused as much as possible before they are discarded. This can involve repairing or repurposing products for a different use.
D. Recycling: If reuse isn't possible, the next best option is to recycle materials, turning waste into new products. This reduces the need for raw materials and lowers energy consumption compared to producing new items.
E. Recovery (Energy Recovery): In cases where recycling is not feasible, energy recovery methods, such as burning, converting waste into electricity or heat.
F. Disposal (Landfill): As a last resort, waste should be disposed of in a landfill or through incineration. This is the least sustainable option because it often involves burying waste or burning it without recovering any resources.

2.7.3 Theory Of Circular Economy

The circular economy emerged as a potential solution to optimize resource usage because of the well-known pressure that humans place on the environment through material extraction and waste generation. Circular economy practices, which are positioned as a technology-driven idea, seek to reduce environmental pressure while producing economic benefits. As a way to solve sustainability issues, it has become increasingly popular in the public, corporate, and civic sectors as well as in academia (EMF, 2020). Critics counter that some "sustainable" techniques could really have negative social and environmental effects.

The Ellen MacArthur Foundation (2020) has compiled numerous successful circular economy implementations, showcasing diverse interpretations, including technological, policy, and business model interventions. Despite its growing popularity, circular economy solutions, which range from material-specific waste reduction to product redesign, are not without challenges (Core Centric Solutions, 2020). These concerns about finite resources were first addressed in the World Commission on Environment and Development's Brundtland Report (WCED, 1987), which laid the foundation for the global sustainable

development agenda. Circular economy emerged from the environmental and systems ecology literature of the 1960s and 1970s, offering a way to mitigate natural resource extraction and waste generation (Velentert and pumell, 2021).

2.8 Empirical Evidence on Livestock Manure Recycling

Although recycling of animal manures and household wastes has several advantages, the willingness and incentives for recycling manures and wastes back to crop land are still limited in developing countries (van Beek et al., 2016). For instance, less than 10% of the animal manures and crop residues available to smallholder farmers in Ethiopia were applied to soils (Nigussie et al., 2015), despite net nutrient depletion due to nutrient withdrawal with harvested crops, erosion and leaching, and limited applications of inorganic and organic fertilizers (Tadese et al., 2016).

While some excrements left in animal confinements are partially recovered and applied to cropland and some dung cakes are gathered and used for construction and cooking, the majority of animal depositions are not recovered and recycled. There are cultural barriers to recycling waste, as well as a lack of information and knowledge. Moreover, governmental policies and regulations for manure collection and recycling are lacking (Komakech, 2014) in developing countries.

Tackling nutrient accumulation in urban livestock farms and nutrient depletion in rural crop farms simultaneously, through recycling of manures from urban areas in rural areas, is an opportunity and a necessity (Goulding et al., 2008). Recycling of agricultural wastes is in line with sustainable intensification of crop production ‘‘Save and grow’’ and represents an important contribution to the circular economy (Diacono et al., 2017).

Recycling organic waste through composting could provide mutual benefit for municipalities and farmers. On the one hand, recycling urban organic waste could contribute to the promotion of urban agriculture particularly through using the organic matter as a soil conditioner and fertilizer by urban farmers with the aim for providing nutrients. on the other hand, it can helps to protect and conserve cities and towns space from waste disposal and reduce the costs of landfills as well as to enhance municipal solid waste management for sustainable environmental protections (Danso and van Veenhuizen,2007). However, contributions of manure that can be recycled from urban farms associated fertilizer savings are currently not well studied.

The management of manure is an ongoing challenge for livestock producers, particularly in metropolitan areas of the nation, due to a lack of suitable disposal sites or technology for reusing animal excrement and the need to comply with environmental rules (Asrat et al., 2014). An essential source of organic matter and plant nutrients is animal manures. When distributing nutrients throughout the farm or bringing manure into the property, understanding the composition of the manure is a crucial component of good management (Bittman et al., 2005).

Biogas has received a great deal of attention in academic literature, Although agricultural biogas production capacity has increased tenfold during the 2000-2012 period studies have shown clear ups and downs, in a non-linear pattern and is generally considered to have had little success (Geels and Raven, 2006).

According to the aforementioned literature from different authors and scholars urban manure recycling has significant importance for environmental protection like soil nutrient improvement, minimizing soil and water pollution. It has also economic advantage by minimizing cost for inorganic fertilizer and minimizing costs for urban waste management like transportation costs to dumb cites and is become major element of evolving circular economy system. recycling urban livestock manure has big contribution for social, environmental and economic sustainability of the urban areas.

Even though urban livestock manure recycling has several benefits for urban areas previous studies conducted in urban agriculture did not sufficiently address the practice of urban farmers recycling of livestock manure Addis Ababa. Therefore, the purpose of this research is to assess the practices of urban livestock farmers on recycling of manure in Addis Ababa. To this effect, the study will be guided by the following basic research questions.

2.8. Factors That Affect Urban Livestock Manure Recycling

Recycling of urban livestock manure is a key component of agricultural productivity and sustainable urban waste management. There are a number of factors that determine the efficacy and efficiency of manure recycling with respect to environmental sustainability, public health, and economic feasibility

2.8.1. Policies and Regulations

Regulations and policies play a crucial role in shaping manure recycling practice within urban areas, determining how the waste is collected, processed, and utilized. Environmental policies, such as air and water pollution policies, Land use controls and zoning rules can affect the practices of livestock manure recycling within city. Policies to promote circular economy measures and sustainable urban agriculture can complement manure recycling by further incorporating it within the urban waste management policy. The regulatory structure is thus either going to drive innovation and sustainability in manure recycling or prove to be an obstacle to its implementation (Tadesse et al., 2021).

2.8.2. Technology

Technology helps to improve the efficiency, sustainability, and viability of manure recycling in urban areas. Emerging waste treatment technologies such as anaerobic digestion, composting plants, and biochar production enhance the treatment of livestock waste into valuable byproducts like biogas, organic manure, and soil amendments. Anaerobic digestion, for example, helps convert manure to biogas with methane that is used as a form of energy without adding greenhouse gases. Similarly, composting technology improves decomposition of organic wastes with the end product being high in nutrients and suitable for application in urban agriculture. Automation and monitoring systems coupled with technology also improve waste management by tracing manure production, organizing nutrient makeup, and rendering them environmentally friendly in accordance. In addition, innovative odour and pathogen management technologies help address public health problems and enhance community acceptance of manure recycling in urban spaces. However, their adoption might be subject to cost, availability, and technical expertise (sommer et al.,2013).

2.8.3. Resources and Inputs

Availability of resources, such as land, infrastructure, and inputs, plays an important role in manure recycling operations in urban settings. Among the major constraints is the small availability of land since urban centers are highly populated, leaving limited space for the setup of large composting plants, biogas plants, or manure storage. In the absence of sufficient space, urban farmers and waste managers might not be able to recycle and process manure effectively, resulting in inappropriate disposal that can lead to pollution. Additionally, the availability of infrastructure like waste collection infrastructure, composting bins, and

anaerobic digesters is also a key factor in influencing the feasibility of recycling manure. The cost and availability of the inputs such as bulking agents for composting, energy for processing, and transport facilities for the collection of waste also affect recycling activities. The implementation of manure recycling technologies may be restricted if these inputs are unavailable or costly in some areas (yallew, 2020).

2.8.4. Public Awareness and Acceptance

Public awareness and opinion are the focal points with recycling activities in municipal manures, since public perception either encourages or discourages waste recycling practices. An informed public with knowledge about environmental and economic advantages of manure recycling is likely to encourage and engage in cleaner waste management systems. Public awareness campaigns highlighting the benefits of composting, biogas generation, and organic manure can enhance acceptability and induce urban citizens, enterprises, and policymakers to invest in these activities. However, unawareness would normally result in opposition because of myths regarding odor, sanitation, and possible health hazards. Most urban residents would relate recycling of manure to odors, pest attraction, and disease transmission, hence objecting to composting facilities or biogas facilities in their neighborhoods. Public perception can also affect policymakers in a manner that stringent legislation protecting against manure recycling activities is developed (Smit et al.,2006).

2.8.5. Environmental Concerns

Environmental concerns significantly impact the practice of manure recycling in urban areas, influencing how waste is treated, managed, and recycled. Among the foremost concerns is water contamination, where unmanaged manure can infiltrate into groundwater or wash into urban water bodies, air pollution is also a significant issue because ammonia, methane, and other greenhouse gases are released as manure decomposes, aggravating climate change and air pollution problems (Tadesse et al.,2021). Odor management is also a significant issue because the pungent smells of manure can result in neighbor complaints, and thus large scale composting or storage can be problematic in densely populated areas. Environmentally friendly manure recycling technologies, including controlled composting, anaerobic digestion for biogas, and precision application of manure-based fertilizers, can be used to reduce these environmental hazards. These issues must be surmounted by the implementation of adequate waste management practices and contemporary recycling technologies so that

manure recycling can be made both environmentally acceptable and socially acceptable in urban settings (Petersen et al., 2007).

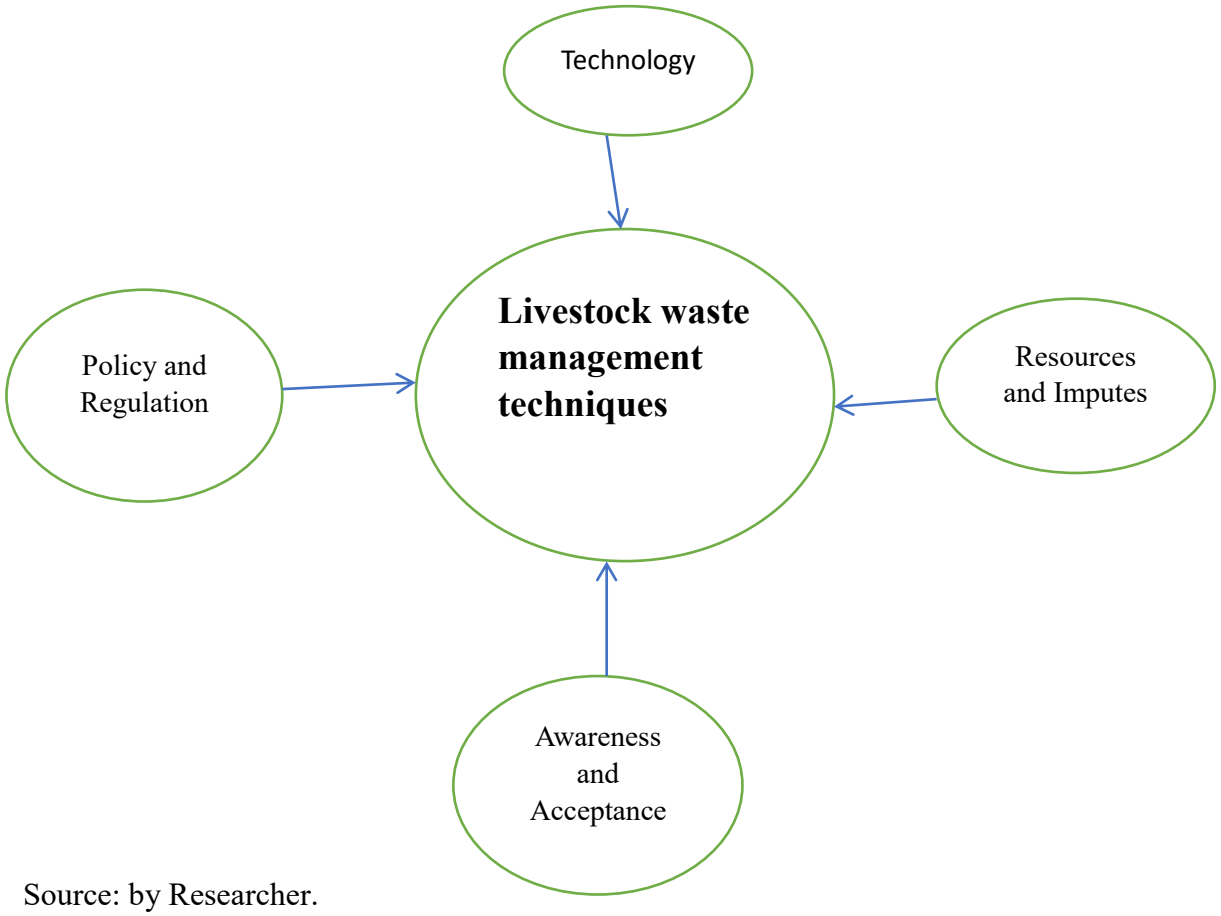
2.4. Knowledge /Research Gap

As presented above in the theoretical and empirical reviews, most of the studies have focused on the livestock waste management are focused on other part of the world (other than Ethiopia) and specifically in Addis Ababa. Despite the growing demand for sustainable waste management in urban areas, research on livestock manure recycling practices and challenges in Addis Ababa remains limited. While studies acknowledge the potential of manure as a valuable organic resource for composting and biogas production, there is insufficient data on the extent to which these practices are implemented within the city's livestock sector. Most available research focuses on rural manure management, leaving urban-specific challenges underexplored. Addis Ababa, as a rapidly urbanizing city, faces unique constraints such as limited space, weak infrastructure, and a lack of formal manure collection and recycling systems. There is a research gap in understanding the current manure disposal methods used by urban farmers, the efficiency of recycling initiatives, and the socio-economic factors influencing their adoption. Additionally, few studies have examined the environmental and public health risks associated with improper manure disposal in urban areas, which could be crucial for policy development.

There is also a need for empirical research on the effectiveness of existing policies and regulations related to urban livestock waste management. Without a clear understanding of these issues, it is difficult to develop effective interventions that encourage sustainable manure recycling. Addressing this research gap would help policymakers, urban farmers, and environmental agencies design strategies that promote efficient and environmentally friendly manure management practices tailored to the city's unique challenges. This study tries to fill the knowledge gap on the livestock waste recycling practices and challenges in Addis Ababa specifically in Lemi Kura and Akaki Kality Sub cities.

2.9 Conceptual Framework of the Study

By delineating the components, relationships, and outcomes, the conceptual framework provides a structured approach to understanding and assessing livestock waste recycling practices/ techniques andChallenges.



Source: by Researcher.

The nexus of resource management, policy and regulations, and technology developments is very important in sustainable livestock waste management. Effective livestock waste management in urban areas requires a balanced approach that integrates technological solutions, robust policies, adequate resources, and optimized inputs. Collaboration among stakeholders, including governments, urban planners, and livestock owners, is essential for sustainable practices. And Sustainable livestock waste management is essential for maintaining environmental balance and improving the health of soil, water, and air. By turning waste into valuable resources and reducing pollution, it supports long-term ecological and community well-being.

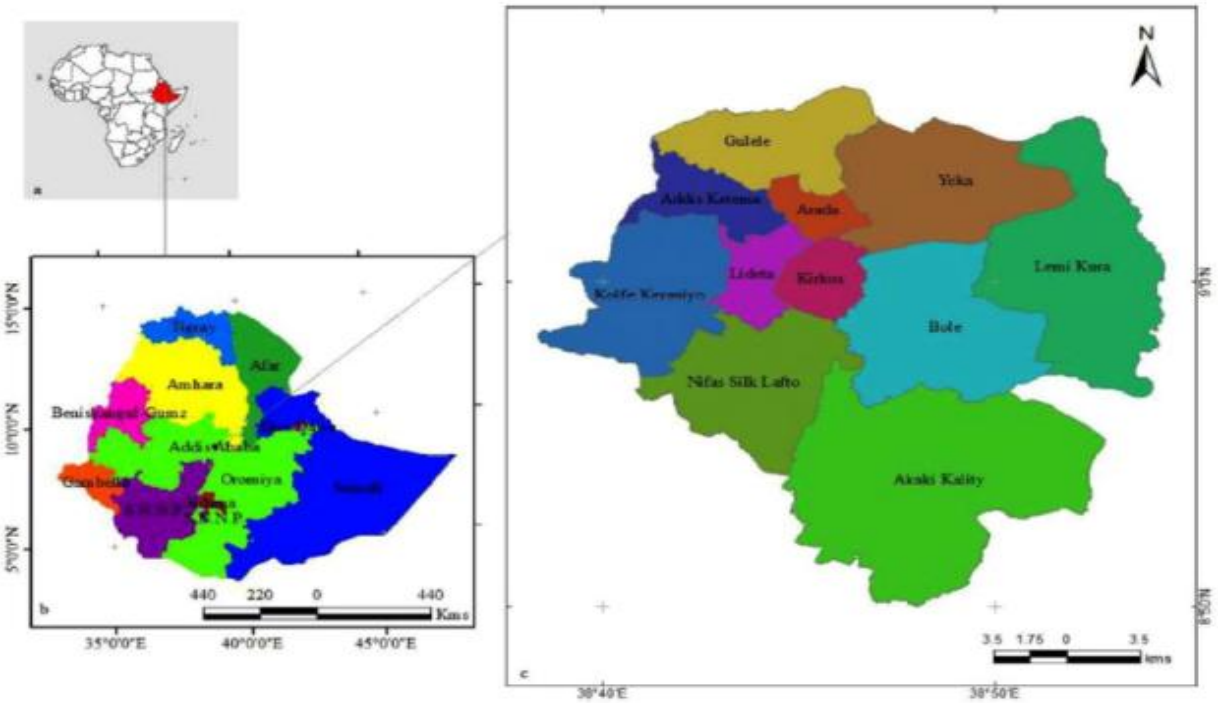
CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1 Description of the Study Area

The study was conducted in Addis Ababa, the capital city of Ethiopia since 1886, located at 9°1′48″N 38°44′24″E coordinates and it has an area of 527 km2. The city is simultaneously experiencing high rates of economic growth and urbanization having 25% of the urban population of Ethiopia (UN HABITAT, 2017) World Bank Group, 2015). According to the State of Ethiopian Cities 2015 Report 2, Addis Ababa‘s share in GDP accounts for 29% of the total urban centers (UN HABITAT, 2017). Addis Ababa is the also political center being the head quarter for the African Union and United Nations Economic Commission for Africa.

Addis Ababa has 11 sub cities, under each sub city, there are woreda administrations. The city has a population of over 5 million, which is 25% of the country‘s urban population



(World Bank Group, 2021).

Source: Addis Ababa city Administration website.

3.2 Research Design

The major objective of this study was to assess the urban livestock waste recycling practices and challenges in Addis Ababa city specifically in Lemi Kura and Akaki Kality sub cities. To achieve this purpose, the researcher used mixed approach. Mixed research approach is an approach wherein both quantitative and qualitative data are collected and analyzed in a single study to answer their research questions. This type of research can help provide a more complete picture than a study that relies solely on quantitative or qualitative research. This is because it allows the researcher to gain a depth and breadth of understanding on a specific concept while offsetting the weaknesses that are inherent when using either approach alone (Leech et al., 2010).

As a result, this study employed both quantitative and qualitative methods of research for conducting the study. Through quantitative method, the researcher tried to identify the major ways of urban livestock manure disposal and the major challenges of urban livestock farmers to recycle livestock manure. The quantitative data was collected from urban livestock farmers.

Through qualitative method, data was collected from urban livestock farmers and key informants about the perception on importance of urban livestock manure recycling.

3.3 Sample and Sampling Techniques

The purpose of this study was to assess the practices of urban livestock waste recycling practices and challenges in Addis Ababa. To achieve this purpose, two sub cities of Addis Ababa namely, Lemi-Kura and Akaki-Kality were selected purposively because of their significant population of livestock. Purposive sampling is a sampling technique in which researcher relies on his or her own judgment when choosing members of population to participate in the study. It is a non-probability sampling method and it occurs when elements selected for the sample are chosen by the judgment of the researcher (Emerson, 2015). Four woredas (two woredas from each sub cities) were also selected by using purposive sampling method because of their livestock farmers' population. After selecting woredas, systematic random sampling method was employed to select urban livestock farmers. Simple random sampling is a technique in which a researcher selects a random subset of people from a larger group or population. In simple random sampling, each member of the group has an equal chance of getting selected (Emerson, 2015). The study also employed purposive sampling for selecting, the key informants.

3.4 Data Collection

The major purpose of this study was to assess the practices of urban livestock manure recycling in Addis Ababa. To achieve this purpose, data was collected from both primary and secondary sources. The primary sources of this study were the respondents of this study i.e., Urban livestock farmers of Addis Ababa, key stake holders such as government officials those support the urban livestock farmers at woreda, sub city and city. The secondary sources of data were different journals, articles, previous research papers on area, and published and unpublished reports from pertinent governmental departments. Besides, yearly reports, strategies, directives and manuals also served as secondary sources of data. The following data collection tools were used to achieve the purpose the study.

3.4.1 Questionnaire

To collect the required data for this study, the researcher employed questionnaires. A questionnaire is a research instrument that consists of a set of questions to gather information from individuals or groups of people to achieve a specific purpose (patten, 2016). The researcher went to the selected respondents to collect data through this tool. Questionnaire were used to collect data on what are the major livestock waste disposal ways and major constraints that affect urban livestock farmers practice of manure recycling and understanding and perception of stakeholders on recycling. Questionnaire prepared in English were translated in to the appropriate local language in order to get relevant responses from the respondents.

3.4.2 Interview

Researcher used key informant interview as data gathering instrument for this study. Key informant interviews were done to learn or understand about the issues from the knowledgeable person. Interview provides data that cannot be accessible through other methods like observation and questionnaire (Burkette, 2022). To achieve the purpose of this study, semi structured interview was employed to collect data about the perception of urban livestock farmers and key stakeholders on how they perceive practices of urban livestock manure recycling.

The interview guide prepared in English and was translated into the appropriate local language before interviewing.

3.4.3 Document Review

In addition to the above data gathering tools, the researcher used document review to assess the urban livestock manure recycling practices. The researcher reviewed and analyzed documents like published and unpublished reports from pertinent governmental departments, minutes, articles, and previous research papers on the area. Besides, annual reports, strategies, directives and manuals were also reviewed to get some insights about the issue under the study.

3.5 Data analysis

Quantitative Analysis: Data collected through questionnaire were entered into a computer and analyzed with Statistical Package for the Social Sciences (SPSS) version 20 and Microsoft Excel2007. Descriptive statics (frequency, percentages, mean and standard deviation) was used to assess livestock waste recycling practices and associated challenges.

Qualitative Analysis: Qualitative data gathered from interviews, and observations were analyzed thematically.

3.6 Ethical Consideration

Ethical consideration in research is very important according to Palaganas et al. (2007) and it is a moral commitment that researcher is required to fulfill while conducting study. It includes informed consent, voluntary participation, respect for privacy, safeguarding anonymity and confidentiality. In this context, respondents were not being forced to participate in the study and have the right to remain anonymous. On the top of that, researcher has given adequate information for all participants those will take part in giving data. For instance, respondents in the interview and questionnaire were informed about the details and purpose of this study which is assessing the practice of livestock manure recycling in Addis Ababa.

CHAPTER FOUR

4. RESULTS AND DISCUSSION

This chapter provides an explanation for the collected data by going over the analysis and research findings. Following distribution of 216 questionnaires, 200 (92.59 % of response rate) were returned and used for further analysis. First, a demographic overview of the respondents was provided. Descriptive statistics were also used to assess Likert Scale items and environmental sustainability-elated aspects. Additionally, the study the qualitative data that was obtained through observations and interviews was summarized Using theme analysis.

Table 4.1: Response rates

Categories of questions	Frequency	Percentage
No. of responses	200	92.59
No. of non-responses	16	7.41
Total Supplied	216	100

Source, Author's research survey

The primary information presented in table 4.1 shows that 216 questionnaires were supplied to respondents. Of these, 92.59 percent were returned while 7.41 percent were not returned. The researcher was however convinced that the 92.59 percent that were returned was enough to give accurate sufficient information to the study.

4.1. Demographic Information

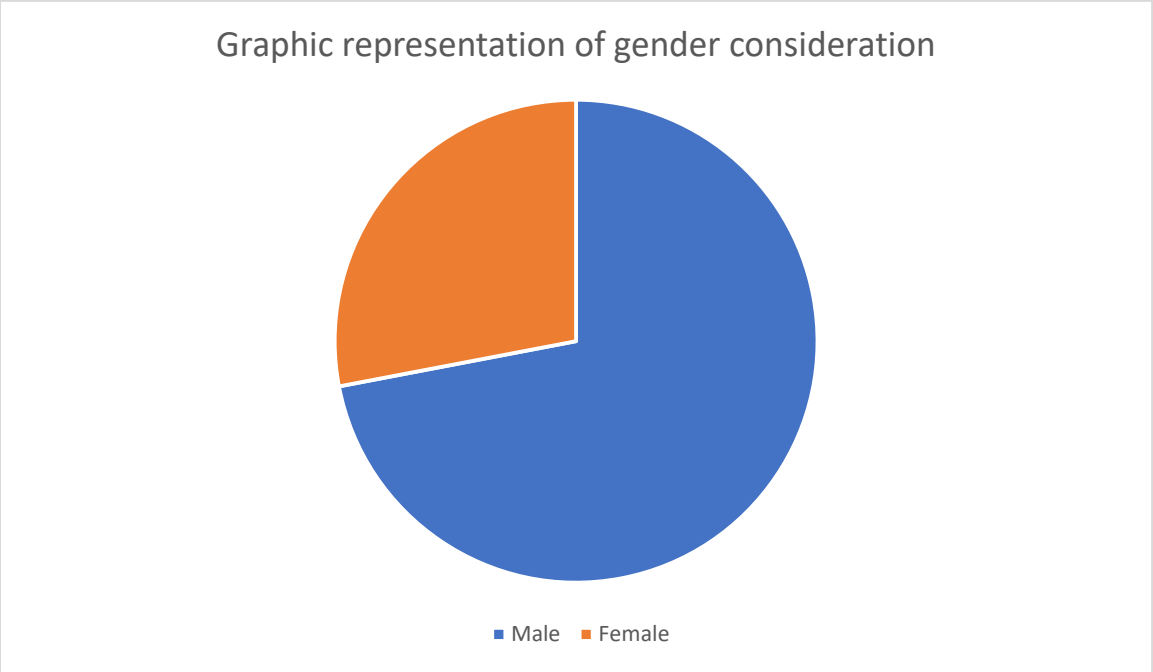
The bio-data of respondents is presented by gender, age, level of education and experience in livestock farming.

Table 4.1 ***Gender consideration of livestock farmer's respondents***

Gender	Frequency	Percentage
Male	144	72
Female	56	28
Total	200	100

Source: Author's research survey.

Table 4.1 presents the sex distribution of livestock farmer respondents based on their frequency and percentage. Out of 200 total respondents, 144 are Male, representing 72% of the sample. In comparison, 56 respondents are female, accounting for 28% of the total. This distribution indicates that the majority of livestock farmers in this study are male, comprising over two-thirds of the respondents. Meanwhile, females make up just over one-quarter of the participants. The table highlights a notable gender imbalance in the livestock farming community represented in this dataset.



Source: Author's research survey

Table 4.2: ***Age of livestock farmer respondents***

Age	Frequency	Percentage
18-35	25	12.5
36-50	94	47
51-65	63	31.5
65-Above	18	9
Total	200	100

Source: Author's research survey

The table 4.2; presents the distribution of livestock farmers based on their age groups. The data is divided into four categories, detailing the number of respondents (frequency) and the corresponding percentage each group represents in the total sample of 200 farmers. Age group 18-35 is the youngest group of respondents, consisting of 25 farmers, which accounts for 12.5% of the total. This indicates that a relatively small proportion of younger individuals are engaged in livestock farming. Age group 36-50 representing the largest group, 94 respondents fall within this age range, making up 47% of the total sample. This suggests that middle-aged individuals are the most prominent demographic in livestock farming. Age group 51-65 in this group, there are 63 farmers, comprising 31.5% of the total respondents. This proportion indicates that a considerable number of livestock farmers are in the later stages of their careers but still actively engaged in farming. Age group 65 and above the oldest category includes 18 farmers, which constitutes 9% of the sample. It shows that some older individuals remain involved in livestock farming. Overall, the data reflects that the majority of livestock farmers are in the middle-age range (36-50), followed by those nearing retirement age (51-65). The younger generation (18-35) and the oldest group (65 and above) make up smaller portions of the farmer population. This age distribution may suggest trends in the sustainability of the profession and possible challenges in attracting younger farmers.

Table 4.3. ***Levels of education***

Levels of education	Frequency	Percentage
Primary	130	65
Secondary	43	21.5
Diploma	12	6
Degree and above	13	6.5
Others	2	1
Total	200	100

Source: Author's research survey.

The data in Table 4.3 provides an overview of the educational background of respondents, highlighting the distribution across different levels of education. 65% of respondents have attained a primary education. This indicates that majority of the respondents have foundational education but may have limited formal schooling beyond the basics. This substantial percentage suggests that the population predominantly consists of individuals who have completed only the initial stages of formal education. 21.5% of respondents have completed secondary education, reflecting a considerable proportion who have pursued education beyond the primary level, typically encompassing middle and high school education. This group represents those who have gained additional knowledge and skills compared to those with only primary education.6.5% of respondents hold a degree, which signifies that a smaller but notable portion of the respondents have achieved higher education, usually at a university or college level. This level of education often corresponds to specialized knowledge and skills in various fields. 6% of respondents have earned a diploma, indicating that they have completed post-secondary education that provides specific skills and knowledge, often through technical or vocational programs.1% of respondents are categorized under other levels of education, which could include various forms of traditional education or certifications not covered by the primary categories.

In summary, the educational background of respondents shows a predominance of primary education, with fewer individuals holding secondary, diploma, or higher education qualifications. This distribution highlights that the majority of the respondents have a basic educational foundation, while a smaller percentage have pursued further education.

Table 4.4: ***Experience in livestock farming in urban setting.***

Experience	Frequency	Percentage
1-5 years	21	10.5
6-10years	55	27.5
11-15 years	45	22.5
16-20 years	50	25
20 years and above	29	14.5
Total	200	100

Source: Author's research survey

The table provides an overview of the duration of experience among livestock farmers in urban areas, breaking down the data into five categories based on the number of years of experience. The table shows both the number of respondents (frequency) in each category and their corresponding percentages, with a total of 200 respondents. 1-5 years of experience this group consists of 21 respondents, making up 10.5% of the total. These are the least experienced urban livestock farmers, suggesting that a small portion of respondents are relatively new to the profession. 6-10 years of experience, the second-largest group, with 55 farmers, constitutes 27.5% of the respondents. This group represents those who have a moderate level of experience, indicating a significant portion of urban farmers have been in the profession for this period.11-15 years of experience 45 respondents fall into this category, representing 22.5% of the total. This group shows a sizable number of farmers with a longer-term commitment to livestock farming. 16-20 years of experience, with 50 farmers, this is the third-largest group, making up 25% of the respondents. These individuals have considerable experience, suggesting a stable and experienced presence in urban livestock farming. More than 20 years of experience, this group, consisting of 29 respondents, accounts for 14.5% of the total. These are the most experienced farmers, indicating that a smaller but significant portion of farmers have been involved in urban livestock farming for over two decades. In summary, the table highlights that the majority of urban livestock farmers (70%) have between 6 and 20 years of experience. The largest portion of farmers (27.5%) has 6-10 years of experience, while fewer farmers are either new to the field (1-5 years, 10.5%) or have over 20 years of experience (14.5%). This suggests a balanced distribution of experience, with many farmers having a solid background in livestock farming within urban setting.

4.2. Livestock Waste Management Practices.

Table 4.5. Methods of livestock waste management.

Method	Frequency	Percentage (%)
Dumping on open spaces	120	60
Recycling (composting, Biogas production)	65	32.5
Connecting to nearby drainage system.	10	5
Others (like, Dung cake)	5	2.517
Total	200	100

Source: Author's research survey.

The findings from Table 4.5 illustrate the various methods employed by respondents for managing livestock waste, revealing a diverse range of practices.60% of respondents reported that they dump livestock manure on open spaces and around their house's latter collected by government authorities. This practice, which involves placing manure in open areas in front of residences or nearby, is the most common method observed. It indicates a reliance on undeveloped approach to waste management, which may have implications for environmental and health concerns, such as contamination of soil and water sources, as well as unpleasant odors. 32.5% of respondents use recycling methods, such as composting or biogas production, to manage their livestock waste. This practice reflects a more sustainable approach, as recycling methods can help convert waste into valuable resources, like compost for soil enrichment or biogas for energy. This proportion of respondents indicates adoption of more advanced and environmentally friendly waste management techniques, suggesting an awareness of and commitment to sustainable practices.5% of respondents connect their waste to a nearby drainage system or rivers, which suggests a method of managing waste by directing it away from immediate surroundings. However, this approach could lead to environmental issues if the waste is not adequately treated, as it may contribute to pollution in water bodies. 2.5% of respondents utilize other methods, such as creating dung cakes for fuel consumption or sale. This traditional practice indicates that a small number of respondents are using manure in a way that provides additional utility, either by creating a resource for energy or by generating economic value.

In summary, the data shows a predominance of open space dumping for livestock waste management, highlighting potential concerns regarding environmental and health impacts. A

notable proportion of respondents are adopting recycling methods, reflecting a growing awareness of sustainable practices. However, the small percentages of those using drainage systems or alternative methods suggest that while there are varied approaches, many still rely on less sophisticated methods. The findings underscore the need for broader adoption of recycling and management techniques to address environmental and health concerns effectively.

Figure 6 farmers composting (recycling) manure in the study area. Source: Author's research survey

Figure 7 farmers connecting in nearby drainage in the study area, Source: Author's research survey

Figure 8 farmers connecting livestock waste to the river Lagajida in lemikura sub city. Source: Author's research survey

Figure 9 dumping near to their living house, Source: Author's research survey.

There are a number of health and environmental issues when livestock manure is disposed of or collected close to residential areas in urban environments. Residents may experience respiratory problems and disagreeable smells as a result of the toxic gases released by

manure, including ammonia and methane. Additionally, the buildup of manure draws rodents, flies, and other disease-carrying pests, which raises the possibility of infectious disease transmission.

Appropriate manure management techniques must be used to solve these problems. To guarantee that manure is handled away from residential areas, urban regions should set up facilities specifically for its collection and treatment. For example, composting the manure can provide useful organic fertilizer for urban agriculture and lessen odors.

Figure 10 dumping in open space. Source: Author's research survey

Table 4.6. Staying updated with the latest advancements in waste recycling technologies.

	Frequency	Percent
Strongly disagree	110	55
Disagree	45	22.5
Neutral	5	2.5
Agree	25	12.5
Strongly agree	15	7.5
Total	200	100

Source: Author's research survey.

The data presented in Table 4.6 reveals a significant lack of engagement with or access to the latest advancements in waste recycling technologies among respondents. 55% of respondents strongly disagreed with the statement that they stay updated on technological advancements, and an additional 22.5% disagreed, indicating a substantial majority 77.5% feel they are not keeping pace with new developments in waste recycling technology. This suggests that respondents either lack access to information about new technologies or have not integrated these advancements into their practices. A very small portion of respondents, 12.5%, agreed that they stay updated, and only 7.5% strongly agreed, reflecting that a minority of individuals are actively engaged with the latest technological trends in recycling. This low percentage highlights that while some respondents are making an effort to stay informed; this is not the prevalent experience among the majority. Additionally, 2.5% of respondents were neutral, suggesting that a few individuals are either unsure about their engagement with new technologies or may not have a clear opinion on the matter. The findings are further supported by the researcher's observation that there is a lack of technological updates provided by the relevant governmental bodies. This lack of support may contribute to the overall difficulty in staying current with advancements, as residents and practitioners may not receive timely or adequate information about new technologies that could improve waste recycling practices. The study reveals that although there are a few NGOs actively assisting livestock farmers to adopt modern technologies, the researcher pointed out that these organizations confront several challenges. These groups are working to help farmers turn animal waste into useful resources like biogas and organic fertilizer by offering both technical support and practical training. Nevertheless, the biogas plants are regularly operating poorly or malfunctioning in spite of these efforts. Biogas has received a great deal of attention in academic literature, although agricultural biogas production capacity has increased tenfold during the 2000-2012 period studies have shown clear ups and downs, in a non-linear pattern and is generally considered to have had little success (Geels and Raven,2006). In the study area the problems with the biogas plants are caused by a number of variables. For instance, environmental factors frequently result in water intrusion, which impairs plant function. Furthermore, many of these plants are poorly constructed, having structural flaws that reduce their longevity and efficiency. The absence of continuous maintenance and assistance for the biogas systems is another significant issue. Small problems can worsen without routine technical follow-up and monitoring, which would further diminish the plants' operational success and limit their potential advantages for sustainable agricultural operations.

In summary, the data indicates a significant gap in the dissemination and adoption of new waste recycling technologies. The majority of respondents are not up-to-date with advancements, which could impede the effectiveness and efficiency of recycling efforts. This underscores the need for better communication and support from relevant authorities or organizations to ensure that stakeholders have access to the latest technological developments and can integrate them into their practices

Table 4.7. Applying modern technology for livestock waste recycling

	Frequency	Percent	Valid Percent
Strongly disagree	95	47.5	47.5
Disagree	35	17.5	17.5
Neutral	25	12.5	12.5
Agree	30	15	15
Strongly agree	15	7.5	7.5
Total	200	100	100

Source: Author's research survey.

The data from Table 4.7 indicates that when it comes to the application of modern technology for livestock waste recycling, the largest portion of respondents (47.5%) strongly disagreed with the idea, while another 17.5% simply disagreed. This suggests that over 60% of respondents are not in favor of utilizing modern technology for this purpose. The reasons for this could vary, including a lack of understanding of the technology, perceived high costs, concerns about its practicality, or a preference for traditional methods of waste management.

In contrast, a smaller portion of respondents (15%) agreed with the application of modern technology, and 7.5% strongly agreed, reflecting that a minority is adopting new technological methods for livestock waste recycling. These respondents may be more aware of the environmental or efficiency benefits that modern technology can offer in managing livestock waste. The 12.5% of respondents who were neutral may be unsure about the specific advantages or disadvantages of using modern technology, or they might not have enough information to form a strong opinion.

Overall, the practice of applying modern technology for livestock waste recycling appears to face significant challenges, with the majority of respondents either resistant or uncertain

about its use. This could suggest a need for increased education, outreach, or demonstration of the benefits of modern waste recycling technology to improve acceptance and adoption.

Table 4.8: The need for expert support to improve our recycling technologies

	Frequency	Percent	Valid percent
Strongly disagree	5	2.5	2.5
Disagree	13	6.5	6.5
Neutral	19	9.5	9.5
Agree	67	33.5	33.5
Strongly agree	96	48	48
Total	200	100	100

Source: Author's research survey.

This table 4.8 presents the distribution of respondents' attitudes towards the statement seeking support and feedback from experts to improve our integration in waste recycling. The responses are categorized into five levels: strongly disagree, disagree, neutral, agree, and strongly agree. The results reflect varying degrees of agreement with the idea of consulting experts to enhance waste recycling efforts. The largest group of respondents, 96 out of 200 (48%), strongly agree that they seek expert support and feedback for improving their integration in waste recycling. This suggests that nearly half of the respondents are highly committed to involving external expertise to enhance their recycling practices. Another 67 respondents (33.5%**)**, agree with the statement, bringing the combined agreement (agree + strongly agree) to 81.5%. This indicates a strong overall tendency among respondents to value and actively pursue expert advice for improving waste recycling efforts. 19 respondents (9.5%) remain neutral, showing no strong opinion on whether or not they seek expert support. This group may either have limited engagement with waste recycling practices or may not see expert consultation as a critical factor in their operations. A small group of 13 respondents (6.5%) disagree with the statement, suggesting that these individuals do not actively seek expert support. They may face barriers such as lack of access to experts, or they might not perceive expert feedback as necessary for their waste recycling efforts. 5 respondents (2.5%) strongly disagree with the statement, indicating a strong disinterest or opposition to seeking expert advice in this context. The vast majority of respondents (81.5%) either agrees or strongly agrees that seeking expert support and feedback is important to improving their

waste recycling integration. This demonstrates a widespread recognition of the value of external expertise in fostering better recycling practices.

Table 4.9. Environmental Contribution Monitoring Of Livestock Waste Management Practices

	Frequency	Percent	Valid Percent
Strongly disagree	93	46.5	46.5
Disagree	53	26.5	26.5
Neutral	10	5	5
Agree	27	13.5	13.5
Strongly agree	17	8.5	8.5
Total	200	100	100

Source: Author's research survey

The data in Table 4.9 reveals that larger portion of respondents do not regularly monitor the environmental impact of their livestock waste management practices. A combined 73% of respondents either strongly disagreed (46.5%) or disagreed (26.5%) with the statement that they regularly monitor the environmental effects of their practices. This indicates that the majority of respondents do not have systems in place to track or assess the potential environmental consequences of their livestock waste management. Only a small portion of respondents actively engage in environmental monitoring, with 13.5% agreeing and 8.5% strongly agreeing, totaling 22% of respondents who report regular monitoring efforts. These respondents are likely more conscious of the environmental impacts and possibly more proactive in adopting sustainable practices. Additionally, 5% of respondents were neutral. This suggests there may be a lack of awareness, resources, or motivation to track the environmental impact of livestock waste management, which could have implications for both environmental sustainability and regulatory compliance in the livestock sector.

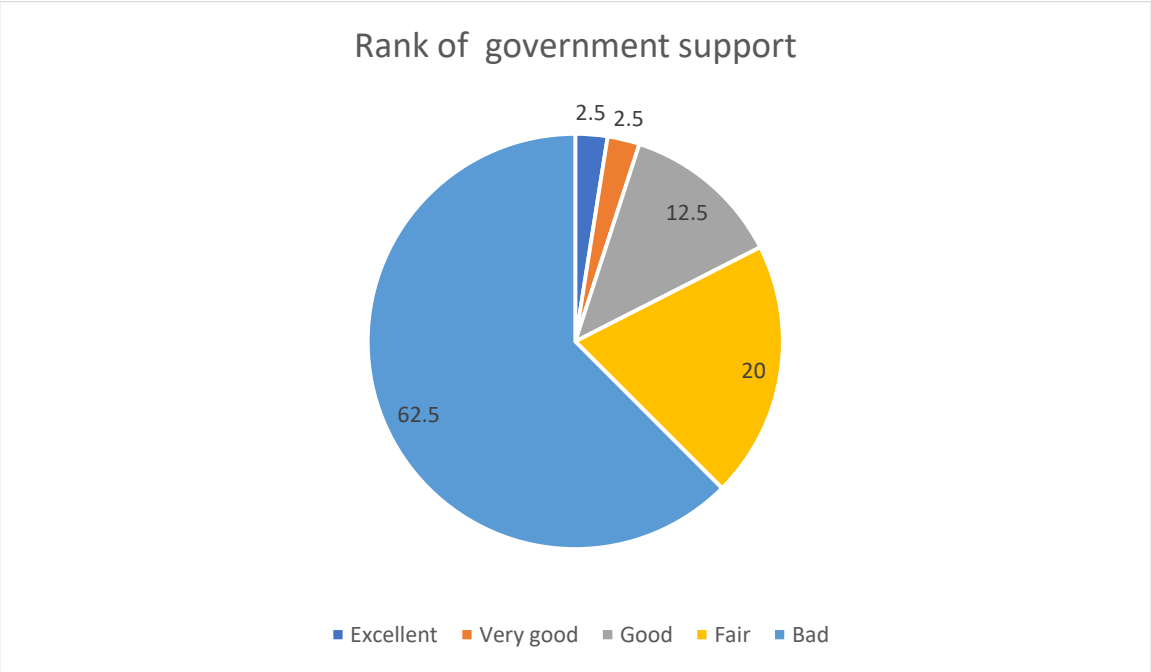
Table 4.10. Ranking of government support for livestock waste recycling

Status	Frequency	Percentage
Excellent	5	2.5
Very good	5	2.5
Good	25	12.5
Fair	40	20
Bad	125	62.5
Total	200	100

Source: Author's research survey.

Table 4.10 provides a detailed overview of the respondents' perceptions of government support for livestock waste recycling, reflecting a largely negative view on the effectiveness of such support. The majority of respondents, 62.5%, rated the government support as bad. This big proportion indicates widespread dissatisfaction with the level of assistance provided. Respondents who view the support as bad likely feel that it is inadequate, ineffective, or insufficiently addresses their needs in managing livestock waste. This perception points to potential deficiencies in policy, resources, or implementation that could be impacting the overall success of waste recycling efforts. 20% of respondents considered the support to be fair. While this rating is somewhat more positive than "bad," it still suggests that the support is seen as merely adequate, without any exceptional quality. Those who rated the support as fair may believe that it meets basic requirements but does not go beyond to offer substantial help or improvements. A smaller portion, 12.5%, felt that the support was good. This group perceives the assistance as satisfactory and effective, suggesting that these respondents have experienced a level of support that positively impacts their waste recycling practices. However, given that this is a minority view, it indicates that good support is not the norm. Only 2.5% of respondents rated the support as excellent, and another 2.5% rated it as very good. These minimal percentages reflect that only a very small fraction of the population feels highly satisfied with the level of government support. The rarity of these high ratings suggests that exceptional support is limited and not widely experienced. In summary, the data highlights a predominant dissatisfaction with government support for livestock waste recycling, with the majority of respondents viewing it as bad. There is a clear need for improved support and resources to enhance the effectiveness of waste management practices. The relatively small percentages of those rating the support as good, very good, or excellent further emphasize the gap between the current level of assistance and the ideal standards of

support that could significantly benefit livestock waste recycling efforts.



Source: Author's research survey.

Table 4.11: Contribution of Increased Government Support improvement on Livestock Waste Recycling Practices

	Frequency	Percent	Valid Percent
Strongly disagree	12	6	6
Disagree	32	16	16
Neutral	10	5	5
Agree	125	62.5	62.5
Strongly agree	21	10.5	10.5
Total	200	100	100

Source: Author's research survey.

The data presented in Table 4.11 reflects respondents' opinions on whether increased government support could enhance livestock waste recycling practices in their area.62.5% of respondents agree that increased government support could improve livestock waste recycling practices. This majority view suggests that largest portion of the population believes that additional or enhanced support from the government would be beneficial in

advancing recycling practices. This could imply that respondents see potential for improvement through more resources, better policies, or increased assistance from government initiatives.10.5% of respondents strongly agree with the statement, indicating a smaller but still notable segment that strongly believes in the positive impact of increased government support. This group likely feels that substantial improvements in recycling practices are achievable with strong governmental backing. 16% of respondents disagree with the idea that increased government support would improve recycling practices. This indicates that some individuals do not believe that additional support would lead to better outcomes, possibly due to skepticism about the effectiveness of government interventions or a belief that other factors are more critical.6% of respondents strongly disagree with the notion, reflecting a minority who are firmly against the idea that more government support would make a difference. This view may stem from doubts about the impact of such support or other perceived barriers to effective recycling practices.5% of respondents are neutral, meaning they neither agree nor disagree with the statement. This group may lack sufficient information to form a clear opinion or might be unsure about the potential effects of increased government support. The data indicates a strong belief among the majority of respondents that increased government support could positively impact livestock waste recycling practices. While there broad level of agreement, there are also a notable proportion of respondents who are skeptical about the effectiveness of additional support. The variety of opinions underscores the complexity of the issue and suggests that while increased government support is seen as a potential avenue for improvement, other factors and perspectives should also be considered in addressing livestock waste recycling challenges.

Table 12. Coordination and collaboration among the various government agencies

	Frequency	Percent	Valid Percent
Strongly disagree	68	34	34
Disagree	78	39	39
Neutral	10	5	5
Agree	31	15.5	15.5
Strongly agree	13	6.5	6.5
Total	200	100	100

Source: Author's research survey.

Table 12 presents that, 68 respondents (34%), strongly disagreed with the statement, indicating that they perceive a substantial lack of coordination and collaboration among government agencies. The largest group of respondents, 78 individuals (39%), disagreed, reinforcing the view that coordination among government agencies is inadequate. 10 respondents (5%) remained neutral, suggesting that they have no strong opinion on the matter. 31 respondents (15.5%) agreed that there is some coordination and collaboration among government agencies. Only 13 respondents (6.5%) strongly agreed, showing a small portion of the population who believes that the agencies work well together.

Table 4.1.3 Availability of support from non-government organizations to enhance recycling practices of livestock manure

Support	Frequency	Percentage (%)
Available	35	17.5
Unavailable	165	82.5
Total	200	100

Source: Author's research survey.

The findings from Table 13 reveal a considerable lack of support from non-governmental organizations (NGOs) in enhancing recycling practices for livestock manure, specifically in terms of providing storage receptacles. A large majority 82.5% of respondents reported that support was unavailable, indicating that most livestock owners do not receive external support for recycling purposes. This lack of support could hinder the effectiveness of manure recycling efforts, as proper support is crucial for safe and efficient waste management. Only 17.5% of respondents indicated that support was available, suggesting that a small minority have access to NGO support in this area. This could mean that either the scope of NGO initiatives is limited, or that certain regions or communities are receiving more attention and resources than others. Overall, the findings highlight a substantial gap in NGO involvement in providing practical support for livestock manure recycling. The overwhelming unavailability of support suggests that there is a need for greater engagement from NGOs or other external organizations to help enhance recycling practices. Without adequate solutions, the ability of residents to manage and recycle livestock manure effectively may be compromised, potentially leading to environmental and health concerns. This data underscores the importance of expanding support mechanisms to improve waste management infrastructure in local communities.

4.4. Challenges

The most prominent problems cited by many studies include; over-emphasis placed on mechanized process than labor intensive operations, lack of vision and marketing plans for the final compost product, contamination with heavy metals, financial problems since the revenue generated from the sale of compost will rarely cover processll1g, transportation and application costs, nuisance potential such as odors, rats, poor marketing experience, and poor integration with agricultural community (Jerry and Huang, 2006 ; Daniel et ai, 1999).

The data gathered from Lemikura, woreda 13 and 14 and Akaki kality subcity woreda 4 and 8 woredas is described below.

Table 4.14. Major challenges of recycling livestock manure

	Frequency	Percent	Rank
Lack of access to market.	25	12.5	3rd
Lack of Space	100	50	1st
Lack of Skill	15	7.5	4th
Regulatory barriers	55	27.5	2nd
Lack of Labor	5	2.5	5th
Total	200	100	

The findings from Table 4.14 provide insight into the major challenges and constraints faced by respondents when it comes to recycling livestock manure. The data reveals that lack of space is the most significant challenge, with 50% of respondents identifying it as the primary issue. This suggests that respondents do not have adequate physical space to properly manage and recycle livestock manure, possibly due to crowded living conditions, limited land availability, or zoning restrictions that limit the allocation of space for waste recycling. In addition to space constraints, 27.5% of respondents cited regulatory barriers as a major challenge. These barriers could include local laws or policies that restrict the use of open areas for manure recycling, making it difficult for individuals or communities to engage in such practices. These regulatory issues could also relate to environmental protections, land-use regulations, or health and safety standards that prevent or complicate manure recycling efforts. A smaller but still considerable portion of respondents (12.5%) pointed to a lack of market for their composted fertilizer as a challenge. This lack of support could be in the form of insufficient funding, inadequate access to resources, or a lack of policy initiatives to

promote livestock manure recycling. It indicates that some respondents feel that government involvement is either lacking or ineffective in addressing their needs for waste recycling solutions.7.5% of respondents mentioned a lack of skill as a challenge, suggesting that there is a knowledge gap when it comes to the technical know-how required for effectively recycling livestock manure. This could include the need for training in composting techniques, waste management, or the use of modern recycling technologies.

Finally, 2.5% of respondents identified a lack of labor as a constraint, indicating that some people struggle to find or allocate enough workers or manpower to handle the demands of manure recycling.

4.5. Perception of Respondents

Using livestock waste for fertilizer and energy rural and peri-urban agriculture and its related concerns in developing countries have become the burning issues in academic and non-academic spheres. It is often argued that reuse of livestock waste through agriculture is a viable alternative to support small-scale urban and peri-urban farmers, to sustain the urban food system and to maintain the urban environment. However, researches and studies in developing countries have confirmed that the unsafe and unregulated reuse poses several public health and environmental risks. (wester et al., 2005) In this context, exploration of farmers' perceptions might be an important contribution in the wisdom of knowledge and in the field of research. This study is an attempt to explore farmers' perceived benefits and perceived risks of using livestock waste in Addis Ababa city.

Table 4.15 Understanding on negative environmental impacts of livestock Manure

	Frequency	Percent	Valid Percent
Strongly disagree	10	5	5
Disagree	14	7	7
Neutral	54	27	27
Agree	81	40.5	40.5
Strongly agree	41	20.5	20.5
Total	200	100	100

Source: Author's research survey.

Table 4.15 shows the distribution of responses regarding whether livestock farmers understand that livestock manure can negatively impact the environment. The largest portion of respondents, 81 out of 200 (40.5%), agree that livestock manure can have negative environmental impacts. This suggests that larger number of respondents acknowledge the potential harm manure can cause, such as water, air and soil pollution. 54 respondents (27%) are neutral on the issue, meaning they neither agree nor disagree. This neutral stance could indicate a lack of awareness or uncertainty about the specific environmental consequences of livestock manure. 41 respondents (20.5%) strongly agree with the statement, representing a group that holds a firm belief in the negative environmental impact of livestock manure. These respondents likely have a solid understanding of the issue and may be more inclined to adopt mitigation strategies. A small group of 14 respondents (7%) disagrees with the statement. These individuals may believe that livestock manure does not pose a significant environmental threat or may feel that its benefits (such as fertilization) outweigh any negative impacts. 10 respondents (5%) strongly disagree with the statement. These respondents are likely confident that livestock manure does not have harmful effects on the environment, potentially due to their own experiences or a lack of awareness about environmental impacts. Combining those who agree and strongly agree, 61% of respondents acknowledge that livestock manure can negatively impact the environment. This suggests a majority of livestock farmers are aware of the potential environmental risks associated with improper manure management. The result highlights that while a majority of livestock farmers recognize the potential negative environmental impacts of livestock manure, a significant portion remains neutral or unconvinced. This suggests there may be room for additional education or policy interventions aimed at increasing awareness and promoting environmentally sustainable manure management practices. The results also show a small but present minority who either lack knowledge or do not see manure as harmful, indicating potential gaps in communication or experience in this area.

Table 4.16: Contribution of livestock manure recycling to climate change mitigation

	Frequency	Percent	Valid Percent
Strongly disagree	5	2.5	2.5
Disagree	10	5	5
Neutral	25	12.5	12.5
Agree	55	27.5	27.5
Strongly agree	105	52.5	52.5
Total	200	100	100

Source: Author's research survey.

The findings from Table 4.16 indicate that a strong majority of respondents believe that livestock manure recycling efforts contribute positively to mitigating environmental pollution. The largest portion 52.5% of respondents strongly agreed with the statement, while an additional 27.5% agreed, meaning that 80% of respondents hold a positive view of manure recycling as an effective strategy for addressing climate change. This suggests widespread recognition among respondents of the environmental benefits of manure recycling, such as reducing greenhouse gas emissions, improving soil health, and promoting sustainable agricultural practices. A smaller portion of respondents (12.5%) were neutral, indicating some uncertainty or ambivalence about the relationship between manure recycling and climate change mitigation. These respondents may need more information or education about the specific environmental impacts of manure recycling. On the other hand, 5% of respondents disagreed, and 2.5% strongly disagreed, suggesting that a small minority of people are either skeptical about the effectiveness of manure recycling in combating climate change or may not prioritize it as a solution. Their disagreement could stem from a lack of awareness, differing views on climate change, or a focus on other environmental concerns.

Overall, the data reflects a highly positive perception of livestock manure recycling as a beneficial practice for mitigating climate change, with the vast majority of respondents supporting the idea. However, the small number of neutral or disagreeing responses indicates that some individuals may not fully understand or believe in the link between manure recycling and environmental sustainability. This highlights the importance of continued education and awareness efforts to address any remaining doubts or misconceptions.

Table 4.17: Cost-effectiveness of using recycled livestock manure as organic Fertilizer

	Frequency	Percent	Valid Percent
Strongly disagree	10	5	5
Disagree	14	7	7
Neutral	34	17	17
Agree	90	45	45
Strongly agree	52	26	26
Total	200	100	100

Source: Author's research survey.

The findings from Table 4.17 indicate that 10 respondents, representing 5% of the total, respondents strongly disagreed that recycled livestock manure is cost-effective compared to chemical fertilizers. 14 respondents (7%) disagreed with the statement. 34 respondents (17%) were neutral, indicating no strong opinion on the cost-effectiveness. The majority of respondents, 90 individuals (45%), agreed that recycled livestock manure is cost-effective compared to chemical fertilizers. 52 respondents (26%) strongly agreed with the statement.

In summary, a significant portion (71%) of respondents agree or strongly agree that using recycled livestock manure as organic fertilizer is cost-effective, while only 12% disagree or strongly disagree, and 17% remain neutral.

Table 4.18: Environmental benefits and Soil improvement of livestock manure compost

	Frequency	Percent	Valid Percent
Strongly disagree	5	2.5	2.5
Disagree	10	5	5
Neutral	11	5.5	5.5
Agree	81	40.5	40.5
Strongly agree	93	46.5	46.5
Total	200	100	100

Source: Author's research survey.

Table 4.18 presents that, 5 respondents, or 2.5% of the total, strongly disagreed with the statement, indicating a minority who do not believe in the environmental benefits of livestock manure compost. 10 respondents (5%) disagreed with the idea that livestock manure compost is environmentally friendly and improves soil quality.11 respondents (5.5%) were neutral, showing no strong opinion on the topic. A large portion, 81 respondents (40.5%), agreed that livestock manure compost is environmentally friendly and enhances soil quality. The highest number of respondents, 93 individuals (46.5%), strongly agreed with the statement, showing strong support for the environmental benefits of livestock manure compost.

4.6. Mean and Standard deviation of Study Variables

Table 19. Waste management practices. (Mean and Standard deviation)

	N	Mean	Std. Deviation
Staying updated with the latest advancements in waste recycling technologies	200	1.36	0.629
Applying modern technology for livestock waste recycling	200	1.78	0.803
The need for expert support to improve our recycling technologies.	200	4.25	1.032
Environmental Impact Monitoring of Livestock Waste Management Practices	200	1.69	0.979
0verall average		2.27	0.86

Source: Author's survey result, 2024.

Scale: < 1.80 Strongly Disagree, between 1.81 and 2.60 Disagree, between 2.61 to 3.40 Neutral, between 3.41 to 4.20 Agree and > 4.21 Strongly agree.

As shown in table 19, the overall mean and standard deviation scores for waste management practice are 2.27 and 0.86 respectively. This indicates that respondents were disagreeing about the issues raised under waste management practices. The individual mean values vary between the lowest 1.36 and the highest is 4.25

Table 20. Policy and Regulations (Mean and Standard deviation)

	N	Mean	Std. Deviation
Impact of Increased Government Support improvement on Livestock Waste Recycling Practices.	200	4.13	0.96
Coordination and collaboration among the various government agencies.	200	2.32	0.477
Overall average		3.22	0.72

Scale: < 1.80 Strongly Disagree, between 1.81 and 2.60 Disagree, between 2.61 to 3.40 Neutral, between 3.41 to 4.20 Agree and > 4.21 Strongly agree.

As shown in table 20, the overall mean and standard deviation scores for above issues are 3.22 and 0.72 respectively. The individual mean value for impact of increased government support improvement on Livestock Waste Recycling Practices is 4.13 shows that the respondents agree on the issue and the individual mean value of coordination and

collaboration among various government agencies is 2.32 indicates that respondents disagree on issue.

Table 21. ***Perception (Mean and Standard deviation)***

	N	Mean	Std. Deviation
Understanding on negative environmental Impacts of Livestock Manure	200	4.15	0.477
Contribution of Livestock Manure Recycling to Climate Change Mitigation.	200	4.29	0.972
Cost-Effectiveness of Using Recycled Livestock Manure as Organic Fertilizer	200	4.19	0.970
Environmental Benefits and Soil Improvement of Livestock Manure Compost	200	4.25	1.032
Overall average	200	4.22	0.863

Source: Survey result, 2024)

Scale: < 1.80 Strongly Disagree, between 1.81 and 2.60 Disagree, between 2.61 to 3.40 Neutral, between 3.41 to 4.20 Agree and > 4.21 Strongly agree

As shown in above table 21, the overall mean and standard deviation scores for perception of respondent on recycling livestock manure are 4.22 and 0.863 respectively. This indicates that respondents were strongly agreeing about the issues raised about livestock waste recycling. The individual mean values vary between the lowest 4.13 and the highest is 4.65.

Therefore, based on the above result and definition the respondents have positive attitude for livestock waste recycling and it effects.

4.7. Discussion

The quantitative and qualitative methodologies are employed, whereby structured questionnaires were prepared for the survey of randomly selected households among the smallholder city farmers, and the thorough discussion made with the purposefully screened key informants and observation of the study area was also the other statistical tools used by the researcher in the courses of the study. In addition to that, observations and discussions with government officials were used for the researcher to have an insight about the realities of the study area. Thus, analysis of data was made based on the collected information through

the stated research approaches that was fed into the computer software system for analysis and interpretation and then came to a concluding remark. The study reveals people that are engaged in urban livestock farming. In an educational parameter, the type of people engaged in urban agriculture varies from illiterate to a level of university graduate that signifies the need to engage in urban livestock farming is not only for a single reason but using it either as the major source of livelihood, an additional source of livelihood, or as a survival strategy.

4.7.1. Livestock Waste Management Practices.

Reusing and recycling products would slow down the use of natural resources, reduce disruption to landscapes and habitats, and help limit biodiversity loss, according to related literature (Bui.T et al., 2022). Additionally, while recycling household wastes and animal manures has many benefits, developing countries still lack incentives and willingness to recycle wastes and manures back to crop land (van Beek et al., 2016).

According to this report, 60% of farmers put their livestock manure in open areas, which is bad for the ecology. Only 32.5% of respondents used more ecologically friendly techniques, such as composting for recycling or producing biogas, indicating a limited uptake of these strategies. The remaining 2.5 percent employ alternative techniques, such as making dung cakes, while the remaining 5% connect waste to drainage systems.

In consistent to the above, the key informant from Lemi kura sub city woreda 13 also confirm that, some farmers in the area have been carelessly disposing of livestock excrement by connecting it straight to neighboring rivers, and drainage system causing serious water and environmental pollution. The river's quality has been severely deteriorated by this contamination, endangering the local population's health.

Controlling this practice is challenging due to a lack of regulatory oversight in the area and a lack of cooperation between stakeholders, including various government agencies. The farmers' harmful practices have not resulted in any enforcement measures or consequences, despite the clear environmental damage.

This demonstrates the prevalence of conventional, possibly hazardous waste management techniques. The aforementioned findings are strengthened by other findings. There are cultural barriers to recycling waste, as well as a lack of information and awareness. Furthermore, developing nations lack laws and policies pertaining to the collecting and recycling of manure (Komakech, 2014).

The field observation report also indicates that there is tendency of seeking simplest way of disposing waste livestock among the farmers. Dumping in open spaces close to their farms is the method that most farmers choose. Due to the fact that the weight of the garbage they collect determines the amount of money they receive, certain government and private waste collection services also urge them to dispose of their livestock waste outdoors. Some farmers connect their animal waste to the local drainage and rivers, despite the fact that some farmers attempt to produce biogas and compost on their property. The local air and water are being seriously contaminated as a result of this. The data collector also observed that some farmers make dung cake with their livestock waste, which they use for cooking, the last few farmers, who are primarily elderly women, practice producing dung cakes. Some studies add weight for the above findings, for example Karin, (2007), some of the farmers poured the manure into a water stream and this can give rise of diseases and destroyed water sources for people downstream. A sizable percentage of participants (77.5%) acknowledged that they are out of touch with the latest developments in manure recycling technology. Additionally, 65% of respondents disliked or strongly disagreed with the use of contemporary technologies in trash management. This indicates that farmers generally lack access to or knowledge of contemporary waste recycling innovations, indicating the potential value of educational outreach and training. Nevertheless, 81.5% of participants concurred that obtaining professional assistance may enhance their recycling integration, demonstrating a readiness to adopt recycling. According to Habitamu, Farmers and urban development office team Leader in Akaki kality woreda 8, there are some indications of advancements in livestock waste recycling technologies, but they are not yet sufficient to drive widespread change. While there have been notable developments in certain areas, such as more efficient recycling processes and the use of innovative materials, these advancements are not yet fully integrated into mainstream practices. More research, investment, and policy support are needed to accelerate the adoption and impact of these technologies on a larger scale. The study reveals that limited government support for livestock waste recycling practices is obvious through the lack of adequate policies, funding, and technical assistance for sustainable waste management specifically for recycling. The absence of enough space, market for compost, lack of skill and labor hinder effective recycling efforts. As a result, livestock waste often accumulates unmanaged, leading to environmental pollution and missed opportunities for resource recovery.

4.7.2. Perception of farmers and local government officials about livestock recycling.

The majority of respondents (61%) agreed that the environment can be adversely affected by livestock excrement. Furthermore, 80% of respondents concurred that recycling livestock manure helps to mitigate climate change, demonstrating a thorough awareness of the advantages recycling waste has for the environment. Strong community involvement was indicated by the majority of respondents (90%) who thought their neighbors participated with livestock manure recycling practices. Nonetheless, 73% of respondents stated that they do not routinely assess how their waste management procedures affect the environment, indicating a serious lack of environmental awareness. Long-term effects on sustainability initiatives may result from this lack of environmental monitoring. The same conclusion applies to Anderson (2014). Recycling livestock manure to mitigate climate change is widely accepted; according to 80% of respondents, it has a good impact.

According to Dereje, lemi kura woreda 14 cleansing agency officer the majority of farmers in the woreda recognize environmental risks associated with livestock waste, including soil and water contamination, and air pollution caused by improper disposal. They understand that if manure is not managed effectively, it can contribute to, unpleasant odors, and public health concerns. Alongside this awareness of risks, there is also a strong understanding of the benefits of manure recycling. Many farmers acknowledge that proper manure recycling practices, such as composting and biogas production, can help improve soil fertility, reduce dependence on chemical fertilizers, and contribute to sustainable farming.

4.7.3. Challenges

According to the report, 62.5% of participants were dissatisfied with government assistance, calling it "bad." Furthermore, a sizable majority (62.5%) said that more government assistance could improve recycling procedures. Additionally, 82.5% of respondents said non-governmental organizations (NGOs) did not help them. Farmers' capacity to effectively recycle animal manure is hampered by a number of issues, but the most indicated problem by respondents is a lack of space for recycling (50%), the second most indicated barrier is regulatory obstacles (27.5%), and inadequate government help (12.5%). In qualitative interviews, government officials acknowledged the challenges farmers face in recycling their livestock manure and voiced similar concerns.

According to Dawit, farmers and urban agriculture officer in Lemikura sub city woreda 13, while there are general waste management policies in place, they do not specifically address

the unique needs of livestock waste recycling. The lack of a dedicated framework for managing livestock manure means that policies are often vague or insufficient, leaving farmers with limited guidance on how to handle waste sustainably. Additionally, there is a lack of financial incentives or subsidies to encourage the adoption of recycling technologies, such as composting or biogas production. This results in a reliance on traditional, often environmentally harmful methods of waste disposal, like open dumping or direct discharge into water systems.

The government faces resource constraints, including limited infrastructure and technical expertise, which hampers the development of effective waste recycling systems. Regulatory enforcement is often weak, and there is little emphasis on educating stakeholders about the benefits of livestock waste recycling.

Progress is hindered by issues like space limitations and regulatory barriers, as well as a lack of assistance from the government and non-governmental organizations. Nonetheless, a high degree of community collaboration and a general understanding of the harm that animal manure causes to the environment indicate that, with the right assistance, sustainable waste management techniques may become more popular.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The study looked at Addis Ababa's livestock manure recycling procedures, concentrating on the Livestock waste management methods, obstacles, and attitudes of urban livestock farmers and concerned government officials. Sustainable livestock waste management is essential in Addis Ababa because of the city's fast urbanization, which is putting more stress on the land and resources. The study draws attention to an alarming dependence on cautious livestock waste management techniques, especially the disposal of animal manure in open areas, which presents serious environmental hazards. There is a need for more farmers to use recycling methods because fewer of them participate in more environmentally friendly activities like composting and biogas production, reflecting a need for greater adoption of recycling techniques.

The majority of respondents were unaware of the latest developments in livestock manure recycling technologies, and many of them stated that they were unable to adopt modern technology because of a variety of obstacles, such as a lack of support, access, and understanding. Long-term sustainability initiatives may be endangered by the lack of routine monitoring of the environmental impact, even though farmers are generally aware of the advantages of reusing manure.

It was discovered that obstacles like a lack of market access, regulatory restrictions, and space constraints hinder recycling processes. The problems faced by urban livestock farmers in recycling their livestock manure are made worse by the lack of clear policies and strategies specifically for managing livestock manure, the reluctance of local government officials to increase community participation, and the overall lack of government and non-governmental organization support, even though many farmers recognized the potential for such support to improve waste recycling.

The data reveals a strong sense of community cooperation in waste recycling practices. However, the lack of governmental support, compounded by regulatory challenges because of a lack of coordination and collaboration among the various government agencies like health sector, police (“denb maskeber”), environmental protection agency, and farmers development and urban agriculture offices limits the broader adoption of sustainable livestock waste

management. The research underlines the importance of addressing these gaps to enhance the environmental and economic benefits of manure recycling.

5.2. Recommendations.

- One of the specific objectives of the study was to assess the current livestock waste management practices and extent of recycling. The Finding of the study indicates that there are fewer numbers of farmers use recycling methods activities like composting and biogas production. Larger portion respond are using environmentally unfriendly ways of livestock waste disposal. The majority of respondents were unaware of the latest developments in manure recycling technologies, and many of them stated that they were unable to adopt modern technology. To overcome these problems it is recommended that the city government of Addis Ababa has to do more to encourage and make recycling livestock manure easier. This involves updating legislative frameworks to lower obstacles and expand waste management space accessibility. Animal manure recycling can effectively eliminate pathogens, reduce waste weight, improve soil fertility, and lessen pollution in the environment. Training programs on modern technology for urban livestock waste recycling should be offered by the government in partnership with non-governmental organizations.
- The study was also aimed to assess current challenges on livestock waste recycling practices. It was discovered that obstacles like a lack of space, regulatory restrictions, and market access constraints hinder recycling processes. The problems faced by urban livestock farmers in recycling their livestock manure are made worse by the lack of clear policies and strategies specifically for managing livestock manure. To overcome these challenges the government ought to look into options like establishing manure recycling zones in urban planning or allocating certain locations for the processing of animal waste. Facilitating the market for compost fertilizers is an additional method to help and organize livestock farmers with vegetable growers that want to use organic fertilizers or compost, which could alleviate space restrictions. It is important for policymakers to develop and implement clear regulations and guidelines for livestock waste recycling to ensure sustainable waste management practices. The absence of a well-defined policy framework results in inconsistent waste handling, environmental pollution, and missed opportunities for resource recovery.

- The research findings indicate that the lack of coordination and collaboration among key stakeholders significantly hinders effective livestock waste recycling practices. The absence of structured partnerships between government agencies, farmers, and relevant organizations has resulted in fragmented efforts and inefficient waste management strategies. Additionally, the absence of NGO support further exacerbates the challenge, as there are limited external resources, technical expertise, and advocacy initiatives to promote sustainable waste recycling. Without coordinated efforts and the involvement of NGOs in providing financial assistance, training, and policy advocacy, the implementation of effective waste recycling programs may remain inadequate. So government should strengthening collaboration among stakeholders and encouraging NGO participation is essential to improving livestock waste management and ensuring environmentally sustainable agricultural practices.
- Livestock farmers in the study area generally hold a good understanding of both the positive and negative effects of livestock manure. On the positive side, many farmers recognize the value of manure as an organic fertilizer that enhances soil fertility, reduces the need for chemical fertilizers, and improves soil fertility. They also understand the negative consequences when manure is not handled properly. Thus, government should encourage livestock farmers in the study area by implementing sound policies that provide both financial and practical support for sustainable manure management. This could include offering training programs on best practices for manure handling, composting, and recycling to minimize environmental risks. The government should also facilitate access to technical resources and expert advice to encourage farmers adopts more environmentally friendly waste management practices.
- The majority of farmers in the study area are not actively monitoring the contribution of their livestock waste management practices on the environment. Despite being aware of the potential negative effects, such as soil contamination and water pollution, many farmers do not assess or evaluate how their waste disposal methods are contributing to environmental degradation. It is recommended that the government should support environmental monitoring efforts by implementing policies that promote regular environmental assessments, offering incentives for sustainable waste management practices, and facilitating access to affordable monitoring technologies. Moreover, the government could establish awareness campaigns to educate farmers

on the importance of environmental monitoring and its role in ensuring long-term environmental sustainability. Collaboration between farmers, government agencies, and environmental organizations is essential to create a comprehensive approach for monitoring livestock waste impact in their community.

REFERENCE

Alexandratos, N., & Bruinsma, J. (2012). World agriculture towards 2030/2050: the 2012 revision

Asrat M., Gebrekidan, H., Yli-Halla, M., Bedadi, B., & Negassa, W. (2014). Effect of integrated use of lime, manure and mineral P fertilizer on bread wheat (Triticum aestivum) yield, P uptake and status of residual soil P on acidic soils of Gozamin district, North–Western Ethiopia. Agriculture, Forestry and Fisheries, 3(2), 76-85.

Bakker N., Dubbeling M., Gündel S., Sabel-Koshella U., de Zeeuw H. (2000) Growing cities, growing food. Urban agriculture on the policy agenda. Feldafing, Germany: Zentralstelle für Ernährung und Landwirtschaft (ZEL).

Belete E., & Ayza, A. (2015). A review on alternative technologies to manage manure: Cost effective and environmentally beneficial. Live stock Research for Rural Development, 27(10). Beveridge, M. C., Thilsted, S. H., Phillips, M. J., Metian, M., Troell, M., & Hall, S. J. (2013). Meeting the food and nutrition needs of the poor: the role of fish and the opportunities and challenges emerging from the rise of aquaculturea. Journal of fish biology.

Bittman, S., Hunt, D. E., Kowalenko, C. G., Chantigny, M., Buckley, K., & Bounaix, F. (2011). Removing solids improves response of grass to surface-banded dairy manure slurry: a multiyear study. Journal of environmental quality, 40(2), 393-401.

Bren d'Amour, C., Reitsma, F., Baiocchi, G., Barthel, S., Güneralp, B., Erb, K. H., ... & Seto, K. C. (2017). Future urban land expansion and implications for global croplands. Proceedings of the National Academy of Sciences, 114(34).

Buckwell, A., & Nadeu, E. (2016). Nutrient Recovery and Reuse (NRR) in European agriculture. A review of the issues, opportunities, and actions. Brussels: RISE Foundation.

Burkette, J. (2022). The research interview: a performative reinterpretation. Qualitative Inquiry, 28(3-4), 300-311.

Buhaug, H., Urdal, H., & Østby, G. (2013). Sustainable urbanization and human security. In A Changing Environment for Human Security. Routledge.

Bui, T. D., Tseng, J. W., Tseng, M. L., & Lim, M. K. (2022). Opportunities and challenges for solid waste reuse and recycling in emerging economies: A hybrid analysis. Resources, Conservation and Recycling.

Chihambakwe, M., Mafongoya, P., & Jiri, O. (2018). Urban and peri-urban agriculture as a pathway to food security: A review mapping the use of food sovereignty.

Cooke, g. W., & williams, r. J. B. (1973). Significance of man-made sources of phosphorus: fertilizers and farming: the phosphorus involved in agricultural systems and possibilities of its movement into natural water. In phosphorus in fresh water and the marine environment (pp. 19-33).

Corbetta, P. (2003) Social Research: Theory Methods and Techniques. SAGE Publications Ltd.,

Delahoy, M. J., Wodnik, B., McAliley, L., Penakalapati, G., Swarthout, J., Freeman, M. C., & Levy, K. (2018). Pathogens transmitted in animal feces in low-and middle-income countries. International journal of hygiene and environmental health.

Delgado, C. L., Rosegrant, M. W., Steinfeld, H., Ehui, S. K., & Courbois, C. B. (1999). The coming livestock revolution. Choices.

Diacono, M., Persiani, A., Testani, E., Montemurro, F., & Ciaccia, C. (2019). Recycling agricultural wastes and by-products in organic farming: Biofertilizer production, yield performance and carbon footprint analysis. Sustainability.

Djurfeldt, A. A. (2015). Urbanization and linkages to smallholder farming in sub-Saharan Africa: Implications for food security. Global Food Security.

Dorward, A., & Chirwa, E. (2012). The Malawi agricultural input subsidy programme: 2005/06 to 2008/09. Sustainable Intensification.

Emerson, R. W. (2015). Convenience sampling, random sampling, and snowball sampling: How does sampling affect the validity of research?. Journal of Visual Impairment & Blindness, 109(2), 164-168.

Ezeadichie, (2023). Effects of urban agriculture on residential neighbourhoods. Irish Journal of Environment and Earth Sciences.

Færge, J., & Magid, J. (2004). Evaluating NUTMON nutrient balancing in sub-Saharan Africa. Nutrient Cycling in Agroecosystems.

Feliciano, D., Recha, J., Ambaw, G., MacSween, K., Solomon, D., & Wollenberg, E. (2022). Assessment of agricultural emissions, climate change mitigation and adaptation practices in Ethiopia. Climate policy.

Geels, F., & Raven, R. (2006). Non-linearity and expectations in niche-development trajectories: ups and downs in Dutch biogas development (1973–2003). Technology Analysis & Strategic Management.

Goulding, K., Stockdale, E., & Watson, C. (2008). Plant nutrients in organic farming. Organic crop production–Ambitions and limitations.

Herrero, M., Thornton, P. K., Notenbaert, A. M., Wood, S., Msangi, S., Freeman, H. A., ... & Rosegrant, M. (2010). Smart investments in sustainable food production: revisiting mixed crop-livestock systems. Science.77.

Heubach, K. (2012). The socio-economic importance of non-timber forest products for rural livelihoods in West African savanna ecosystems: current status and future trends.

Holloway, G. J., & Ehui, S. (2002). Expanding market participation among smallholder livestock producers: A collection of studies employing Gibbs sampling and data from the Ethiopian highlands, 1998-2001 (Vol. 48). ILRI (aka ILCA and ILRAD).

Holm-Nielsen, J. B., Al Seadi, T., & Oleskowicz-Popiel, P. (2009). The future of anaerobic digestion and biogas utilization. Bioresource technology, 100(22).Jabbar, A., Ahmad, R., Bhatti, I. H., Aziz, T., & Nadeem, M. (2011). Residual Soil Fertility as Influenced by

Diverse Rice-based Inter/Relay Cropping Systems. International Journal of Agriculture & Biology, 13(4).

Kassa, F. (2013). Conurbation and urban sprawl in Africa: The case of the city of Addis Ababa. Ghana Journal of Geography

Komakech, A. J., Banadda, N. E., Kinobe, J. R., Kasisira, L., Sundberg, C., Gebresenbet, G., & Vinnerås, B. (2014). Characterization of municipal waste in Kampala, Uganda. Journal of the Air & Waste Management Association, 64(3).

Kothari, C. (2004). Research methodology: Methods and techniques (2nd revised edition). New Delhi: New Age International (P) Limited, Publishers.

Leech, N. L., Dellinger, A. B., Brannagan, K. B., & Tanaka, H. (2010). Evaluating mixed research studies: A mixed methods approach. Journal of mixed methods research, 4(1).

Loss, A., Souza, M., Lourenzi, C. R., Brunetto, G., Lovato, P. E., & Comin, J. J. (2022). Soil attributes and crops productivity: changes due to the long time use of animal manure. Agroindustrial Science, 12(1).

Moll, H. A., Staal, S. J., & Ibrahim, M. N. (2007). Smallholder dairy production and markets: A comparison of production systems in Zambia, Kenya and Sri Lanka. Agricultural systems.

Nicholson, F. A., & Chambers, B. J. (2008). Livestock manure management and treatment: implications for heavy metal inputs to agricultural soils. SCHLEGEL, P. et al. Trace Elements in Animal Production Systems, 55-62.

Osak, R. E. M. F., Hartono, B., Fanani, Z., & Utami, H. D. (2015). Biogas and bioslurry utilization on dairy-horticulture integrated farming system in Tutur Nongkojajar, District of Pasuruan, East Java, Indonesia. Livestock Research for Rural Development, 27(4), 65.

Parnell, S., & Walawege, R. (2011). Sub-Saharan African urbanisation and global environmental change. Global Environmental Change, 21, S12-S20.

Petersen, S. O., Sommer, S. G., Béline, F., Burton, C., Dach, J., Dourmad, J. Y., ... & Mihelic, R. (2007). Recycling of livestock manure in a whole-farm perspective. Livestock science, 112(3), 180-191.

Potter, P., Ramankutty, N., Bennett, E. M., & Donner, S. D. (2010). Characterizing the spatial patterns of global fertilizer application and manure production. Earth interactions, 14(2).

Rao, S., Klimont, Z., Smith, S. J., Van Dingenen, R., Dentener, F., Bouwman, L., ... & Tavoni, M. (2017). Future air pollution in the Shared Socio-economic Pathways. Global Environmental Change, 42.

Raven, R. P., & Gregersen, K. H. (2007). Biogas plants in Denmark: successes and setbacks. Renewable and sustainable energy reviews, 11(1), 116-132.

Rayne, N., & Aula, L. (2020). Livestock manure and the impacts on soil health: A review. Soil Systems, 4(4), 64.

Regassa, N., Sundaraa, R. D., & Seboka, B. B. (2011). Challenges and opportunities in municipal solid waste management: The case of Addis Ababa city, central Ethiopia. Journal of human ecology, 33(3).

Rodionov, M., & Nakata, T. (2011). Design of an optimal waste utilization system: a case study in St. Petersburg, Russia. Sustainability, 3(9), 1486-1509.farms for closing the urban–rural nutrient loops. Nutrient Cycling in Agroecosystems, 119(1), 51-67.

RUAF (2007). What is urban agriculture? http://www.ruaf.org/node/512

Saleem, M. M. (1998). Nutrient balance patterns in African livestock systems. Agriculture, ecosystems & environment, 71(1-3), 241-254.

Si, Z., Marshman, J., Berge, S., Dai, N., Soma, T., Dale, B., ... & Levkoe, C. Z. (2016). Cities and Agriculture: Developing Resilient Urban Food Systems by Henk de Zeeuw and Pay Drechsel (Eds.). Canadian Food Studies/La Revue canadienne des études sur l'alimentation, 3(2), 216230.

Smit, J., Bailkey, M., & Van Veenhuizen, R. (2006). Urban agriculture and the building of communities. Van Veenhuizen, R. Cities farming for the future, urban agriculture for green and productive cities. Leusden: RUAF Foundation.

Sommer, S. G., Christensen, M. L., Schmidt, T., & Jensen, L. S. (2013). Animal manure recycling: Treatment and management. John Wiley & Sons.

Sonnino, R. (2016). The new geography of food security: exploring the potential of urban food strategies. The Geographical Journal.

Tadesse, S. T., Oenema, O., van Beek, C., & Ocho, F. L. (2018). Diversity and nutrient balances of urban and peri-urban farms in Ethiopia. Nutrient cycling in agroecosystems, 111, 1-18.

Tadesse, S. T., Oenema, O., van Beek, C., & Ocho, F. L. (2021). Manure recycling from urban livestock.

UN habitat, 2017 urban population annual Progress report.

UN-habitat, & United Nations Human Settlements Programme. (2010). Solid waste management in the world's cities: Water and sanitation in the world's cities 2010. Earthscan.

Westerman, P. W., & Bicudo, J. R. (2005). Management considerations for organic waste use in agriculture. Bioresource technology, 96(2).

Yang, L., Liu, M., Lun, F., Min, Q., & Li, W. (2019). The impacts of farmers' livelihood capitals on planting decisions: A case study of Zhagana Agriculture-Forestry-Animal Husbandry Composite System. Land Use Policy, 86, 208-217.

Yu, Z., & Schanbacher, F. L. (2010). Production of methane biogas as fuel through anaerobic digestion. Sustainable Biotechnology: Sources of Renewable Energy.

Zhu, Y. S., Yang, J. H., Sun, J. F., & Wang, H. (2017). Zircon Hf-O isotope evidence for recycled oceanic and continental crust in the sources of alkaline rocks. Geology, 45(5).

Zhang, C., Hu, M., Di Maio, F., Sprecher, B., Yang, X., & Tukker, A. (2022). An overview of the waste hierarchy framework for analyzing the circularity in construction and demolition waste management in Europe. Science of the Total Environment, 803, 149892.London.

Appendix A: Questionnaire for farmers

Addis Ababa University College of Developmental Studies Department of Environment and Sustainable Development

Questionnaire to be completed by farmers

Dear Respondents,

The purpose of this questionnaire is to collect data for a study entitled "Analyzing Livestock Waste Recycling Practices for Environmental Sustainability in Addis Ababa City Administration: The Case of Lami Kura and Akaki Kality Sub-cities". The study is conducted in partial fulfillment for the degree of Master of Science in Department of Environment and Sustainable Development at Addis Ababa University. Your privacy will be kept anonymously and, therefore, no one knows who provided the information. Any information provided will be used for academic purpose only and will be treated in strict confidence. Therefore, you are kindly requested to provide your responses to different questions below. Thank you in advance for agreeing to participate in this study.

1. HOUSEHOLD DEMOGRAPHIC CHARACTERISTICS

1.1. Age a) 18-35 b)36-50 c) 51-65 d) 65-Above

1.2. Sex a) Male b) Female

1.3. Level of Educational status. a) primary b) secondary c) Diploma d) Degree and above e) others.

1.5. How many years of experience do you have in Livestock farming in Urban setting.

a) 1-5 b) 6-10 c) 11-15 d) 16-20 e) 20 and above.

1.6. Type of farming a) Crop-Livestock b) Livestock Only c) Both mixed

2. WASTE MANAGEMENT PRACTICE

2.1. Which type of waste disposal method are you applying currently? a) Dumping on open spaces

b) Recycling (composting, Biogas production). c) Connecting to nearby drainage system.

d) Others (like, Dung cake).

2.2. Are you *Staying updated with the latest advancements in waste recycling technologies*?

a) Strongly Disagree b) Disagree c) Neutral d) Agree e) Strongly Agree

2.3. *Do you seek support and feedback from experts to improve our integration in waste recycling technologies?*

a) Strongly Disagree b) Disagree c) Neutral d) Agree e) Strongly Agree

2.4. *Do you believe your neighbors cooperate with recycling practices of livestock manure.*

a) Strongly Disagree b) Disagree c) Neutral d) Agree e) Strongly Agree

2.5. We monitor the environmental impact of our Livestock waste management practices regularly

a) Strongly Disagree b) Disagree c) Neutral d) Agree e) Strongly Agree.

3. Over all Government support and policies

3.1 How do you rank over all government support and feedback on your livestock waste management. Status

a) Excellent b) Very good c) Good d) Fair e) Bad

3.2 *Do you think that increased government support could improve livestock waste* recycling practices in your area?

a) Strongly Disagree b) Disagree c) Neutral d) Agree e) Strongly Agree

3.3 Do you get any support from non-government organizations to enhance recycling practices of livestock manure?

a) Strongly Disagree b) Disagree c) Neutral d) Agree e) Strongly Agree

3.4. The policies on livestock waste recycling are clear and easy to follow.

a) Strongly Disagree b) Disagree c) Neutral d) Agree e) Strongly Agree

3.5. Government actively invites livestock farmers in government programs that support livestock waste recycling**.**

a) Strongly Disagree b) Disagree c) Neutral d) Agree e) Strongly Agree

3**.**6 There is coordination and collaboration among the various government agencies**.**

a) Strongly Disagree b) Disagree c) Neutral d) Agree e) Strongly Agree

4. Challenges and Constraints.

4.1 What is the major challenge and constraint of recycling livestock manure in your community?

a) Lack of access to market. b) Lack of Space c) Lack of Skill d) Regulatory barriers e) Lack of Labor.

4.2 What measures or support mechanisms would you recommend to overcome these challenges and promote livestock manure recycling practices in Your community?

_____

5. Perception of Respondents

5.1 I understand livestock manure can have negative impacts on environment.

a) Strongly Disagree b) Disagree c) Neutral d) Agree e) Strongly Agree

5.2 I believe livestock manure recycling efforts contribute positively to mitigating environmental pollution**.**

5.3. I believe that actively using recycled livestock manure as organic fertilizer is cost effective method compared to chemical fertilizers.

a) Strongly Disagree b) Disagree c) Neutral d) Agree e) Strongly Agree

5.4. I believe that livestock manure compost is environmentally friendly and helps to improve soil quality.

a) Strongly Disagree b) Disagree c) Neutral d) Agree e) Strongly Agree

5.5 We actively collaborate with other stakeholders to amplify the environmental impact of waste recycling initiatives

a) Strongly Disagree b) Disagree c) Neutral d) Agree e) Strongly Agree

5.6 we believe that our farms should invests an appropriate way of waste management practice to avoid negative impact of livestock manure on the Environment.

a) Strongly Disagree b) Disagree c) Neutral d) Agree e) Strongly Agree

Appendix B: Key Informant Interview

Addis Ababa university College of Developmental Studies Department of Environment and Sustainable Development

Questionnaire to be completed by KII

Dear Respondents,

The purpose of this questionnaire is to collect data for a study entitled "Analyzing Livestock Waste Recycling Practices for Environmental Sustainability in Addis Ababa City Administration: The Case of Lami Kura and Akaki Kality Sub-cities". The study is conducted in partial fulfillment for the degree of Master of Science in Department of Environment and Sustainable Development at Addis Ababa University. Your privacy will be kept anonymously and, therefore, no one knows who provided the information. Any information provided will be used for academic purpose only and will be treated in strict confidence. Therefore, you are kindly requested to provide your responses to different questions below. Thank you in advance for agreeing to participate in this study.

1. RESPONDENT INFORMATION

1.1. Age a) 18-35 b)36-50 c) 51-65 d) 65-Above

1.2. Sex a) Male b) Female

1.3. Level of Educational status. a) primary b) secondary c) Diploma d) Degree and above e) others.

2. WASTE MANAGEMENT PRACTICES

2.1 Can you describe the current waste management practices used in the livestock industry?

2.2 Are there any innovative or emerging practices for recycling livestock waste?

2.3 What technological advancements have been made in the field of livestock waste recycling?

2.4. If there is an advancement, how do these advancements improve the efficiency and effectiveness of waste recycling practices?

3. ENVIRONMENTAL CONDITIONS AND PERCEPTIONS

3.1 How do environmental conditions (e.g., weather conditions and Natural resources) influence livestock waste recycling practices?

3.2 Is their specific challenge or consideration related to environmental conditions in your area?

3.3 How does livestock waste recycling help for improving Environmental conditions?

3.4 What are the environmental impacts associated with traditional livestock waste management practices?

3.5 How do sustainable waste recycling practices mitigate these impacts?

3.6 Can you mention examples of positive environmental outcomes resulting from the adoption of sustainable waste recycling practices?

4. GOVERNMENT POLICY AND SUPPORT

4.1 What are the existing policies or regulations and supports related to livestock waste management and recycling?

4.2 How do these policies impact the adoption of sustainable waste recycling practices?

4.3 Are there any gaps or areas where policy improvements are needed?

5. CHALLENGES AND CONSTRAINTS OF RECYCLING LIVESTOCK MANURE

7.1 What are the major challenges and constraints of recycling livestock manure in your community?

7.2 What strategies does your office have in place to address and resolve the challenges you mentioned?

Appendix C: Check list for Direct Observation

This checklist will help systematically assess the current state of urban livestock manure recycling practices and challenges through direct observation.

A. General Information

•Physical characteristics of the place: (vegetation, rivers and drainage sytems, land forms)

•Space for recycling manure properly

•Type of livestock observed: (Cattle, goats, etc.)

•Number of animals present

•Type of waste generated: (Solid manure, liquid waste, mixed).

B. Waste Collection and Storage Practices

•Is livestock waste collected regularly? (Yes/No)

•Where is the waste stored before recycling?

• Is there waste spillage or leakage to drainage system or rivers? (Yes/No)

•Are there bad odors near the storage site? (Yes/No)

•Are flies, rodents, or pests present around the waste? (Yes/No)

C. Waste Recycling Methods Observed

•Livestock manure composted before use:

• Direct Land Application:

•Biogas Production:

•Others (dung cake):