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## COLLEGE OF TECHNOLOGY AND BUILT ENVIRONMENT

## SCHOOL OF BUILT ENVIRONMENT

PHYSICAL AND ENVIRONMENTAL DETERMINANTS OF VEGETABLE MARKET PLACE AND RELATED FACILITIES: THE CASE OF LAFTO VEGETABLE MARKET CENTER, ADDIS ABABA, ETHIOPIA.

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# Physical and Environmental Determinants of Vegetable Market Place And Related Facilities: The Case of Lafto Vegetable Market Center, Addis Ababa, Ethiopia.

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**A Thesis Submitted to the School of Graduate Studies of Addis Ababa University, Collage of Technology and Built Environment, in Partial Fulfillment of the Requirements for the Award of Masters of Science Degree in Urban Planning.**

**Thesis Advisor: Mulugeta Maru (PhD)**

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**Declaration**

I now declare the thesis entitled **"PHYSICAL AND ENVIRONMENTAL DETERMINANTS OF VEGETABLE MARKET PLACE AND RELATED FACILITIES: In The Case of Lafto Vegetable Market Center, Addis Ababa, Ethiopia.."** submitted for the Collage of Technology and Built Environment, of Addis Ababa University is done by close supervision of my advisor; Dr. Mulugeta Maru (PHD) and I declare that this study is my original work and has not been presented for a degree, a diploma or fellowship to any other University and that all the materials used for this study have been duly acknowledged.

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**Confirmation**

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

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**Approval Sheet**

This thesis is submitted the Collage of Technology and Built Environment, of Addis Ababa University and to the School of Graduate Studies of Addis Ababa University in the partial fulfillment of the requirements for the degree of Masters of Urban Planning.

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**Approved by Board of Examiners:**

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# ABSTRACT

Urbanization is a prominent trend and an important issue in the world's development discourse. The study focuses on solid waste management and stormwater management at the Lafto Vegetable Market Center in Addis Ababa, highlighting significant environmental sustainability concerns. Urban markets like Lafto generate substantial waste and face complex water management issues, adversely impacting the environment and public health. Key problems identified include inadequate waste collection and disposal systems, ineffective waste segregation, and increased pollutants, leading to health risks and operational challenges during heavy rainfall. Utilizing a mixed-method approach, the research examined municipal policies, conducted interviews with local authorities and vendors, and made field observations, particularly focusing on the drainage system, stakeholder perspectives, and current waste management practices. Data was collected using site observations, Google Earth images, and insights from key informants, analyzed with SPSS 26.1 software. The study findings revealed significant sustainability issues, including the lack of waste bins near businesses, designated waste collection areas, and no effective waste management practices. Accumulated waste on-site, in drainage systems and traffic congestions on streets exacerbates these problems. The study recommends several solutions for developing comprehensive waste collection systems, enhancing recycling and composting facilities, and improving garbage pickup schedules for solid waste management. For storm water management, it suggests upgrading drainage infrastructure. Additionally the study provides valuable insights for market operators, policymakers, and urban planners aimed at improving public health and environmental quality in Addis Ababa's vegetable markets.



Key words: physical environment; vegetable market; resilience; sustainability.

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# Dedication

This paper is dedicated to my Grand Parents and my father,

May their Souls Rest in Peace!

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| | |
|---|---|
| **AAEPA** | **Addis Ababa City Administration Environmental Protection Authority** |
| **CAGR** | **Compound Annual Growth Rates** |
| **CAD** | **Computer Aided Design** |
| **CSA** | **Central Statistics Agency** |
| **EEPA** | **Ethiopian Environmental Protection Authority** |
| **EPA** | **Environmental Protection Agency** |
| **ETFRUIT** | **Ethiopian Fruit and Vegetable Marketing Enterprise S.C.** |
| **FVW** | **Fruit and Vegetable Waste** |
| **GIS** | **Geographic Information System** |
| **IWRM** | **Integrated Water Resource Management** |
| **KII** | **Key Informant Interview** |
| **LVM** | **Lafto Vegetable Market** |
| **NEPA** | **National Environmental Policy Act** |
| **SDG** | **Sustainable Development Goals** |
| **SPSS** | **Statistical Package for the Social Science** |
| **SWM** | **Solid Waste Management** |
| **UN** | **United Nation** |
| **US** | **United States** |
| **USD** | **United States Dollar** |

# CHAPTER 1 INTRODUCTION

This chapter encompasses a significant portion of the research. Therefore, the study pays careful attention to several key elements, including the background of the study, the problem statement, research questions, general and specific objectives, the significance of the study, and the overall structure of the research presented in this chapter.

## 1.1. BACKGROUND OF THE STUDY

Urbanization is a prominent trend and an important issue in the world's development discourse. With close to 70% of its population rural, urban centers are still secondary places of habitation in sub-Saharan Africa (Weldegebriel et al., 2021). Historically, the key context for investment in old urban areas has been blight which was, again, historically defined as an urban quality that creates concerns about public health and safety (Terefe, 2021).

The market for fresh vegetables was estimated to be worth USD 632.54 billion in 2021, and from 2022 to 2028, it is expected to increase at a compound annual growth rate (CAGR) of 2.8%. Over the course of the projected period, the expanding global food sector and rising consumer spending on fresh food goods like vegetables are anticipated to fuel market expansion.

In Ethiopia, different conventional organizations exist in both urban and rural situations. Examples of such associations in Addis Ababa include community-based social organizations (burial and church based); social and religious gatherings (Mahber); memberships in the local parish (Sebekagubae); and economic saving groups (Abebe & Hesselberg, 2013).

However, sustainable development requires an integrated approach that takes into account both environmental concerns and economic advancement. The Brundtland Commission of the United Nations defined sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" in 1987. The Sustainable Development Goals (SDG) offer the cornerstone for raising global human well-being while mitigating the hazardous consequences of human-caused climate change.

Therefore, Lafto Vegetable Market is a popular marketplace located in the Lafto district of Addis Ababa, the capital city of Ethiopia. The market is well-known for its wide variety of fresh vegetables, fruits, and other agricultural products sourced from local farmers and suppliers. The market plays a significant role in the local economy by connecting farmers and traders with customers from various parts of the city.

Hence, at Lafto Vegetable Market, customers can find a range of seasonal and year-round produce, including leafy greens, root vegetables, legumes, herbs, and fruits. In addition to fresh produce, the market also offers an assortment of spices, grains, and other essential ingredients for Ethiopian cuisine.

Following the onset of the Novel Coronavirus (COVID-19) pandemic, Atikilt Tera, a vast open vegetable and fruit market originally based in Piassa, temporarily moved to the fields of Jan Meda, a sports ground, to curb the spread of the virus. The market stayed in Jan Meda for over five months. Ultimately, it was given its new home at the Lafto Vegetable & Fruit Market Centre in the Haile Garment neighborhood of southwestern Addis Ababa. The location seemed to surprise both customers and vendors (Sileshi E., 2021).

Thus, in order to identify clarifies the sustainability and resilience of the vegetable market situated in Addis Ababa's waste collection and disposal issues and environmental issue areas.

The study's objectives are to analyse the current situation of the Lafto vegetable market's physical sustainability of accessibility and traffic congestion and environmental resilience in drainage and waste collection redundancy and diversity of parking, to pinpoint problems related to environmental sustainability, to identify variables influencing the market's physical sustainability and resilience, and to identify obstacles that must be overcome in order to implement sustainable and resilient practices. Additionally, the study is thought to advance the fundamentals of sustainable growth in Addis Ababa vegetable market specifically.

## 1.2. STATEMENT OF THE PROBLEM

Addis Ababa, the capital city of Ethiopia, has witnessed rapid urbanization in recent decades due to a combination of natural population growth and rural-urban migration. As a result, the city has experienced a high demand for goods and services, leading to the development of various market centers. Lafto vegetable market, serving one of the largest communities in Addis Ababa, is an essential source of fresh produce and livelihoods for many residents.

The emerging of the new vegetable market in Lafto sub-city is selected as a problem observation has taken place. The main observed problem on this site is the waste management and congestion of sustainability on traffic management, on taxi bay and damages of sustainability.

Therefore, this study sheds light on sustainability and resilience in terms of physical and environmental areas in Addis Ababa in the case taken on Lafto Vegetable Market. The purpose of this research is to identify factors affecting physical sustainability, to assess the environmental sustainability issues on waste management and to identify resilience characteristics of Lafto vegetable market for suitability. Furthermore, the study is supposed to promote sustainability issues in vegetable market in Ethiopia and Addis Ababa particular.

However, Lafto vegetable market faces several challenges in terms of physical and environmental sustainability and resilience. These include issues related to solid waste management, pollution, congestion, inadequate infrastructure, and vulnerability to natural and man-made hazards. Consequently, it is crucial to assess the current state of the market and identify strategies to enhance its overall sustainability and resilience.

The observation of the problem has taken place in the inner city selectively at the area of Lafto sub city, where the new vegetable market is contemporary. The main observed problem on this site is waste management of vegetable waste provision on the site and physical infrastructure effects on the site. According to studies this cause leads to traffic congestion and pollution. Additionally, main observations were: the absence of each shops waste collection material and total waste collection space on the site; the shortage of parking space and un-proper use of parking space; the absence of storm water drainage in

the internal road and the presence of traffic jam outside the site.

In conclusion, this study overall problem statement analyzes how the Lafto vegetable market is resilient and sustainable and offers suggestions for improving its physical and environmental aspects.

The main research gap could be the current lack of comprehensive data and understanding about various environmental impacts and the physical resilience of the Lafto vegetable market.

## 1.3. OBJECTIVES OF THE STUDY

### 1.3.1. General Objective

The general objective of this study is to investigate the environmental determinants affecting the market, such as waste management practices, the existing physical infrastructure of the Lafto Vegetable Market, including layout, facilities, and accessibility, to identify strengths and weaknesses that impact market operations to determine their sustainability.

### 1.3.2. Specific Objective

This study has the following specific objective

- To explore the factors affecting physical condition of the Lafto vegetable market,
- to identify the challenges of environmental sustainability of the study area,
- to investigate the types of resilient principles that can be applied in the study area.

## 1.4. RESEARCH QUESTIONS

Given the objectives, the following questions were addressed in the research:

1. What are the factors affecting the physical condition of ‘Lafto vegetable market’?
2. What are the major challenges of environmental sustainability issues of the study area?
3. Which resilience principles are applied in the study area?

## 1.5. SIGNIFICANCE OF THE STUDY

While there may be numerous studies on urban markets globally, there is often a lack of localized case studies that focus specifically on the Lafto vegetable market. Research could explore the unique socio-economic, cultural, and environmental contexts of this market compared to others. Many urban vegetable markets operate informally. There is a gap in understanding how informal market practices can be integrated into formal sustainability frameworks. Research could investigate how these practices contribute to or hinder sustainability efforts.

Since the research focuses on physical and environmental issues of vegetable market area and making it suitable and easily accessible areas and the primary significance of the study is to all users (means whole sellers, buyers, retailers, loaders, securities, cleaners and all workers which uses the site) in the market system. Analysis of the whole system and identifying clearly will be an important document for government officials and Non-Governmental Organizations (NGOs): future researchers, policy makers and urban designers as a data.

Studying the physical and environmental sustainability and resilience of vegetable market center in the line with the above indicated problems. The research outputs would improve our knowledge about vegetable market suitability and accessibility and the study will add information to the limited research done so far on the physical and environmental sustainability and resilience of vegetable market areas.

## 1.6. SCOPE OF THE STUDY

The area coverage of this study is limited in theme and space. The research is conducted to assess one of the largest Vegetable market located focusing on Lafto vegetable market confined within the city of Addis Ababa, Nifas silk Lafto sub-city, Woreda 10.

The Thematic /Subject scope of the study focus on the physical sustainability parameters since it has too many parameters like circulation: road and parking, and its impacts on transportation and infrastructure. Furthermore, it is also focus on the environmental factors: solid waste management of vegetable wastes, storm water drainage and collection of waste and its effect on air pollution.

It is also emphasize how to relate the resilience concept or principle with environmental and physical sustainability. Principles such as redundancy of drainage: dust bins, baskets and what type of basket is used, where the place and the size is and what type of waste is put on each dust bins. Then identification of vehicle type diversity required different space areas for different vehicles. The storm water drainage system is robust if the drainage lines go to the receiving area on rainy season. Day to day number of purchasers and the traffic flow that affects the transportation system will also center of the study.

## 1.7. LIMITATION OF THE STUDY

This paper's limitation includes practical weakness in the methodologies adapted, lack of access to the right data and lack of statically data of users of population on the site. A shortage of historical site data, a restricted literature study and luck of up-to-date literature in the area are the additional limitations pertaining to the topic of discussion. The other limitation include the availability of limited resource and there is no written document about Lafto vegetable market. There shortage of literature done on vegetable market sustainability are also the main limitation.

## 1.8. STRUCTURE OF THE THESIS

This thesis is organized into five chapters. Chapter one introduces the study, outlining the background, statement of the problem, objectives, significance, scope, limitations, and overall organization. Chapter two reviews related literature, presenting both theoretical and empirical evidence. Chapter three details the research methodology, including a description of the study area, current approaches, research design, types and sources of data, sampling techniques, data collection methods, and data analysis procedures. Chapter four presents and discusses the results of the study, interpreting information gathered from producers and key informant interviews through tables and graphs. Finally, chapter five summarizes the findings, draws conclusions, offers recommendations, and suggests directions for future research.

# CHAPTER 2 LITERATURE REVIEW

This literature review has looked for and included papers that are closely relevant to the topic of this research. Therefore, the following concerns are given appropriate consideration in the reviews: introduction definition and concepts of the word, theoretical, empirical and conceptual review related to vegetable market. Consequently the focus of the literature search is on the physical factors effects on vegetable market, environmental issues, and sustainability on environment, vegetable market and resilience characteristics, market challenges faced to achieve sustainable and resilient practices.

## 2.1. THEORETICAL LITRATURE REVIEW

### 2.1.1. DEFINITION AND CONCEPT

**Physical**

Physical refers to anything related to the body or material world that can be perceived through the senses. It can also pertain to physics or natural laws and phenomena. It often stands in contrast to things that are mental, spiritual, or digital.

**Environmental**

The environment refers to the natural world and physical surroundings in which living organisms interact and depend on for survival. It includes both living (biotic) elements, such as plants and animals, and nonliving (abiotic) elements, such as water, soil, air, and climate. The environment is integral to the quality of life on earth and is a crucial factor influencing biodiversity and ecosystems.

The environmental aspect looked at environmental issued which was impacted by the external regulations often imposing the responses needed for dealing with environmental issues. This regulations were incorporated in the organizational responses who are tried to reduce usage, conserve resources and implement effective business practices.

**Sustainability**

Vegetable is the name given to that group of horticultural plants grown for human depletion either for their roots, tubers, shoots, stems, leaves, flower buds, flowers, fruit or seed.

Perish- ability-as fruits & vegetables are highly perishable; they start to lose their quality right after harvest and continued throughout the process until it is consumed (Hailegiorgis, 2011).

Vegetables are defined as the fresh parts of plants which, either raw, cooked, canned or processed in some other way, provide suitable human nutrition. Fruits of perennial trees are not considered to be vegetables. The composition of vegetables can vary signif-icantly depending upon the cultivar and origin (Dieter, et al., 2008).Definitions of fruits and vegetables according to health professionals and consumers are heavily influenced by cultural customs and norms related to food selection and preparation. (Thompson, et al., 2011)

Sustainability needs to be examined holistically, moving beyond straightforward environmental problems. One strategy to accomplish sustainability is to shift from short-term, profit-driven measures to long-term, strategic thinking.

**Vegetables**

Vegetables are defined as the fresh parts of that provide suitable human nutrition, either raw, cooked, canned or processed in some other way. Fruits of perennial trees are not considered to be vegetables (Roberts et al., 2005). The composition of vegetables can vary significantly depending upon the cultivar and origin (Dieter, et al., 2008). According to health professionals and consumers, definitions of fruits and vegetables are highly influenced by cultural customs and norms related to food selection and preparation (Thompson, et al., 2011). Perishability-as vegetables are highly perishable, they start to lose their quality right after harvest and continued throughout the process until it is consumed. For this purpose elaborated and extensive marketing channels, facilities and equipment's are vital(Gessesse, 2009).

**Resilience**

Resilience in urban planning refers to the capacity of an urban system to maintain continuity in the face of expected and unexpected change and to bounce back or recover from shocks or stresses. It addresses a city's ability to withstand and recover from

challenges such as climate change, rapid urbanization, social inequality, and critical infrastructure shortages (Godschalk, 2003).

## 2.2. EMPERICAL LITRATURE REVIEW

A vegetable market center is a place where vegetables are traded in large quantities. Traders - both buyers and sellers - gather at the center to conduct their business. This could be a physical location, like a farmers market or wholesale market, or it could also refer to an online platform where such trades are conducted. The vegetables are typically sourced from farmers and then sold to retailers, restaurants, or processed food companies.

In urban planning, a vegetable market refers to a designated area in a city or town where vendors gather to sell their fresh produce directly to consumers. The planning and placement of these markets is significant since it can affect a variety of factors including traffic flow, environmental conditions, economic development, and community health.

These markets are often strategically located to optimize accessibility to the larger public and to ensure a smooth flow of goods into and out of the space. They can also play a key role in supporting local agriculture, building community relationships, and promoting healthy eating habits. In terms of design and infrastructure, a vegetable market should have adequate space for vendors to set up their stalls, safe and easy access routes for customers, proper waste management systems, and necessary amenities.

The processing of agricultural products makes up around 75% of Ethiopia's industrial sector. The estimated area under these crops (vegetables and root crops) was 356,338.82 hectares (CSA, 2003). Individual peasant farmers cultivate nearly 70% of the entire area of fruit plantations. Less than 20% of state sector agriculture's yearly production volume is devoted to fresh fruit. (Hailegiorgis, 2011).

In order to minimize the impact on health and the environment, we must significantly reduce the amount of waste we produce through prevention, reduction, reuse, and recycling as part of the circular economy by 2030, according to the UN, which is one of the major global environmental issues we must address.

The majority of solid wastes are, in short, dumped on land as dumps with a wide variety of materials, tips or spoil heaps, or land infill to quarries and mine shafts. Since waste is

constantly produced, some kind of storage facility is frequently required. The amount, manner of treatment, and disposal of waste all play major roles in environmental poll (Seleshi, 2009).

A vegetable market is a sort of building or structure shaped and planned in various colors, materials, shapes, sizes, and styles with accurate and specific fruit and vegetables. Vegetable markets deliver healthier food items that are fresher than the ones offered in supermarkets.

Due to the market's inaccessibility and the lack of people that used to help us in loading and unloading the products loss of money were happen for distributes. Similar fruit and vegetable market projects were implemented over a year ago, including the markets in Furi and Jemo. However, due to disappointing results and poor maintenance, many vendors choose to leave the markets. Part of the reason for this is that the markets were not promoted well, and there was a lack of customers. The Bureau maintains that these markets are getting a second chance after being renovated and reopened (Sileshi E., 2021).

Because of the markets' proximity to the city's core, it was congested. Because Addis Ababa's transport system is intricate, decentralizing the market is the best solution to the issue. Metropolitan planning includes integrating location, time, and activity in the metropolitan area to establish a pattern and reduce unneeded commotion.

### 2.2.1. The three pillars of sustainability

Sustainability is about meeting the needs of present generations without compromising the ability of future generations to meet their own needs. There are three main pillars of sustainability that many organizations strive to achieve (Environmental sustainability: A commitment to a better future). Sustainability is fundamentally about human interaction, impact on the environment and on each other, environmental and social issues (Sustainability Issues/ Sustainability Trends ).Sustainability is the practice of using natural resources responsibly today, so they are available for future generations tomorrow (Society, 2022).

Economic sustainability is not about money; despite the fact that it may appear that this pillar is concerned with an organization's capacity to maintain profitability over the long term. An organization that can generate money and maintain long-term business growth without having a detrimental effect on the neighborhood, the environment, or the health and welfare of its workers is said to be economically sustainable.

The main focus of this pillar is safeguarding the environment for future generations. Environmentally responsible businesses increase productivity, cut down on resource use and waste, and track and measure carbon emissions along the entire supply chain. Many businesses today are stepping up their environmental initiatives by implementing cutting-edge technology, such as cloud and IoT sustainability solutions that enable them to monitor and lessen their environmental impact.

### 2.2.2. Physical Sustainability

**Physical sustainability approaches**

As Brunner & Kaminski in 2016 explained: Transport within urbanized areas presents unique problems. The density of an urban environment increases traffic, which can harm businesses and increase pollution unless properly managed. Parking space for private vehicles requires the construction of large parking garages in high density areas. This space could often be more valuable for other development.

Fuseini (2016) argues that urban infrastructure and services refers to all facilities and structures that are developed and have productive and service) quality for the economic, political and social development of a society. These facilities and services include roads, electricity, water, health and educational institutions, local markets and commercial centers, housing and sanitary facilities.

Utilizing green infrastructure, such as green roofs, permeable pavements, and urban forests, to manage storm water and enhance urban biodiversity (Fletcher, T.D., et al. 2015). Designing transportation systems that prioritize public transit, cycling, and walking to reduce reliance on fossil fuels and decrease greenhouse gas emissions (Litman, 2017). Developing integrated waste management systems that promote recycling, composting, and waste-to-energy technologies to minimize landfill use (Zaman & Lehmann, 2013).

Promoting the efficient use of resources such as water and energy in urban settings to minimize waste and environmental impact (Morrissey & Horne, 2016).

Urban planners need to consider several aspects when planning for such markets. These include the location for easy accessibility, ample space for vendors and shoppers, storage facilities, sanitary provisions, and waste management facilities. The planning should aim to involve the essential facilities for vendors and consumers and contribute to the economic, societal, and environmental sustainability of the community. Establishing infrastructure that effectively coordinates social, economic, and environmental growth is crucial to sustainable development (Shahrudin & Mustaffa, 2023).

A comprehensive systems approach is essential for effective decision making with regard to global sustainability, since industrial, social, and ecological systems are closely linked. Despite efforts to reduce unsustainability, global resource consumption continues to grow. There is an urgent need for a better understanding of the dynamic, adaptive behavior of complex systems and their resilience in the face of disruptions, recognizing that steady-state sustainability models are simplistic (Fiksel, 2006).

**Physical sustainability factors**

Lafto Vegetable Market Center is a central point for the buying and selling of vegetables and fruits in Addis Ababa, Ethiopia. This market center plays a significant role in the livelihoods of many people, as well as serving as a source of food for a significant portion of the city's inhabitants. To ensure the long-term efficiency and functionality of such a market, it is essential to analyze its physical and environmental sustainability and resilience. This analysis can help identify areas for improvement or mitigation measures to maintain the critical services it provides.

Physical Sustainability:

1. Infrastructure: The condition of the infrastructure within the market, such as buildings, stalls, and storage facilities, is crucial. Proper maintenance and repair should be carried out as needed to ensure these structures do not deteriorate, posing a risk to the vendors and customers. The construction materials used should be of high quality and appropriately selected to withstand environmental stressors such as heavy rainfall and strong winds.

2. Access to basic services: The market should have access to necessary services such as clean water, sanitation, and solid waste disposal systems. These services are critical to maintaining a healthy and hygienic environment, reducing the risk of contamination and the spread of disease.

3. Accessibility: The market should be easily accessible to both vendors and customers by ensuring proper road networks, public transportation options, and available parking. Improved accessibility means more customers, which can benefit the livelihoods of vendors and the overall economy of Addis Ababa.

### 2.2.3. Environmental Sustainability

**Environmental sustainability Approaches**

Efficient use of natural resources is crucial for sustainability. This includes water management, energy efficiency, and sustainable sourcing of materials (Meyer & Kauffman, 2020). "A circular economy approach in urban markets can significantly reduce waste generation and promote recycling, which is critical for achieving sustainability goals" (Geissdoerfer, Martin, et al., 2017). Protecting local ecosystems and promoting biodiversity within urban markets contribute to ecological resilience and sustainability (Barton & Lindhagen, 2015).

While the climate crisis has many factors that play a role in the exacerbation of the environment, there are some that warrant more attention than others. Here are some of the biggest environmental problems of our lifetime, from deforestation and biodiversity loss to food waste and fast fashion (Robinson, 2023).

Food waste and loss occurs at different stages in developing and developed countries; in developing countries, 40% of food waste occurs at the post-harvest and processing levels, while in developed countries, 40% of food waste occurs at the retail and consumer levels (Robinson, 2023).

At the retail level, a shocking amount of food is wasted because of aesthetic reasons; in fact, in the US, more than 50% of all produce thrown away in the US is done so because it is deemed to be "too ugly" to be sold to consumers- this amounts to about 60 million tons

of fruits and vegetables. This leads to food insecurity, another one of the biggest environmental problems on the list (Robinson, 2023).

Waste management: The UN predicts that by 2030, there will be more than 8.5 billion people on the planet, necessitating a significant reduction in the amount of waste that we produce through prevention, reduction, reuse, and recycling as part of the circular economy, with the goal of minimizing the impact on human health and the environment.

Large amounts of vegetable waste are generated near the vegetable market and farms, thereby polluting the environment. Disposal and environmental friendly management of these wastes are becoming a serious global problem. For better recycling and reusing of vegetable market waste, vermicomposting will be carried out using different fruit and vegetables waste (Raja, 2019).

Population, natural resource, terrain and accessibility are major parameters determining standard. Planning and locating new cemetery considers two major issues- the number of followers of the respective religion and accessibility. Environmental susceptibility, wind direction and related with this, optimum distance are parameters to locate liquid and solid waste treatment and damping sites respectively (Lia, 2017).

### 2.2.4. Issues of environmental sustainability

Environmental sustainability is concerned with issues such as: Long-term health of ecosystems. Safeguarding the long-term viability and health of resources to satisfy future societal and economic needs, such as safeguarding food supplies, agriculture, and fisheries. Renewable resources: Diversifying into energy sources that do not rely on non-renewable resources. For example, solar and wind power. Targeting social welfare/happiness and environmental sustainability above crude measures of progress such as GDP. Measures of economic welfare (Pettinger, 2018).

### 2.2.5. Solid waste management

Solid waste management refers to the systematic process of collecting, treating, and disposing of solid waste generated from various sources. This process aims to reduce the environmental impact of waste, promote resource conservation and efficiency, and ensure

public health and safety. Solid waste management activities include waste collection, sorting, recycling, composting, incineration, landfilling, and waste-to-energy conversion.

The key components of solid waste management include: Waste generation: This refers to the process of producing waste from various sources such as households, commercial establishments, industries, and agriculture; Waste collection: This involves gathering and transporting waste from its source or collection points to treatment, recycling, or disposal facilities; Waste segregation: This is the process of separating different types of waste based on their characteristics, such as organic waste, recyclables, hazardous waste, and non-hazardous waste.

Waste recycling: This involves converting discarded materials into new products to reduce consumption of raw materials, save energy, and reduce the amount of waste that goes to landfills. Composting: This is the natural process of decomposing organic waste into nutrient-rich compost, which can be used as a soil amendment in agriculture or landscaping. Incineration: This involves burning waste at high temperatures to reduce its volume and produce heat or electricity. This method is typically used for non-recyclable waste and hazardous waste. Landfilling: This involves the disposal of waste in designated areas, where it is compacted and covered with soil to prevent environmental contamination and minimize odors.

Waste-to-energy conversion: This process involves converting waste into fuel, electricity, or heat through various technologies such as incineration, anaerobic digestion, and gasification. Public education and awareness: This includes programs and campaigns aimed at promoting waste minimization, source reduction, recycling, and proper waste disposal practices among the public. Regulations and policies: Governments enforce laws, regulations, and policies to ensure proper waste management practices are followed by all stakeholders, from waste generators to waste management service providers.

Effective solid waste management requires a combination of these components, with a focus on waste reduction, reusing, recycling, and disposal in an environmentally sound manner. It is essential to involve all stakeholders, including government, businesses, communities, and individuals, in the process to achieve a sustainable and efficient waste management system.

Municipal solid waste in Addis Ababa amounts to around 750.000 tons/year (2020), the average household waste per capita is 0.45 kg/day. The collected waste is dumped at landfills. Open dumping and burning are, despite being illegal, also common practices in both urban and rural communities. Most landfills in Ethiopia are open dump grounds without specific management systems. In Addis Ababa, 85 percent of the city's collected garbage is disposed of at the Koshe landfill and the rest at the neighboring waste-to-energy facility, Reppie.

Waste management in Ethiopia is decentralized at the local level, but due to budgetary and infrastructure constraints, local authorities struggle to contain the increasing waste. In the past years, waste generation has increased from 9.700 tons/day in 2015 to 12.200 tons/day in 2020. It is estimated that the daily amount of waste will double from 2015 to 2030. The collection rates in the cities vary and range from 40 to 60 percent.

### 2.2.6. Storm Water Management Facilities

Green infrastructure refers to a network of natural and semi-natural systems that manage storm water through processes such as infiltration, evapotranspiration, and storage. It emphasizes the use of vegetation, soils, and natural processes to improve water quality and reduce flooding Benedict, (McMahon, E. T., 2006). Watershed Management approach involves managing the entire watershed as a single unit to control storm water runoff and protect water quality. It considers the interactions between land use, hydrology, and water resources (Pahl-Wostl & Hare, 2004)

Integrated Water Resource Management (IWRM) is a holistic approach that integrates the management of water, land, and related resources to maximize economic and social welfare without compromising the sustainability of vital ecosystems (Partnership, 2000). Ecosystem-Based Management approach focuses on maintaining the health of ecosystems while managing human activities that impact storm water runoff. It emphasizes the interconnectivity of ecological systems and human activities (Armitage & Johnson, 2006).

### 2.2.7. Vegetable waste recycle

Vermi-compost generated from vegetable and fruits waste can be utilized as bio-fertilizer. Farmers growing a particular fruit or vegetable can produce vermi-compost at their farm

itself and can utilized or sell to others also. Also, land pollution can be minimized as the waste is utilized at the farm itself (Patel, et al., 2015). The method used to collect the data in vermin composition is collecting of Vegetable market waste and cow dung, collection of earthworms and Vermicomposting-Experimental setup use. Recycling organic waste by composting two composting plants are known in Addis Ababa. Due to a lack of financial incentives, private sector initiatives have so far been limited (Yang et al., 2018).

Like other cities of the developing world, Addis Ababa is facing shortage of equipment to transport its waste. Waste collecting trucks are not available to the level demanded and even some of the available trucks do not perform at daily bases due to their old age, accidents and maintenance issues (Mohammed & Elias, 2017).

However, the hospitality industry is likely to be interested in these services if businesses collect their organic waste to supply a composting facility. Initiatives that implement waste selection procedures at source and pay collection fees could be interesting business opportunities. Processed organic waste can find a market as fertilizer and animal feed.

A significant amount of waste is produced by the fruit and vegetable industry. Because of planned overproduction and a failure to meet retailer quality standards, the majority of fruit and vegetable waste (FVW) in developed nations is produced prior to reaching consumers. (Plazzotta et al., 2017). There has been a critical need to optimize vegetable waste treatment systems because the vegetable industry is thought to be heavily polluting. (Arvanitoyannis & Varzakas, 2008).

Very little has been done at the waste-generating sources to reduce the volumes of waste disposal through the processing of domestic waste into compost as there have been no well-organized and formal type composting centers (Mohammed & Elias, 2017).

## 2.3. CHARACTERISTICS OF RESILIENCE

Resilience related to hygiene: COVID-19 pandemic is relevant to better prepare for future crises that will affect agricultural production and food systems and ensure the resilience of vegetable production and its market supply. Vegetables are broadly acknowledged as an essential part of healthy diets and a key food item to address malnutrition (including micronutrient deficiencies and overweight/obesity) as well as a source of income to rural

and urban dwellers. In the context of COVID-19, vegetable consumption is more than ever advocated for proper nutrition and good health to strengthen human immunity to the coronavirus (Yegbemey, et al., 2021).

The key element driving the need for market upgrades is frequently congestion. When there is just one operational entry and exit and the market authority utilizes the gate to control admission in order to maximize profits, problems frequently arise. One of the secrets of markets' success is the efficient utilization of available space. The primary design choice has to do with figuring out the market's "core" space, or the region where transactions take place.

The efficiency of a market will be greatly impacted by market congestion and the sorts of vehicles used to distribute and collect produce. Due to the bigger amounts handled per trader and more effective management of sales space and traffic, wholesale markets typically have substantially higher turnovers in comparison to their sales area.

Resilience was described by the group as a proactive approach, emphasizing being prepared to address possible shocks, crises, or stressors. Important aspects of resilience were named, such as robustness, adaptability, and transformability. Initially, it was acknowledged that all three concepts fit together and were related. These are overlapping parts of the resilience concept and it was emphasized that resilience should incorporate them. However, the question arose in how far each—adaptation, recovery, and sustainability—are interrelated with resilience and the significance of each of them in this context (Sharifi, et al., 2017).

The interplay between infrastructures' "physical form" and their management methods have also been used to frame the relationships between access, resilience, and the built environment. In relation to urban metabolism and influenced by the (economic) management model of the city, centralization or decentralization of urban infrastructures is a critical factor limiting or facilitating community resilience.

Infrastructures could be managed by water and energy companies in a centralized or decentralized manner. Similar to how garbage, food, and communications can be managed, these resources can also be controlled by relying on a dominant provider, restricting the

amount of service offered and who has access to it, or by using co-shared and co-managed infrastructures at the home or community level.

Investment in the city was dramatically strengthened during the brief occupation of the country by Italy even though its objective was not public interest. One of the areas which were the center of such investment was the central market place. Addis Ababa's central market (then locally known as Arada) was a large open space devoid of any investment.

It had no shopping structures, infrastructure, or paved roads apart from stone and earth mounds (locally called medeb) from which thousands of small retailers selling many kinds of goods operated. Following construction of the railway line mentioned earlier, it had begun to be provided with public and private investment in roads and low investment shopping structures (Terefe, july 2021).

The resilience characteristics in urban planning for Lafto vegetable market mainly focus on increasing sustainability and improving infrastructure in the area.

### 2.3.1. Redundancy

Redundant systems and infrastructure ensure that essential services continue to function even when specific components fail. This can include multiple transportation options, overlapping utility networks, and diverse energy sources (Godschalk, 2003).

### 2.3.2. Diversity

A diverse social, economic, and ecological system enhances a city's ability to adapt to changes and recover from disruptions. This includes promoting mixed-income neighborhoods, economic diversity, and preserving natural habitats (UN-Habitat, 2017).

Diversity in spatial structures is achieved by a well-structured yet fragmented network that appears to be intelligible on a local scale, unintelligent and scattered on a global scale. This provides opportunities for a diversity of ecologies, with a range of social, cultural, and economic behaviors and uses. The diversity in information is where we learn through correlations through our experience in the environment. As a result, the division of labor creates a diverse social and economic organism that evolves and reproduces over time (Cheshmehzangi & Li, 2020).

Integrated urban planning encourages collaboration among different sectors, disciplines, and stakeholders. It involves aligning policies, goals, and investments to foster sustainable and resilient development (Tyler & Moench, 2012).

### 2.3.3. Robustness

The concept of city or urban resilience has emerged as one of the key challenges for the next decades (Abbar et al., 2016). A robust initial decision may be identified by considering the stability of end-state solutions to possible changes of criteria or external conditions during the second period. There are many methodological approaches which could be used to take the need for adaptivity and robustness into account; some of the possible techniques are outlined below (Albegov et al., 1982).

As a consequence, institutions like the United Nations or Rockefeller Foundation have embraced initiatives that increase or improve it. These efforts translate into funded programs both for action on the ground and to develop quantification of resilience, under the form of an index. Ironically, on the academic side there is no clear consensus regarding how resilience should be quantified, or what it exactly refers to in the urban context. Here we attempt to link both extremes providing an example of how to exploit large, publicly available, worldwide urban datasets, to produce objective insight into one of the possible dimensions of urban resilience (Abbar et al., 2016).

### 2.3.4. Green Infrastructure

Green infrastructure, such as parks, wetlands, and green roofs, can enhance urban resilience by providing ecosystem services, like storm water management, climate regulation, and bio-diversity conservation (Ahern, 2011). The issue of green infrastructure is framed within the conceptual contexts of sustainability and resilience, which are described through the analysis of their common aspects and differences with a particular focus on planning elements (Voghera & Giudice, 2019).

The Green Infrastructure (GI) is the network of designed and natural vegetation found in our cities and towns, including public parks, recreation areas, residual vegetation, residential gardens, trees in the streets, community gardens, as well as new innovative and

emerging technologies for urban greening such as rain gardens, green roofs, and green walls (Briony, 2014).

## 2.4. CONCEPTUAL FRAMEWORK

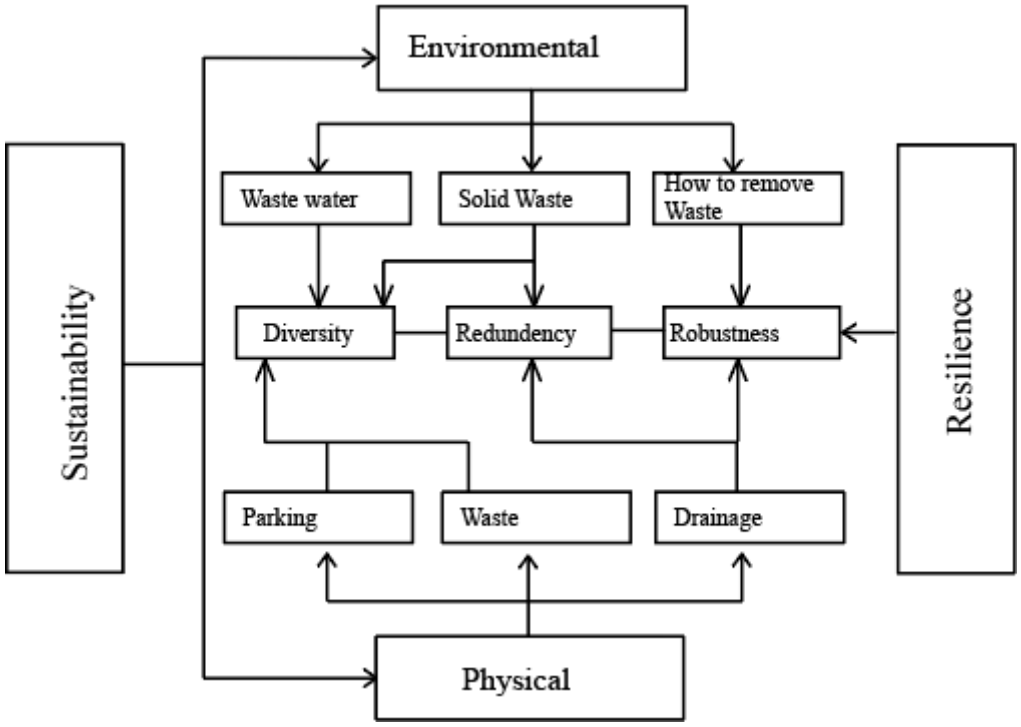


*Figure 2-1: Conceptual framework for physical and environmental sustainability and resilience*

*Source: prepared by the researcher*

## 2.5. SUMMARY OF LITERATURE

In this chapter deals on introduction definition and concepts of the word, theoretical review, conceptual review, characteristics and overview of physical and environmental sustainability and resilience.

Analyzing the physical and environmental sustainability and resilience of Lafto vegetable market framework.

*Table 2-1 General framework for physical and environmental sustainability and resilience*

| *No* | *Specific objective* | *Scope* | *Methods* | | | *Result* |
|---|---|---|---|---|---|---|
| | | | *Primary sources* | *Secondary source* | *Analysis* | |
| *1.* | *To explore the physical condition* | *Factors affecting physical susstainability* | *observation* | *Literature review* | *Physical map* | *Identifying issues* |
| *2.* | *Identify the challenges of environmental sustainability* | *Drainage and waste management* | *Key informant interviewers, questionairs, survey* | *Books, articles* | *Movement map, drainage line map* | *Parking circulation flow and the collected wastesarround the area* |
| *3.* | *Characteristics of resilience* | *Diversity , redendency and roubustness* | *survey* | *articles* | *What a resilience in vegetable market* | *Identifiying the connection of resilience and sustainability of vegetable market* |

*Source: prepared by the researcher*

## 2.6. RESEARCH GAP

There is two research gaps identified in this research. The main aim of this research is to fill the gap that is not done before. The first gap which was theoretical gap and many researches are done on resilience on urban and not specific for vegetable market. Basic characteristics such as robustness, redundancy and diversity are the major concentrated area for this research. Regarding to this there is also a gap on methodology starting from selection of the study area to the methods used to find data on the specific site of urban market most of the studies present related to farm land or production of vegetables.

The bustling Lafto vegetable market in Addis Ababa, Ethiopia, serves as an indispensable hub of food supply for the local community. Despite its importance, its long-term sustainability remains questionable due to factors such as rapid urbanization, poor waste management, inadequate infrastructure, and a changing climate.

The lack of a comprehensive understanding of these issues and their implications for the market's physical and environmental sustainability and resilience is a significant problem. Without this knowledge, devising effective policies and practices to enhance the market's capability to withstand and recover from various shocks, such as climate-related disasters and economic crises, becomes incredibly challenging. Therefore, this research aims to fill this knowledge gap through an in-depth analysis of the current state and potential threats to the Lafto vegetable market's sustainability and resilience.

The main research gap could be the current lack of comprehensive data and understanding about various environmental impacts and the physical resilience of the Lafto vegetable market.

There is a need for comprehensive research on existing sustainability practices within the Lafto market. This includes examining how vendors source their products, manage waste, and utilize resources sustainably, and how these practices compare to international benchmarks. While environmental assessments may exist for urban markets in general, specific studies focusing on the environmental impacts of the Lafto market such as waste management, water usage, and carbon footprint are limited.

# CHAPTER 3 RESEARCH METHODOLOGY

This chapter contains information on the study area, 'Lafto Vegetable Market' with the sites geographical location and establishments to give overall clue. Additionally a description of the research methods and materials used for this research. Which covers what type of research is it, where the source of the data is, how to sample the data with its sampling techniques, sample population and sample size, what type of data collection method use, how the data will be analyzed and how to present the data will be identified in this chapter.

## 3.1. STUDY AREA DESCRIPTION

### 3.1.1. Location

The study area is Located in Ethiopia's capital city, Addis Ababa, Nifas Silk Lafto Sub-city Woreda 01. Lafto Vegetable Market is geographically located between is situated between the latitudes of 8° 55'33.59"N and 8° 55'36.88"N and 38° 44'12.55"E and 38° 44'4.48"E longitude with an elevation ranging from 2217 to 2232 m above sea Level. The study area covers about 3.5 hectares.

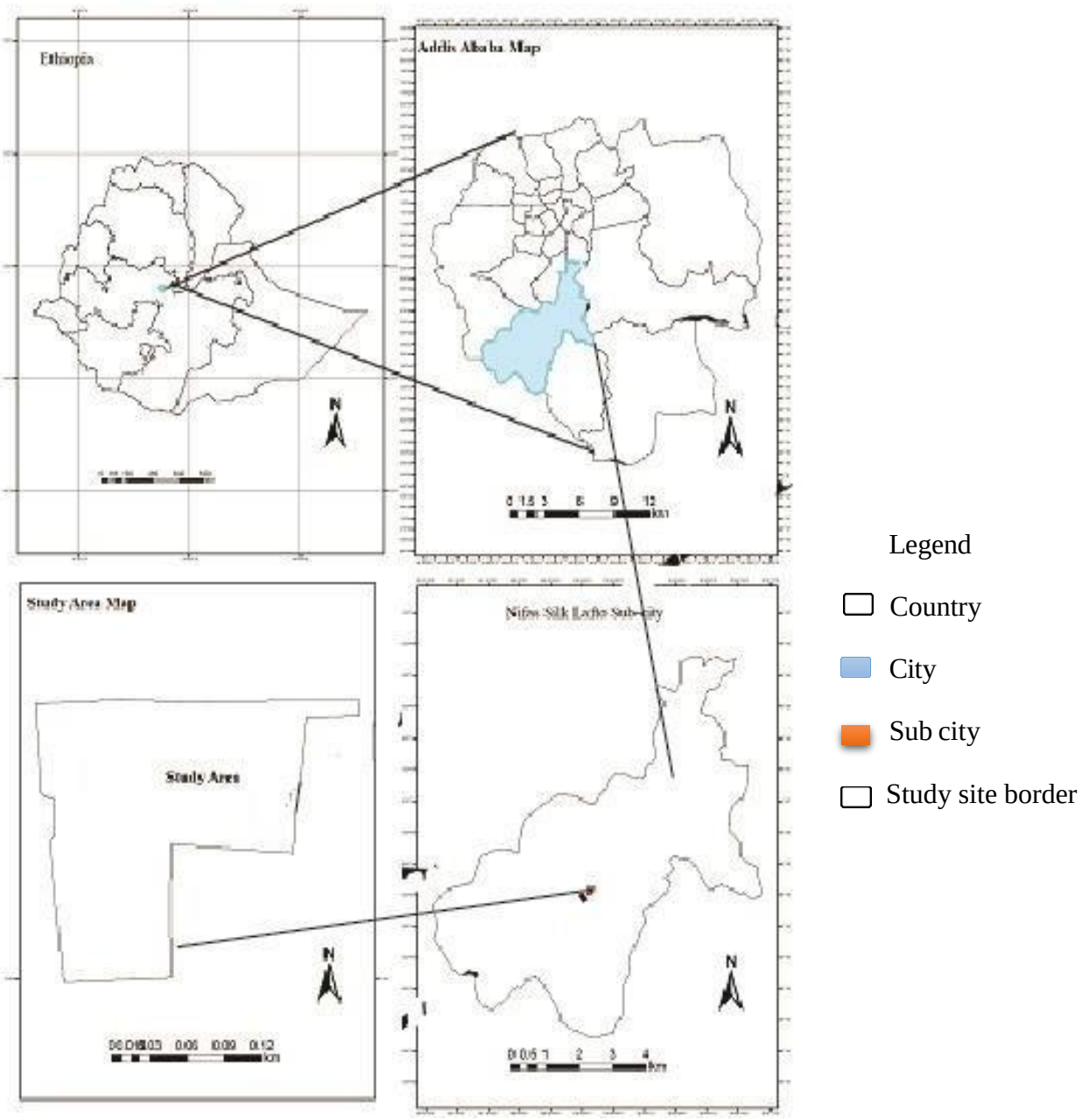


*Figure 3-1 Location Map of the study area*

*Source: extracted from Google map and computed by GIS software, 29-04-2024.*

### 3.1.2. Topography of the site

The study area has an attitude range from 2217 to 2232 m above sea level. Contour interval is 1 meter.

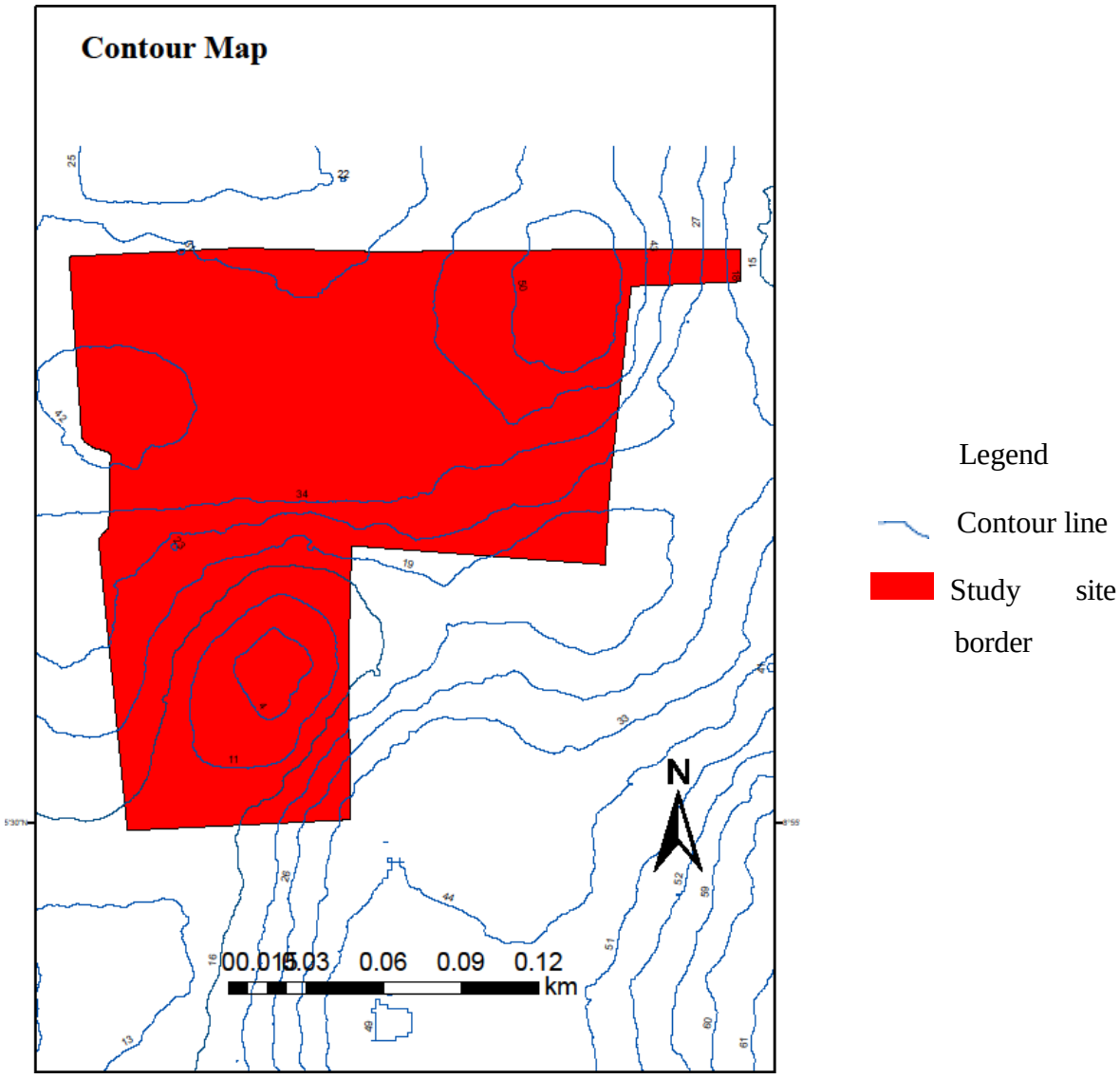


*Figure 3-2 Contour map of the study area*

*Source: Contour extracted from Nifas silk Lafto subcity road map 2007 and computed by GIS, 12- 04- 2024.*

### 3.1.3. Socio economic condition and history of the site

The Lafto vegetable market, which took place in 2020, is where the study area's history began. In previous decades, Atikilt Tera, a large open vegetable and fruit market that was first located in Piassa, temporarily relocated to the fields of Jan Meda, a sports area, in order to stop the spread of the Novel Coronavirus (COVID-19) pandemic. For more than five months, the market was located in Jan Meda. In the end, it was given a new location at the Lafto Vegetable & Fruit Market Centre in southwest Addis Ababa's Haile Garment area. The location surprised sellers and customers (Sileshi E., 2021).

As of right now, the Lafto vegetable market is the biggest in Addis Ababa, Ethiopia. Because it serves wholesalers, retailers, vendors, and a variety of consumers, vegetables are inexpensive and accessible to everyone.

### 3.1.4. Selection of case study area

Hence, it makes sense to take into account two or more vegetable market areas for the purposes of this study. The "Vegetable Market" in Nifas Silk Lafto sub-city Woreda 1 and another location close to Kotebe 02 in Yeka sub-city Woreda-11 and Jemo Atikilt Tera, One site is selected, from Kotebe 02 Atikilt tera and from Jemo Atikilt tera. Lafto vegetable market is selected after detailed observation of three potential sites, based on the following criteria.

1. The existence of different vegetables than others,
2. Activeness and near to the entrance for the southern parts of Ethiopia which are the main source of vegetable markets,
3. Area of the space provided for the market is wide relative to others,
4. Price of existing vegetables are cheap and it is considered are whole sale market area,
5. Number of users more frequently areas,
6. Based on the new establishment of market.

Therefore, ‘Lafto Vegetable Market’ with its large number of users and used now as a large vegetable market area for the city the site is selected and has the potential for the practical implementation of proposals of this paper.

While this is one of Addis Ababa's vegetable markets, the region has a variety of user kinds, thus several sample techniques are also applied. For this study had used a mixture of probability sampling technique (systematic random sampling and simple random sampling) and non-probability sampling technique (quota sampling and purposive selection of areas) are utilized. Nevertheless, the findings of the study would be quite enough to give insights about the physical and environmental challenges and issues of Vegetable market in Ethiopia.

#### 3.1.5. Source maps

Maps were created using the Nifas Silk Lafto sub city's road map to help analysis on physical and environmental issues. Moreover it also indicates garbage collection, circulation, and extract movement analysis were then produced. Additionally, Google Earth satellite photos are utilized to obtain photographic images and to create maps using road maps.

## 3.2. RESEARCH METHODS

### 3.2.1. Research Design

The **descriptive method** is employed to depict the current state of affairs. As a result, the "Lafto Vegetable Market Center "suitability and accessibility are described using this methodology. It is also characterizes environmental problems and physical aspects that would verify the site's sustainability and resilience. This approach was typically used to characterize the overall state of the waste management system, circulation, and facilities.

According to Mekasha (2017), descriptive statistics play a critical role in distilling the data into a form that is manageable. It entails obtaining information about events, organizing, tabulating, illustrating, and summarizing the information gathered. This research design was chosen because it frequently provides the reader with visual aids to help them understand the distribution of the data, such as graphs and charts. The impact of independent variables (waste management, parking, roads, and infrastructure) on dependent variables (vegetable market users) is also explained by explanatory research design.

Another name for **exploratory research** studies is formative research studies. Formulating a problem for more in-depth research or developing working hypotheses from an operational perspective is the primary goal of these studies. (Kothari, 2004). **Exploratory method: -** this method is particularly employed to explore the existing conditions of environmental and physical condition relationship among users of the site based on the base maps, satellite images and check lists. Therefore, the research has used descriptive, and exploratory research methods to several research contributions.

### 3.2.2. Data type and collection technique

#### a. Type of data

**Primary data** were collected through detail field observation which involves, counting, mapping, tracking, test walking and keeping a diary and also photographing, schedules and informal interviews. The respondents will be the Leaders and employers of Sub city and the users of the site which is Atakilttera (Lafto vegetable market).

Individual users of the site was interviewed by using a structured questionnaires (see Appendix III). The questionnaires were separated in 5 groups such as buyers, retailors, street vendors, cleaners and securities depend on the challenges they faced at the time of existence. The questionnaires also contain different topics about socio economic characteristics of the respondents. Overall challenges and problems faced regarding environmental issues and physical issues identified or observed by users.

In order to collect data for the Kobo Tool Box data collection instrument, the interview schedule was first designed in English and then translated into Amharic. Before the 30 respondents were interviewed in-person, a pilot test was conducted. Following that,

questions were improved and modified to make them easier to grasp. The average interviewer took 23 minutes to complete.

Key informants including Addis Ababa Trade and Industry Office (AATIB), Environmental Protection Agency (EPA) and related to waste management and traffic management offices.

**Secondary data** were also collected use for my research to refer and collect different publications such as manuals, handbooks, standards and guidelines, books, journals and articles etc. from different governmental institutions published and unpublished reports were collected, from Addis Ababa Trade and Industry Office full information about Market, different academic articles, the computer data base / internet were also used all with proper citation.

Therefore, scholars can obtain crucial information about legal frameworks, court cases, and public opinion from government publications, policy papers, and newspapers (Bhowmik, 2005). Here, we obtain data from government agencies by looking up Google PDF policies and procedures.

The data sources for this study comprised both primarily and secondary sources of information. Primarily data will be collected by using various data collection instruments or tools. Secondary source of the data answered for both the first and the second research questions. The data gets from the secondary resource is historical information about the vegetable market, data of retailors, cleaners, and number of shops and it gives information about the statistics.

**b. Data collection Instrument's**

**Ethnographic Observation and Field notes: trucking, counting and mapping**

As described by Cross, J. C. (1998): Researchers may immerse themselves in the community to understand street vendors' daily lives, survival strategies and interpersonal relationships. One way to do this is through participant observation, in which the researcher closely documents the experiences of street vendors by spending a lot of time with them.

**Surveys and questionnaires**

It can be provided to street vendors and other stakeholders so that variables like socioeconomic background, incomes, working conditions, and any obstacles faced can be scientifically evaluated. It is feasible to perform statistical analysis on the collected data in order to find general trends and conclusions (Chen, 2012).

Survey employed to check the parking situation, the circulation effect on traffic congestion, the condition of waste management and related issues on the study area.

This was especially prepared with the users of the website in mind. This will provide information about physical obstacles and factors, such as environmental problems that need to be addressed in order to support the resilience and sustainability of the vegetable markets. Additionally, it was prepared for the users of Lafto Vegetable market area such as retailors, buyers, street vendors, loading and unloading, cleaners and securities.

**In-depth Interviews:**

In-depth, semi-structured interviews may be conducted with street vendors and key informants such as local business owners, lawmakers, and law enforcement personnel. Through interviews, researchers can gather in depth knowledge about these people's perspectives, motivations and experiences (Bromley, 2000).

Key Informant Interviews is conducted in order to obtain the above-mentioned data from a small number of knowledgeable and well-connected experts, as well as to ascertain the experts' perspectives and beliefs regarding waste management, drainage, storm water and circulation. Additionally, the KII designed to gather information from experts with a range of backgrounds and viewpoints, as well as to ask probing questions and discuss delicate subjects (such as major solid waste management, waste collection sites, and stakeholder collaboration). It will also gather detailed information about how to create a welcoming environment where experts can engage in candid, open, and in-depth discussions (Adugna, 2023).

## 3.3. METHODS AND SOURCE MAPS

### 3.3.1. Sampling methods

For this study, population of comprised vegetable sellers. The target population found in

Lafto sub-city trade and industry office by survey counting the number of shops and there are a number of employers including in the shops such as three up to eight employers are presented.

These are casher, loading and unloading, seller, cleaner and controller. So if the number of population in side one shop will be average of 4 workers so total population related to the shop will be 548 times 4. The total population is 2192.

Then systematic and stratified sampling was used from 548 shops the selected needed for the sample was randomly selected from 1 to 7. And selected 5 start with the fifth person in every block. Then from total of 548 shops that building sign from A to N, 55 retailors which is 10% of each retailors have been taken as a representative of the retailer's population.

*Table 3-1. Systematic and stratified sampling randomly selected in nth number from every block*

| | A, F & K | B, G & L | C & H | D & I | E & J | M | N | Total |
|---|---|---|---|---|---|---|---|---|
| 1-10 | 2th | 10th | 8th | 6th | 4th | 8th | 7th | 14 shops |
| 11-20 | 12th | 20th | 18th | 16th | 14th | 18th | 17th | 14 shops |
| 21-30 | 22th | 30th | 28th | 26th | 24th | | | 12 shops |
| 31-40 | 32th | 40th | 38th | 36th | 34th | | | 12 shops |
| 41-42 | 42th | | | | | | | 1 shops |
| selected | 5 shops | 4 shops | 4 shops | 4 shops | 4 shops | 2 shops | 2 shops | 55 shops |

*Source: Own computation, 2024*

*In the above table 3-1 the alphabet symbolizes the name of the blocks,*

Systematic and stratified random sampling method has been employed to choose the households from which the data is to be collected. Hence, representative sampling of 10% has been applied where every tenth households (Maru, 2012).

"Simple random sampling is also known as chance sampling or probability sampling where each and every item in the population has an equal chance of inclusion in the sample and each one of the possible samples, in case of finite universe, has the same probability of

being selected" (C. R. Kothari, 2004).

Sometimes, we understand the approximate use of probability sampling in non-probability by introducing specific modeling assumptions (Acharya et al., 2013). With probability samples, every member of the target population has an equal chance of being chosen for the study, making them the gold standard for sampling methodology and ensuring the generalizability of the study results. (Vehovar et al., 2016). From this sampling method we choose two of random sampling methods Systematic Random sampling and stratified random sampling.

The population type that shows a steady increase in variance within a group of elements as the group size increases is one that is commonly encountered in large samplings. The elements in this class of populations can be represented by a serially correlated model, where the correlation between two elements is a positive, monotone decreasing function of their distance from one another (Cochran, 1946).

For populations of this type, the relative efficiencies are compared for a systematic sample of every $k^{th}$ element, a stratified random sample with one element per stratum and a random sample. The stratified random sample is always at least as accurate on the average as the random sample and its relative efficiency is a monotone increasing function of the size of the sample (Cochran, 1946).

Non probability sampling has been considered at different quota. The vendors are categorized in four groups such as sellers of leafy vegetables, root, fruit and upward vegetable types so these categories will be presented around the entrance area so population size are counted on that area and the population number is the average of 340 vendors are presented at the time of survey and 5% also taken to sampling population and 17 were selected from different quotas.

A lot of population were include in this research, so we use 5 % from each group. Tschirhart, N., Sevcikova, H., & Young, L. (2016) have written this method: Capture-Recapture method: This method involves capturing a sample of street vendors, marking them, releasing them back into the population, and then capturing another sample. By comparing the marked and unmarked vendors in the second sample, the total population size can be estimated.

### 3.3.2. Data analysis

The descriptions and arrangement of the interviews with managers, directors, department heads, and team leaders will yield insightful information in addition to qualitative data. Data on many variables pertaining to physical and environmental issues and their impact on sustainability and resilience were also presented and interpreted using descriptive analysis. The statistical software for social science (SPSS) will be utilized to analyze the data.

### 3.3.3. Data presentation and interpretations

Moreover, map and physical analysis was performed using the Geographic Information System (GIS), Excel, AutoCAD and Revit, Illustrator, and Lumion software as analytical tools. Finally, the analyzed data is illustrated using maps, charts, percentages, images, and frequency tables.

# CHAPTER 4 RESULT AND DISCUSSION

In order to create adaptability and ease of access to the site, this section of the article will address the resilience characteristics and physical and environmental sustainability concerns in the Lafto vegetable market. Together with the recommendations from the community for transforming the study area into a more suitable working environment, the data acquired on the environmental and spatial aspects of sustainability will be appropriately presented and discussed. In addition, texts, tables, graphs, and maps have been used to illustrate and assess the conditions in the study area.

## 4.1. RESULT

### 4.1.1. Existing physical and structural conditions of the market facilities

The existing site map of 'Lafto vegetable Market' existing orientation of retail shops, circulation, road, and parking is the result of new vegetable market development. Located at the south west part of Addis Ababa, orientation of buildings along the Lafto vegetable market, on steep slope and limited accessibility of parking space and solid waste collection in every place and collection of waste water on the road and pedestrian pavements made the site unsustainable.

Assessment of the current situation of the study area is major part of this study. The existing study area is estimated to cover an area of about 3.5 hectares. During the assessment of the site, major circulation of pedestrians and vehicles, location of parking for different vehicles, congestion of road, existence of drainage, solid and liquid waste management system etc. have got consideration.

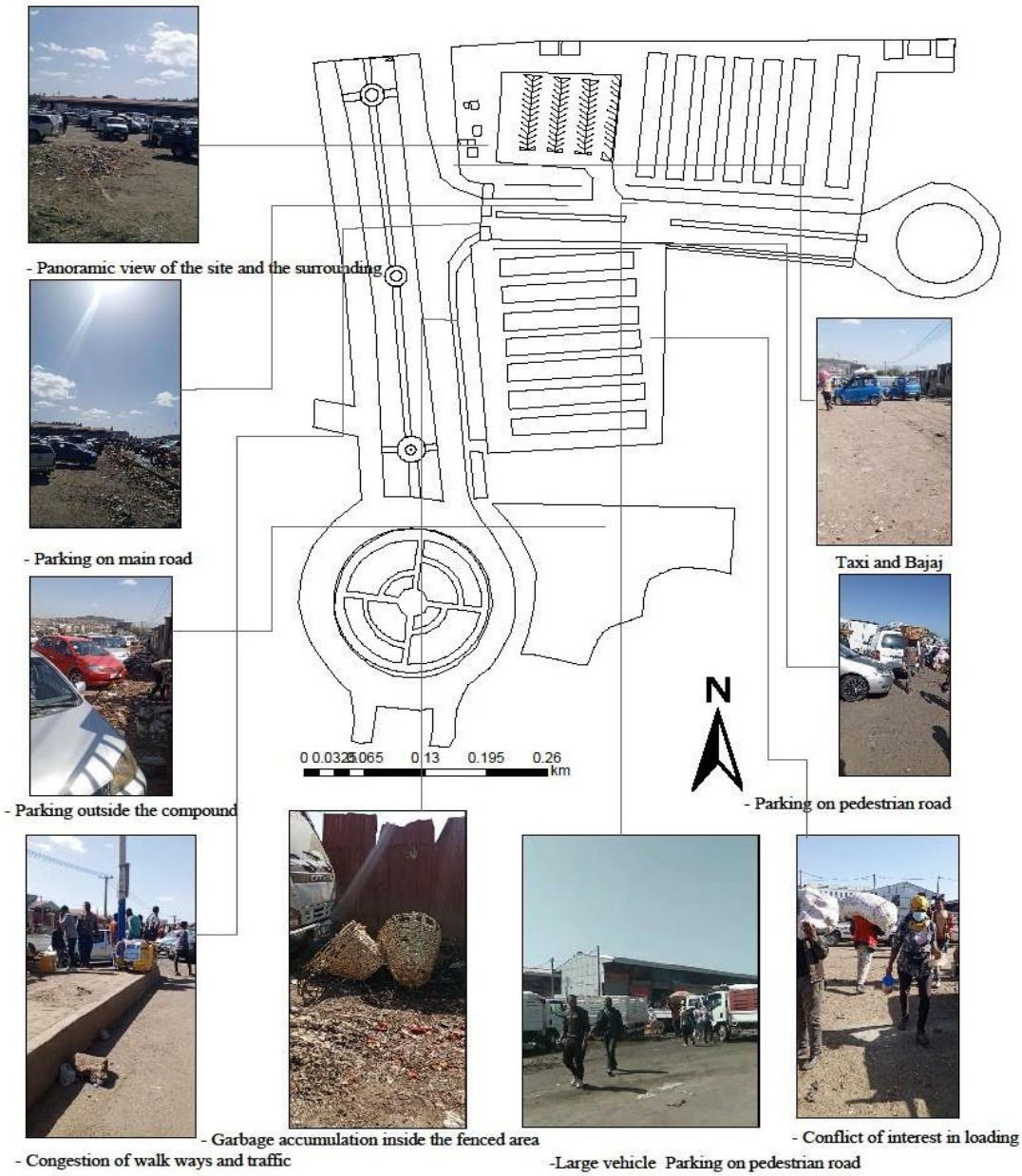


*Figure 4-1 Physical conditions of the Lafto Vegetable Market Center*

*Source: field photography and computed by the author, 2024.*

The figure 4.1 shows all the conditions of the market including parking areas, loading areas, and accumulation of waste.

### 4.1.2. Physical factors of the sustainability of the market place

#### 4.1.1.1. **Drainage system issues:**

The chart below regarding the issues with drainage systems in the market area shows that: 22.5% of participants reported that the drainage systems were clogged with solid wastes; 10% of respondents mentioned that there was no provision of drainage lines inside the roads; a significant majority of 67.5% highlighted the lack of drainage lines inside the roads as a major issue.

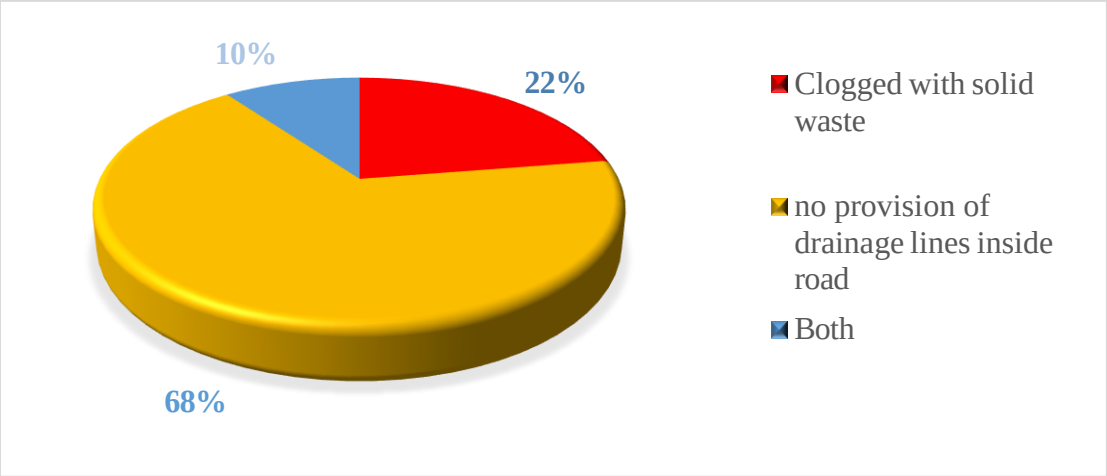


*Figure 4-2 respondents' perceptions regarding the primary issues associated with drainage systems*

*Source: answer from questionnaire, 2024*

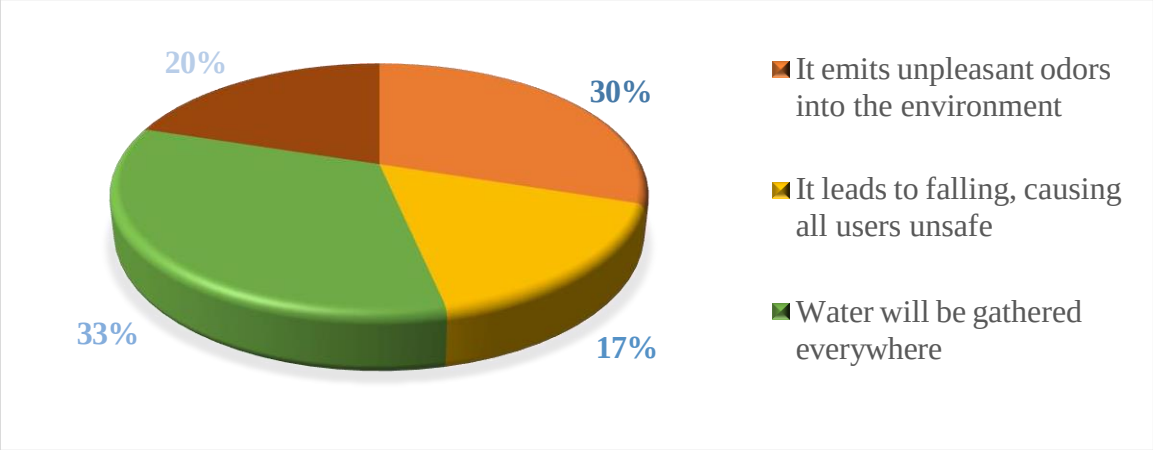


*Figure 4-3 Respondents experiences of challenges during rainy season*

*Source: answer from questionnaire, 2024*

The above Figure 4.30 indicates that the most common challenge experienced during rainy seasons, according to the responses, is water gathering everywhere, cited by 30.0% of respondents. This is followed by unpleasant odors emitted into the environment (26.7%), and the difficulty in removing wastes, which requires energy (16.7%). Falling due to slippery conditions is also noted as a challenge by 13.3% of respondents.

#### 4.1.1.2. **Existing road and circulation of the site**

According to the site observation and base map of Addis Ababa city the road network and circulation covers about 15% of the site's total area, accounts for 6 hectares of land. Hence, the road density of the site is within the acceptable range of urban planning practices. However, the road width, functional hierarchy and provision of accessibility is very poor with lack of proper drainage and maintenance.

The within the site has been impeded by the steep slopes and the narrow width of the roads in the site have impeded the circulation of vehicles and human beings within the site. Thus, some parts of the site are accessed by external long steps that are uncomfortable for elderly, women and children. Other roads are inaccessible for facility vehicles i.e. vacuum and waste trucks which contribute greatly aggravate the health problems of the study area.

*Figure 4-4 Circulation and road condition in the study area*

*Source: Field photography, 2023*

a. Major Infrastructure on the study area


*Figure 4-5infrastructure provided on Lafto Vegetable Market Center*

*Source: Computed by the author, 2024*

**b. Congested areas at different times of the day**

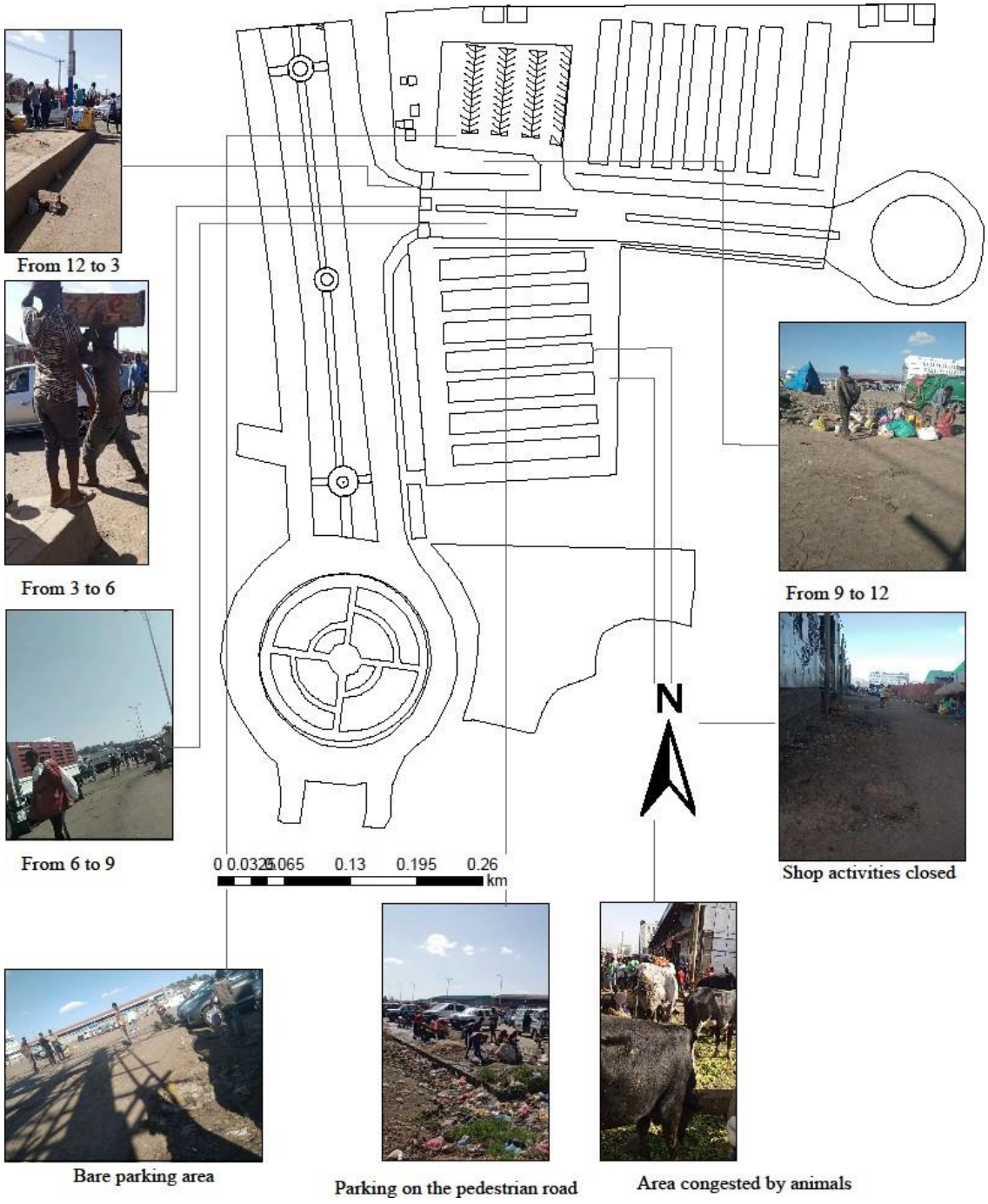


*Figure 4-6 congested areas at different times of the day*

*Source: Computed by the author, 2024*

The figure 4-7 below indicates peak time of the day, according to the street vendor responses, the main stream (76.7%) identified the time range from 12:01 pm to 3:00 pm as the peak time of day. A smaller percentage (16.7%) the time range from 3:01 pm to 6:00 pm as peak times. A very small percentage (6.7%) mentioned multiple time ranges, including the morning and afternoon periods, as peak times.

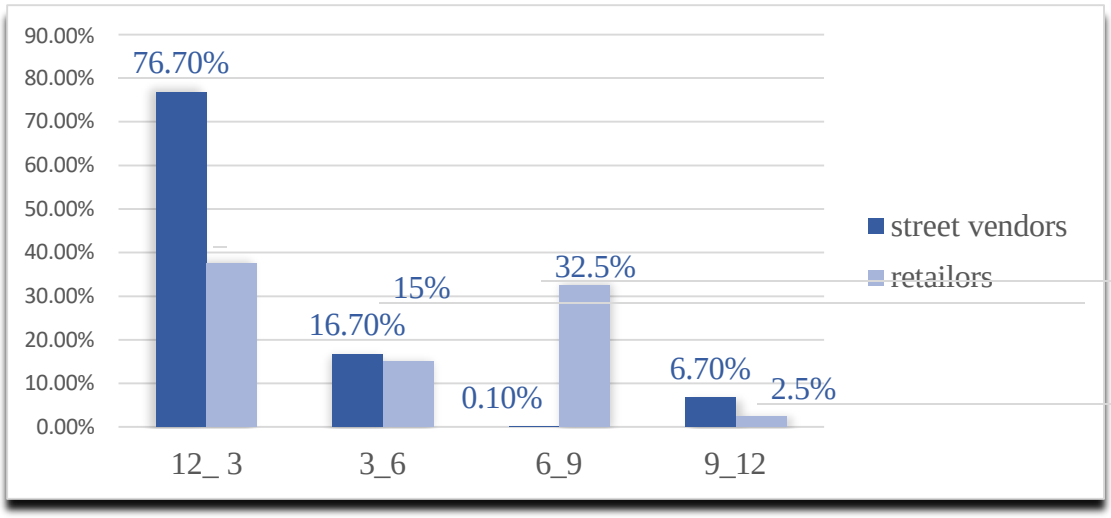


*Figure 4-7 Participants response on when Peak hour of the day in Lafto vegetable market area*

*Source: answer from questionnaire and computed by the author, 2024*

The above figure indicates that retailors response (37.5%) identified the time period from 12 to 3 o'clock as congested, with an additional 15% stating that congestion occurs from 12 to 6 o'clock. Furthermore, 32.5% of participants noted that the evening hours from 9 to 12 were peak hours for congestion, while only 2.5% reported congestion at times other than 6 to 9 o'clock.

The key informant interviewers noted several issues, including the dispersal of garbage, a lack of accountability and responsibility for the workspace, and government-provided restrooms with egotistical patrons. Summertime issues include the requirement for energy to remove waste and clears the air, the need for food, a distinct odor, pneumonia, and other related lung problems will also be present.

*Table 4-1 The key informant interviewers noted several issues*

| No. | Key Informants | Experts | | Total |
|---|---|---|---|---|
| | | Office | Site | |
| 1. | vegetable market leader | 2 | 1 | 3 |
| 2. | Addis Ababa Solid Waste Management Authority | 1 | | 1 |
| 3. | Addis Ababa City Environment Protection Office | 1 | | 1 |
| 4. | Nifas Silk Sub city Solid Waste Management Agency | 3 | | 3 |
| 5. | Traffic and Management Officials | 1 | 1 | 2 |
| 6. | Nifas Silk Lafto Environment Office | 1 | | 1 |
| 7. | Addis Ababa Trade and Industry Office | 3 | | 3 |
| Total | | 13 | 2 | 15 |

*Source: answer from questionnaire, 2024*

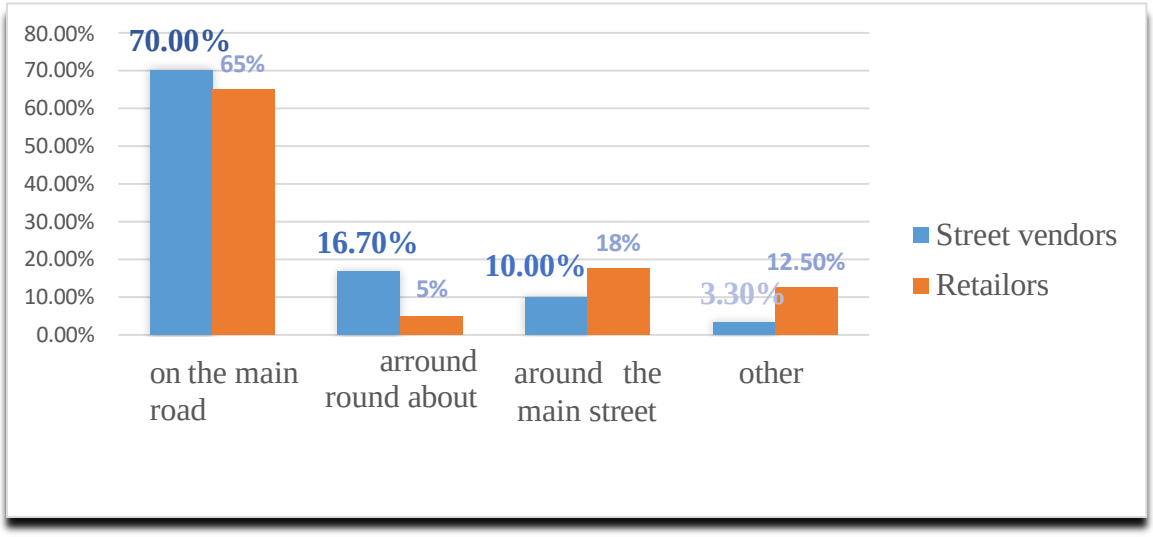


*Figure 4-8 Different participants response on, where is the congested area during Peak hour of the day in Lafto vegetable market*

*Source: answer from questionnaire, 2024*

Regarding the congested areas within the market compound, 65% and 75% of participants observed congestion throughout the entire compound. Additionally, 17.5% and 10% of participants identified the main street as the most congested area, while 5% and 16.7% reported congestion outside the compound. Finally, 12.5% and 3.3% of participants noted congestion on the main street, around the roundabout, and outside the compound.


*Figure 4-9congested areas at different spaces in Lafto Vegetable Market Center*

*Source: Computed by the author, 2024.*

### c. Loading and unloading situation

The figure below shows that according to the responses, 66.7% indicated that the procedure for loading and unloading retail stores is comfortable. However, a significant portion (33.3%) expressed that it is not comfortable. From this 33.3% of the respondents 3.3% identified the discomfort associated with stairs in the entrance of the shop.

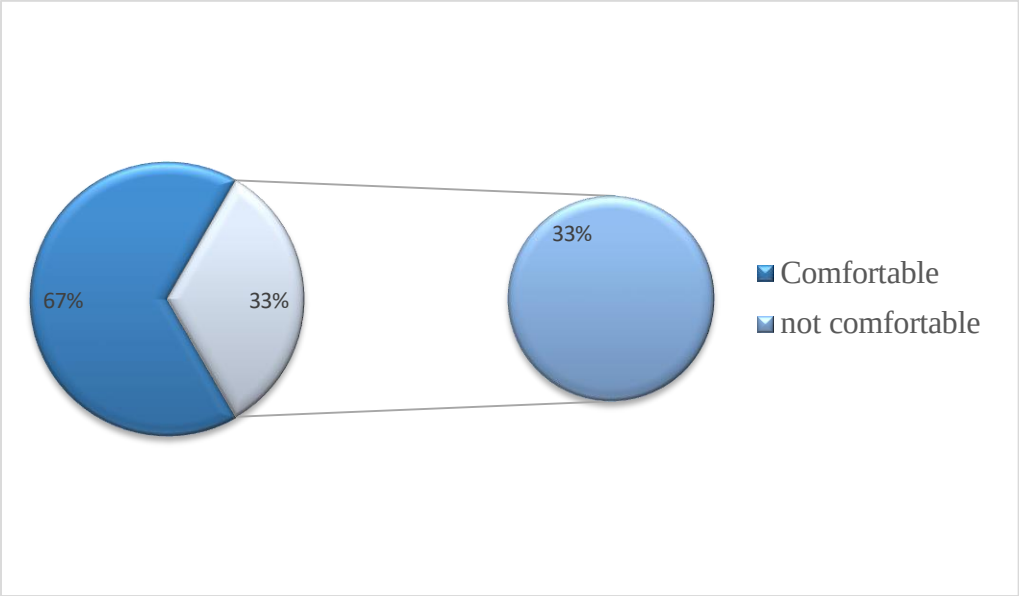


*Figure 4-10 Participants response loading unloading comfortable or not and suggest a problem*

*Source: Computed by the author, 2024.*

**Suggestions for improvements of loading and unloading areas**

Figure 4.11 indicates the majority of respondents (80.0%) did not provide specific suggestions for improvement if they found it is not simple to load and unload items while supplying marketing items for customers. However, a small percentage offered various suggestions, including addressing specific local issues, improving parking, and resolving licensing-related concerns.

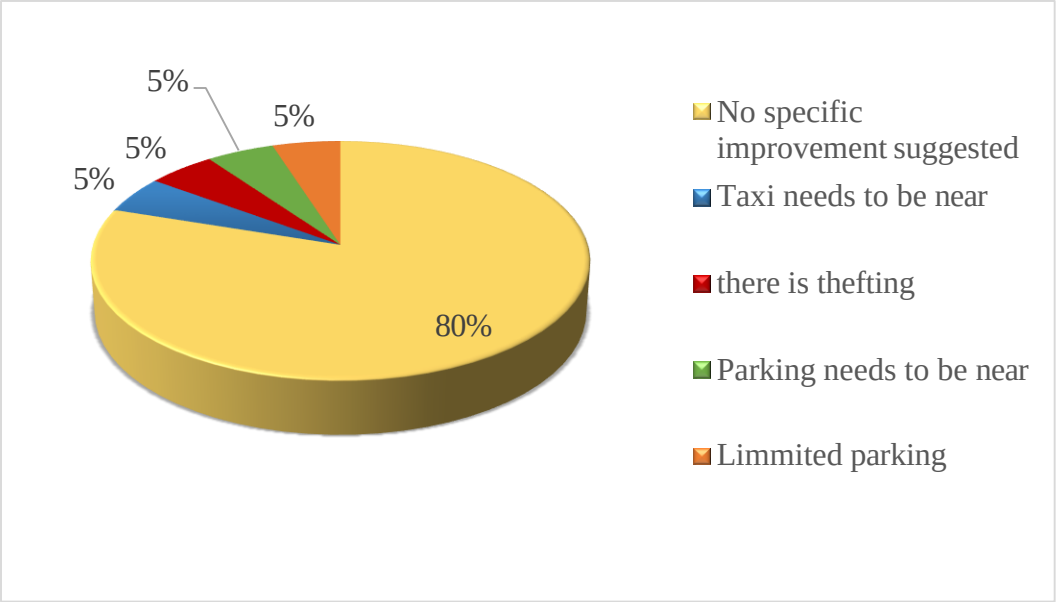


*Figure 4-11 Suggestions for improvements of loading and unloading areas*

*Source: Computed by the author, 2024.*

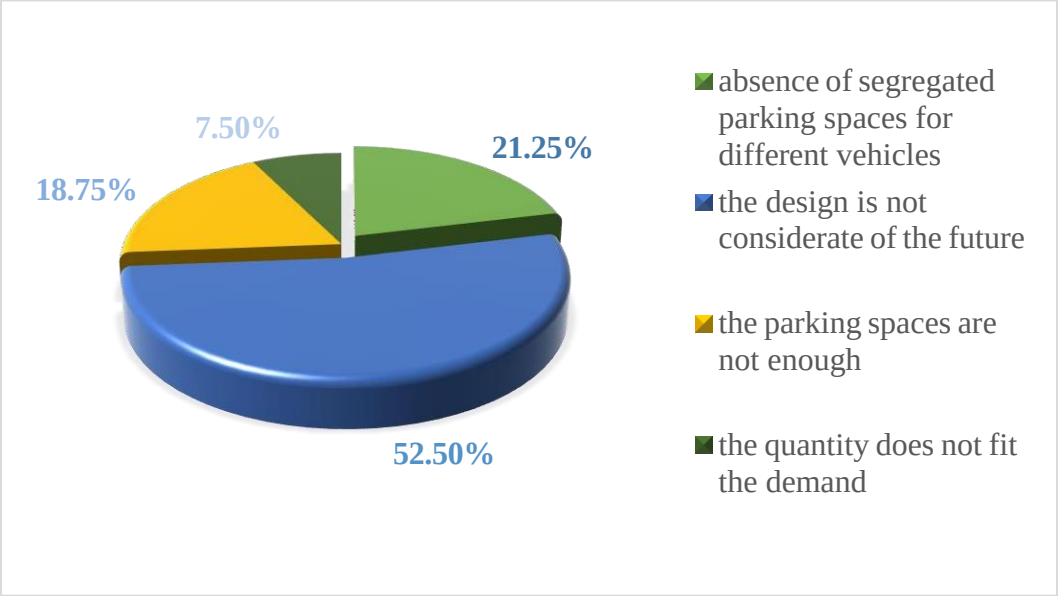


*Figure 4-12 Challenges associated with parking street vendors view*

*Source: Computed by the author, 2024.*

The above Figure 4.12 provided shows the percentage distribution of responses among the participants. (15.0%) mentioned that one of the challenges associated with parking is the "absence of segregated parking spaces for" specific groups or purposes.

(52.5%) indicated that a significant challenge is that "the design is not considerate of the future" in terms of parking facilities. (2.5%) highlighted that another challenge is that "the parking spaces are not enough." (10.0%) identified the challenge of "the parking spaces are not enough." (12.5%) mentioned both "the parking spaces are not enough" and "absence of segregated parking spaces for" as challenges. (7.5%) listed "the quantity does not fit the demand" as a challenge.

From the data, it can be observed that there are several challenges associated with parking as reported by the participants. The most prominent issues include the absence of segregated parking spaces, insufficient parking spaces, design considerations for future needs, and mismatch between parking quantity and demand.

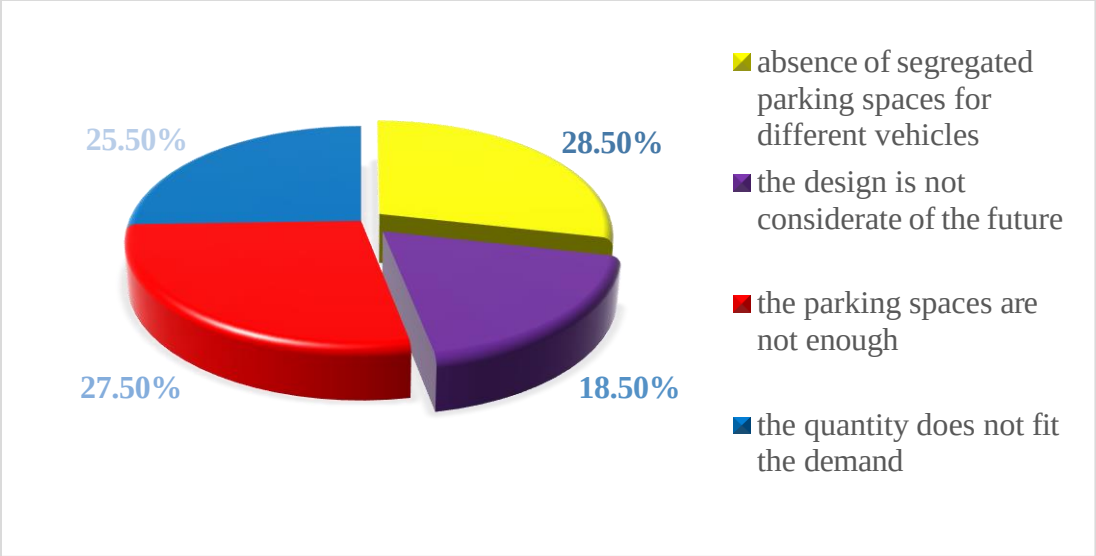


*Figure 4-13Challenges associated with parking in retailors view*

*Source: Computed by the author, 2024.*

According to the responses on figure 4-13, the most commonly cited challenge associated with parking is the absence of segregated parking spaces for loading/unloading and customers (visitors), mentioned by 28.5% of respondents. This is followed by insufficient parking spaces (27.5%), and challenges related to parking quantity not meeting demand (25.5%). Issues with the design not considering future demand for the service were also noted by 18.5% of respondents.

**d. Large truck parking accommodation**

This graph below fig 4.14 suggests that most street vender respondents (80%) believe that the parking accommodates large trucks, while a smaller percentage (20%) feel that it does not. This information can be useful for understanding the needs and preferences of individuals who may require parking for large trucks. According to the above graph retailor responses, 60.0% of respondents indicated that the parking area does not accommodate large trucks, while 40.0% reported that it does.

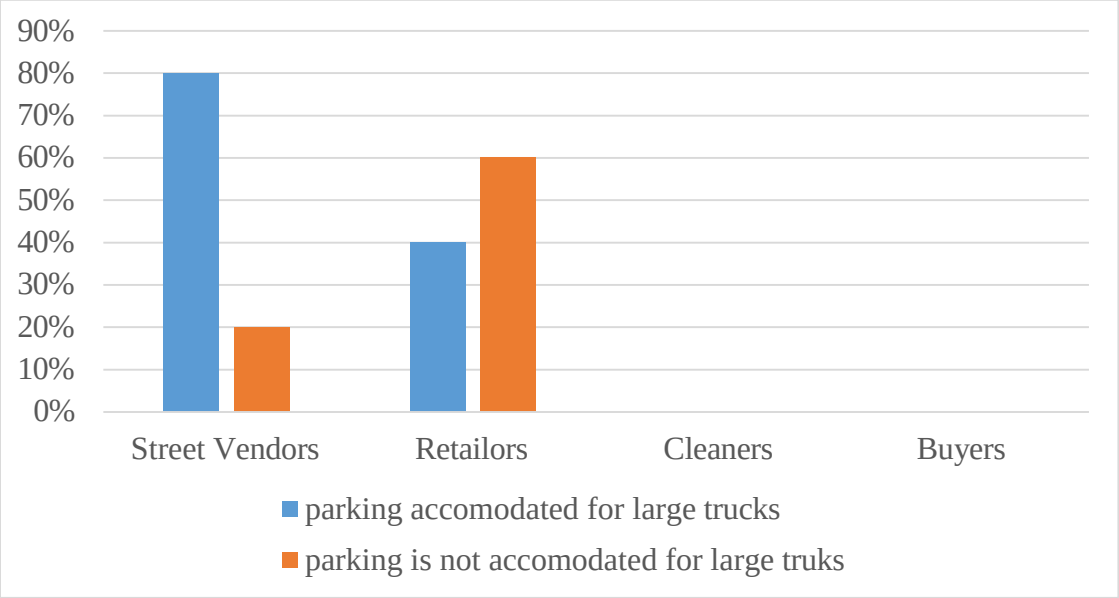


*Figure 4-14 Large truck accommodation from different group of participants perspective*

*Source: Computed by the author, 2024.*

Here there is different view of perspective from different respondents but in the observation of the site there is no accommodation of parking for large trucks the parking is used only for small vehicle types but large trucks enter in to the site and load and unload objects, thy park in different places on the pedestrian roads, on the main roads and bare lands.

**e. Accessibility of market**

Figure 4-15 below shows that a significant proportion of respondents either agree (26.7%) or strongly agree (6.7%) that the current transportation systems make the vegetable market region inaccessible, totaling 33.4%. Conversely, nearly one-third of respondents disagree (30.0%) with this statement, indicating that they perceive the region as accessible despite the current transportation systems. The remaining respondents express a neutral stance (26.7%) on the issue.

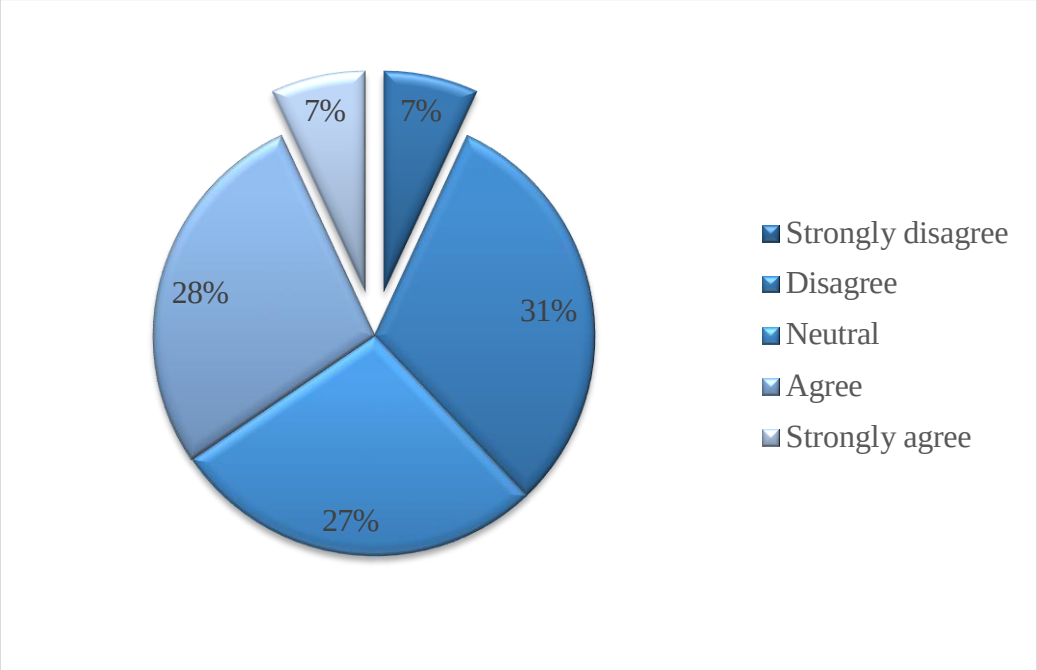


*Figure 4-15 Responses reflecting various opinions regarding with the accessibility of the vegetable market region with the current transportation system (linkert scale)*

*Source: Computed by the author, 2024.*

### 4.1.2. Different activities on the study area

Different activities and places where people choose to perform these activities are captured on different days and times and presented as photo essay bellow.


*Figure 4-16. Activities people perform around Lafto Vegetable Market Center*

*Source: Computed by the author, 2024.*

4.1.2.1. **Compatibility of the site physically**

The environmental compatibility issues related to solid waste, storm water and air pollution from collection of waste in all place. Additionally physical incompatibility with the circulation and no consideration of parking for different vehicles.

*Figure 4-17 waste put on the open space*

*Source: Field photography, 2023.*

**a. Factors affecting vegetable markets**

**Loading and unloading physical factors**

The below figure 4-18 chart shows majority of respondents (72.5%) identified poor space allocation for unloading and distribution as the main concern regarding loading and unloading areas. This indicates a significant consensus among the respondents regarding the need for better space allocation in these areas. The other issues mentioned, such as conflicts of interest and designated loading areas outside the compound, were less frequently cited but still provide valuable insights into potential challenges or conflicts related to loading and unloading processes.

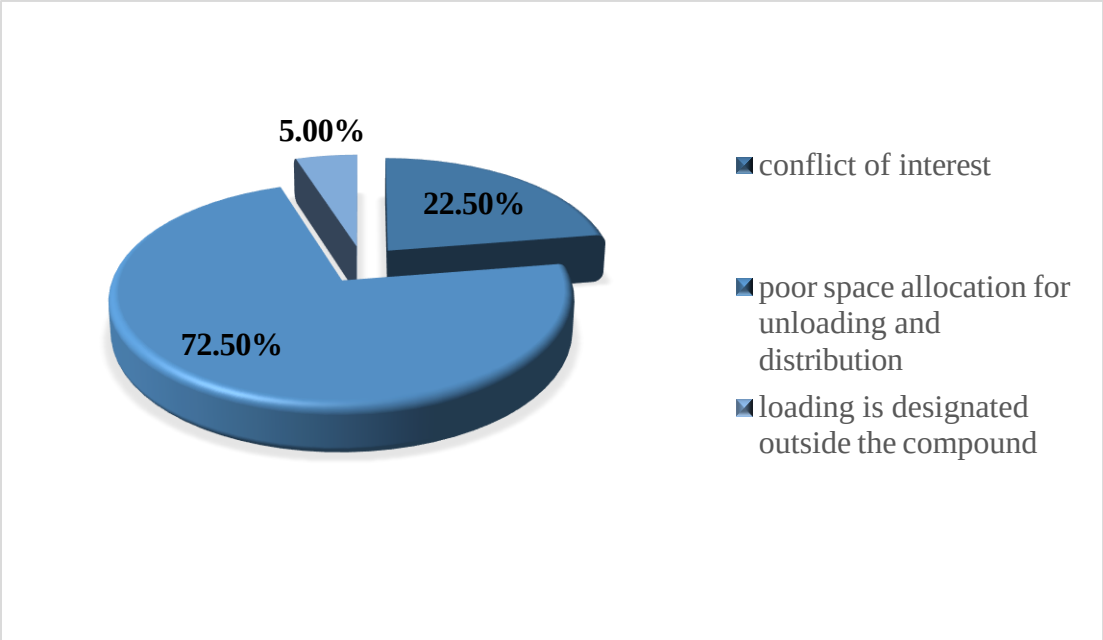


*Figure 4-18 Loading and Unloading challenges from respondents*

*Source: Computed by the author, 2024.*

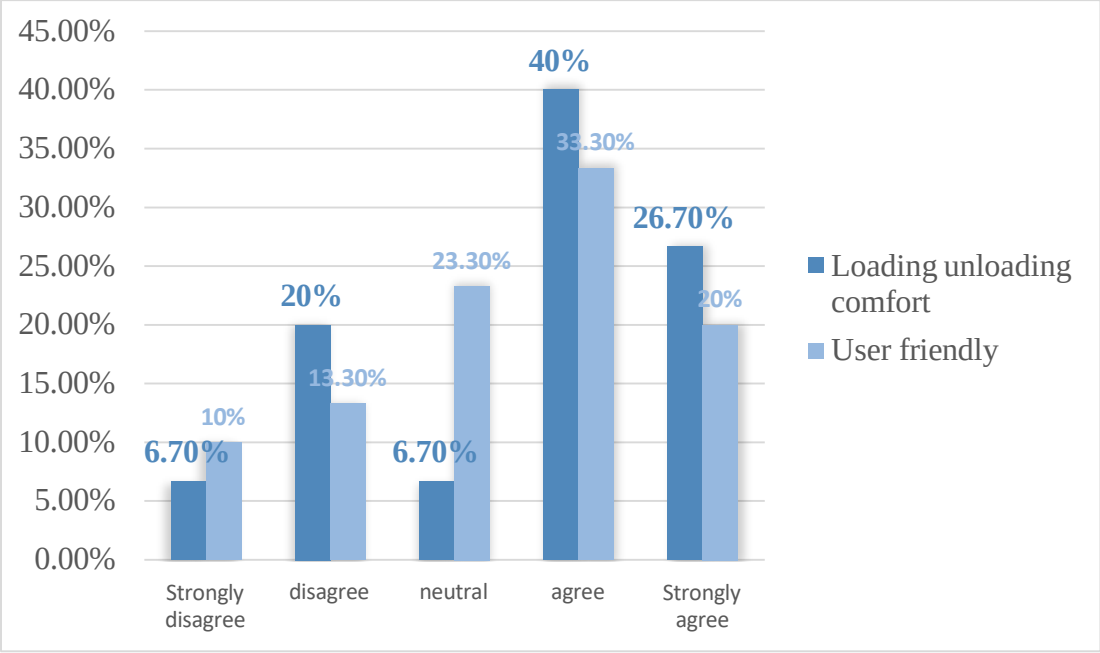


*Figure 4-19 Loading and Unloading is comfortable and the responses indicate varying opinions regarding the superiority of user-friendly locations for loading and unloading.*

*Source: Computed by the author, 2024.*

Figure 4.20 indicates that the majority of respondents either agree (40.0%) or strongly agree (26.7%) that the shop orientation provides comfort during loading and unloading, comprising a total of 66.7%. However, a considerable portion disagrees (20.0%) with this statement, while a smaller percentage strongly disagrees (6.7%).

The above graph indicate a significant proportion of respondents either agree (33.3%) or strongly agree (20.0%) that user-friendly locations for loading and unloading are superior, totaling 53.3%. Conversely, a smaller percentage of respondents either disagree (13.3%) or strongly disagree (10.0%) with this statement, indicating that they do not perceive user-friendly locations as superior. A notable proportion of respondents express a neutral stance (23.3%) on the issue, suggesting a lack of strong opinion or uncertainty.

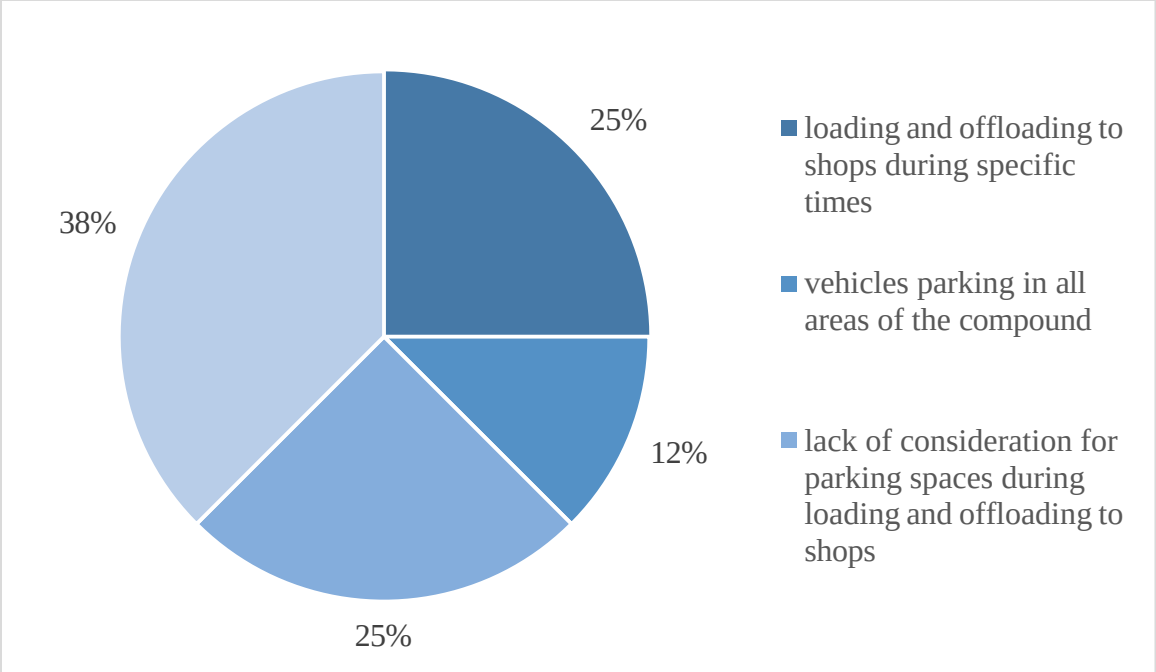


*Figure 4-20multiple challenges present in Atakilt Tera related to parking, loading, and offloading activities*

*Source: Computed by the author, 2024.*

The data suggests that there are multiple challenges present in Atakilt Tera related to parking, loading, and offloading activities. Issues such as improper parking in all areas of the compound and the lack of parking space consideration during loading and offloading contribute to difficulties in smooth operations.

### b. Lighting and power aminities

The figure below shows that most respondents (71%) identified water facilities as lacking to create a better atmosphere. Additionally, other amenities such as lighting, power facilities, and workplace infrastructure were also mentioned but with lower frequencies.

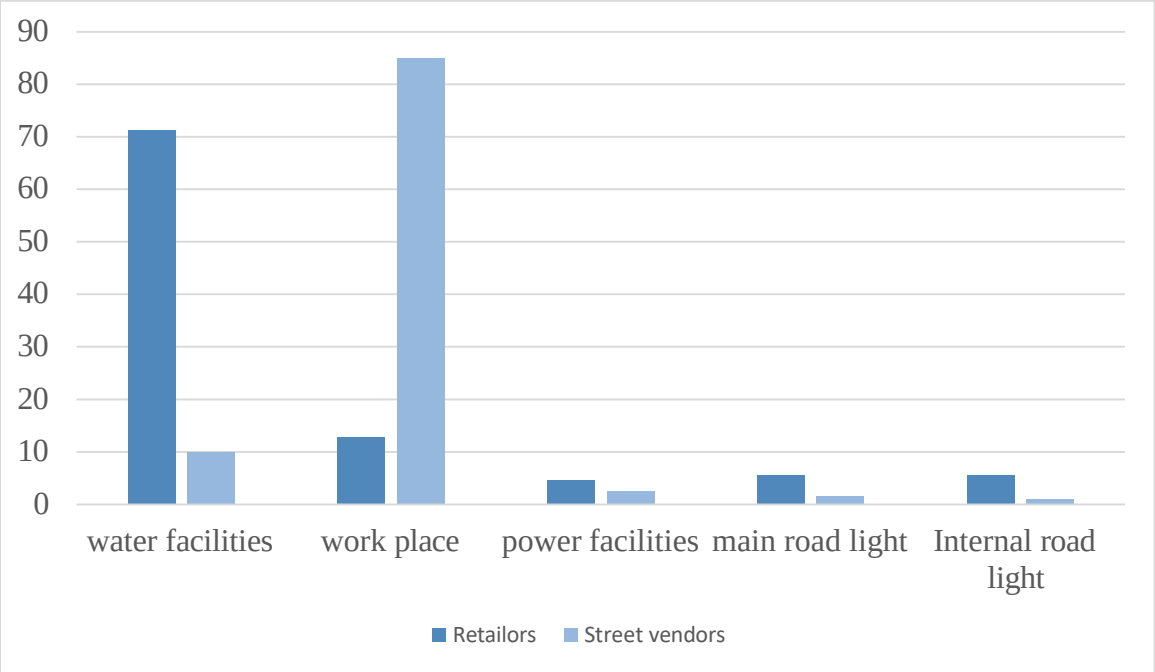


*Figure 4-21 Respondents provided various insights into the amenities lacking to create a better environment. This data presents responses regarding factors that contribute to work support, as perceived by respondents*

*Source: Computed by the author, 2024.*

The above figure 4-21 shows that the majority of respondents (71%) identified water facilities as lacking in order to create a better atmosphere. Additionally, other amenities such as lighting, power facilities, and workplace infrastructure were also mentioned but with lower frequencies.

The data indicates that the most significant factor contributing to work support, as perceived by respondents, is the workplace itself. This suggests that respondents primarily value the overall environment and conditions provided by their place of work. While power and water facilities were also mentioned, they were less frequently cited compared to the general notion of the workplace.

**c. Challenge that affects work effectiveness**

**Factors affecting vegetable markets in terms of activity**

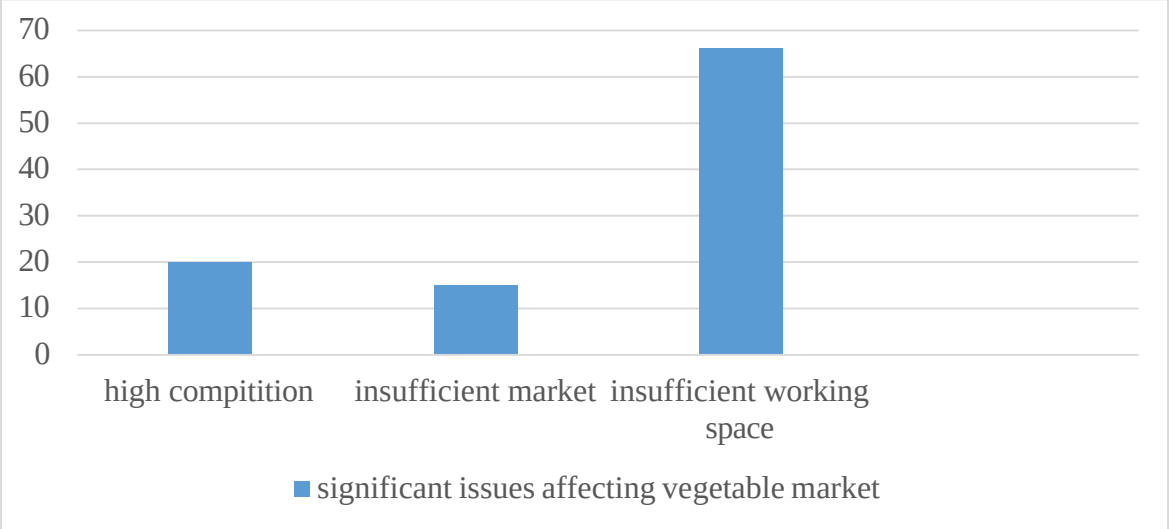


*Figure 4-22 shows the distribution of responses regarding the environmental factors affecting the vegetable market.*

*Source: Computed by the author, 2024.*

Overall, the majority of respondents identified insufficient working space as a significant issue affecting the vegetable market. This suggests that addressing space constraints and optimizing the layout of the market may be crucial for improving operational efficiency and addressing other challenges such as high competition and insufficient market conditions. Additionally, strategies to enhance competitiveness and expand market opportunities could also be explored to overcome these environmental factors impacting the vegetable market.

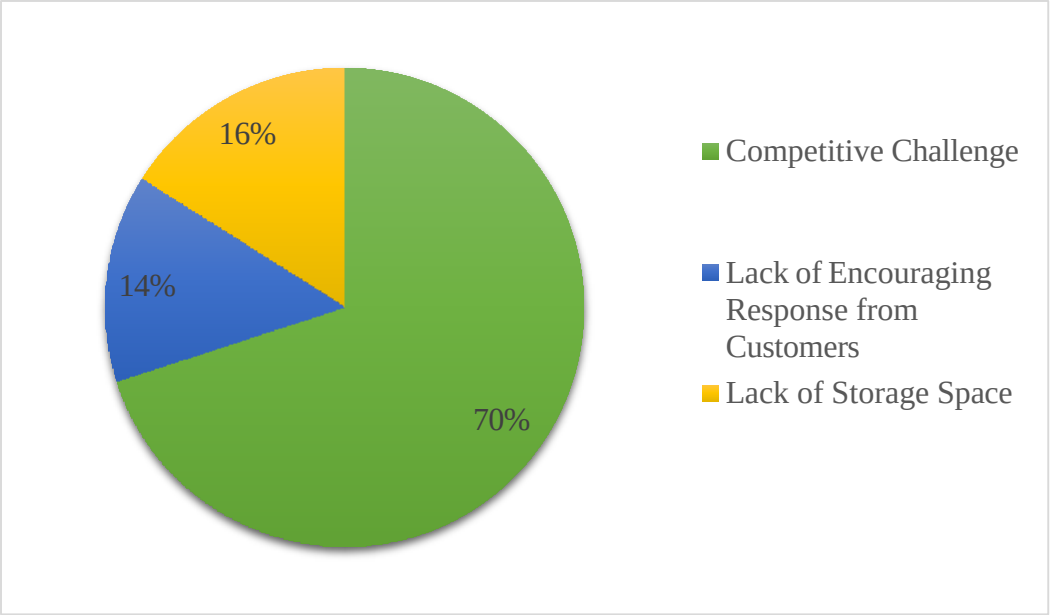


*Figure 4-23 shows the distribution of responses regarding the main problems faced by respondents in the vegetable market.*

*Source: Computed by the author, 2024.*

Overall, the analysis suggests that competitive challenges, lack of storage space, and the lack of encouraging response from customers are the primary problems respondents in the vegetable market. Addressing these issues through strategies such as improving marketing tactics, optimizing storage solutions, and enhancing customer engagement could help overcome these challenges and improve business performance in the vegetable market.

Based on the responses provided, the challenges individuals face in the social security sector can be categorized into several key themes. The most prevalent challenge identified is the lack of flexibility during business hours, with 35% of respondents citing this as a significant issue. This indicates that individuals in the social security's sector may struggle with rigid work schedules that limit their ability to balance work and personal commitments.

Furthermore, common challenge reported by respondents is harassment from officials and shopkeepers, with 22.5% highlighting this issue. This suggests that individuals in this sector may face interpersonal challenges and conflicts in their interactions with authorities and business owners, which can impact their work environment and well-being.

Insecurities about oneself were also identified as a notable challenge, with 20% of respondents expressing concerns in this area. This highlights the importance of addressing personal insecurities and building self-confidence among individuals working in the social security sector to enhance their well-being and job satisfaction.

Additionally, problems of criminal activity were mentioned by a smaller percentage of respondents (10% and 7.5% respectively), indicating that safety and security concerns may also be a significant issue for individuals in this sector.

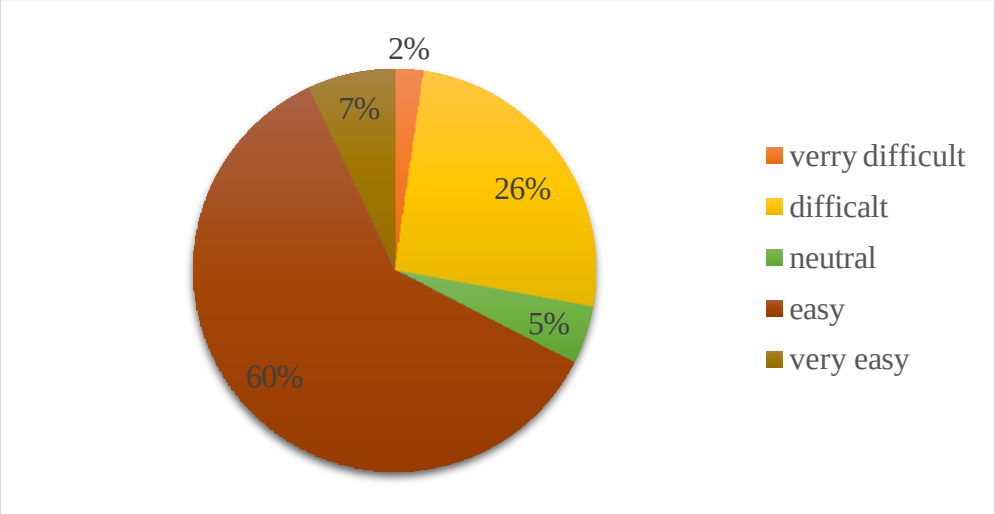


*Figure 4-24 responses to a question regarding the ease of purchasing vegetables in scale*

*Source: Computed by the author, 2024.*

The above figure 4-24 data represents responses to a question regarding the ease of purchasing vegetables, Most respondents (72.5%) perceive purchasing vegetables as easy or very easy. This suggests that for a significant portion of respondents, acquiring vegetables is not a challenging. However, it's worth noting that a notable minority (27.5%) still find it difficult to purchase vegetables.

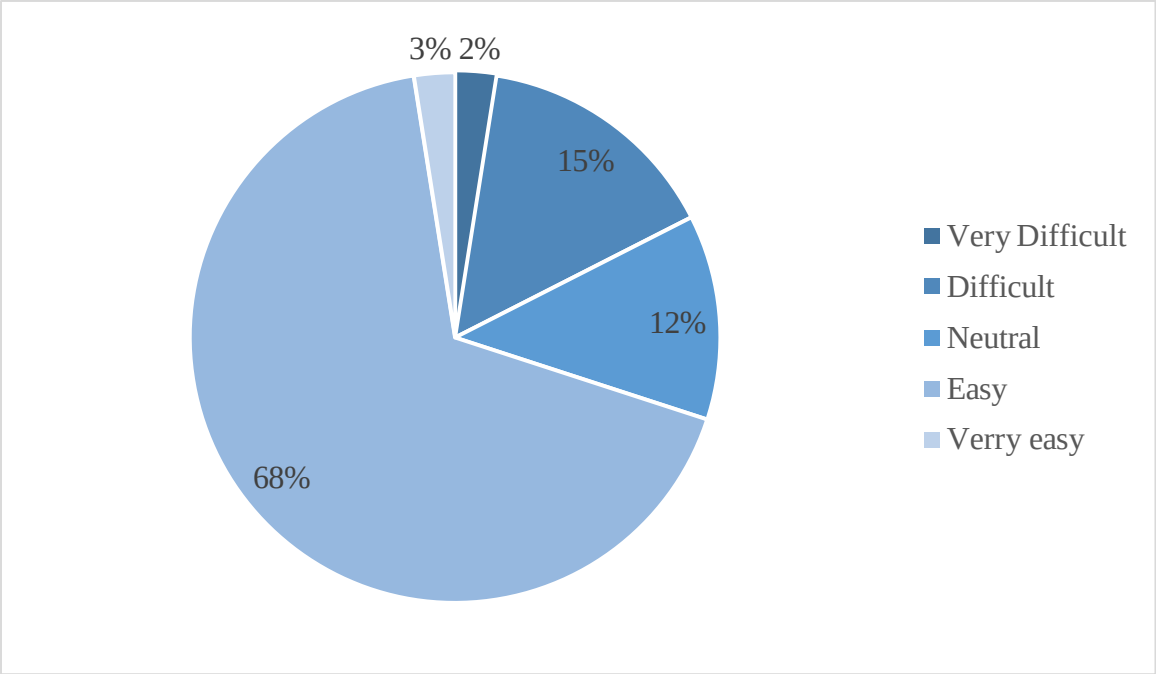


*Figure 4-25responses to a question regarding the availability and ease of parking for heavy trucks*

*Source: Computed by the author, 2024.*

The figure 4-25 data suggests that the majority of respondents (67.5%) perceive parking for heavy trucks to be easy, indicating that they likely find sufficient parking spaces or accommodations available for such vehicles. This positive perception aligns with the high percentage of respondents who rated the ease of parking as either "easy" or "very easy." However, it's worth noting that a small portion of respondents (17.5%) still find parking for heavy trucks either difficult or very difficult, indicating that there may be areas or situations where adequate parking options are lacking for these vehicles.

A majority of respondents in the figure 26 reported that their work does not extend to the parking lot, indicating a clear distinction between work areas and the parking facility. A significant portion of respondents acknowledged that their work includes tasks or responsibilities related to the parking lot.

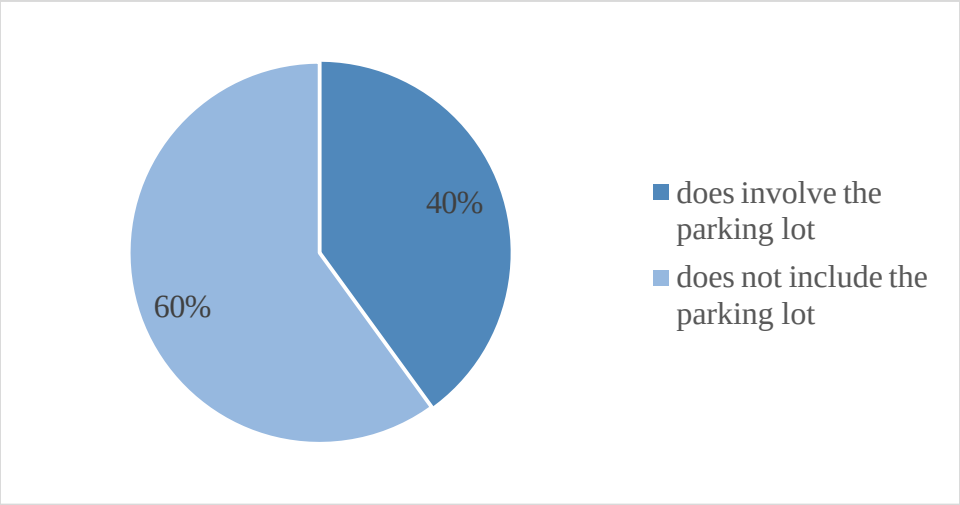


*Figure 4-26Analyzing the data provided in the frequency table regarding whether the work area includes the parking lot:*

*Source: Computed by the author, 2024.*

The respondents as figure 4-27(60%) identified loading and unloading tasks at the shop as a significant challenge that affects their work effectiveness. Other challenges mentioned include limited parking availability for vehicles and the absence of parking provisions at work.

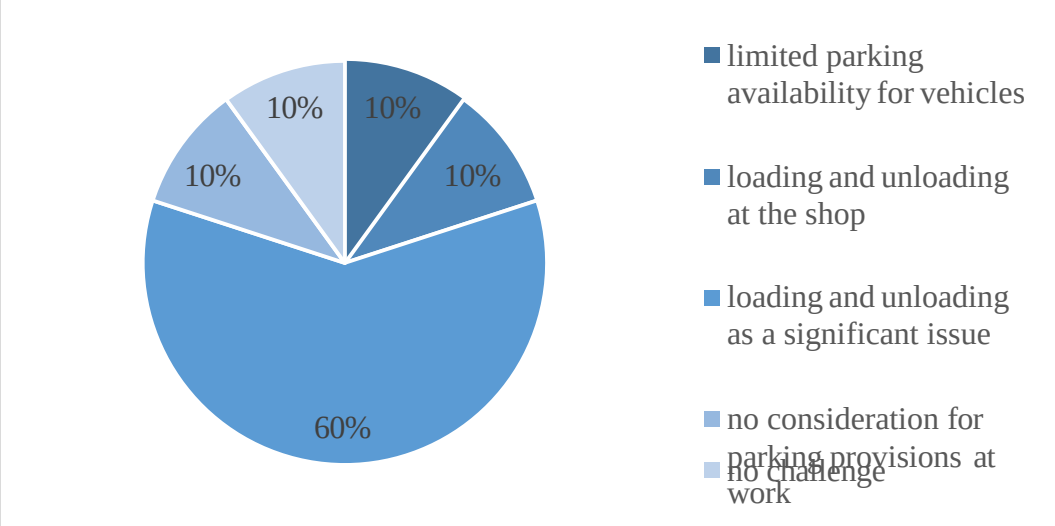


*Figure 4-27 Challenges faced on the working environment*

*Source: answer from questionnaire, 2024*

### 4.1.3. Challenges of Environmental Sustainability

#### 4.1.3.1. Storm Water Management

a. Facilities

The graph below shows, it is evident that the majority of respondents (92.5%) believe that storm water does not enter the drainage lines in the market area, while a small percentage (7.5%) indicated that it does. This information suggests that participants may have varying perceptions or observations regarding the flow of storm water into the drainage lines.

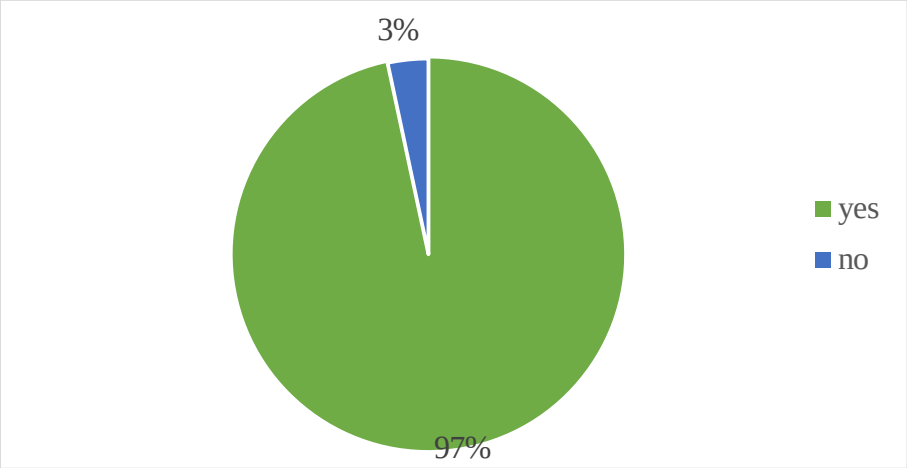


*Figure 4-28 storm water flow drainage line*

*Source: Computed by the author, 2024.*

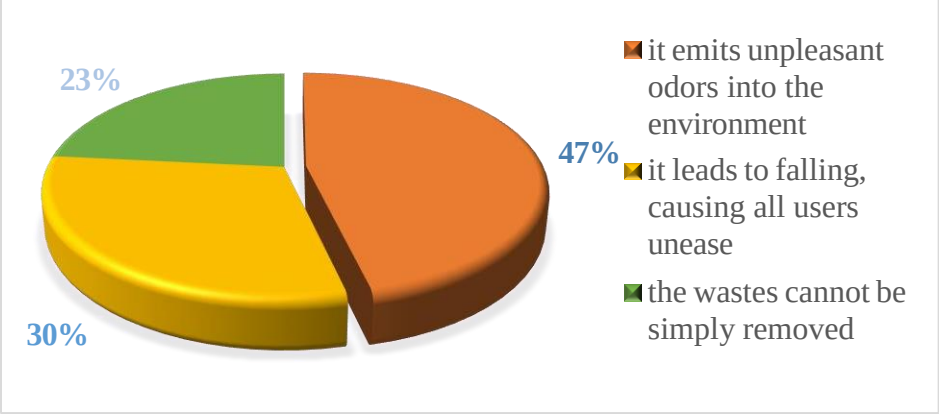


*Figure 4-29 Challenges faced during rainy season*

*Source: Computed by the author, 2024.*

The data shows that multiple challenges are associated with rainy seasons in the market area as reported by the participants. These challenges include unpleasant odors emitted into the environment, risks of falling for users, and difficulties in removing wastes during rainy periods.

4.1.3.2. Waste Management

**a. Solid and liquid waste collection areas**

Figure 4-30, the chart below shows that most respondents (60%) mentioned a waste collection area within the compound, indicating that waste management facilities are available. However, a significant portion (40%) noted the absence of a designated waste collection area, which may pose challenges for proper waste disposal and management.

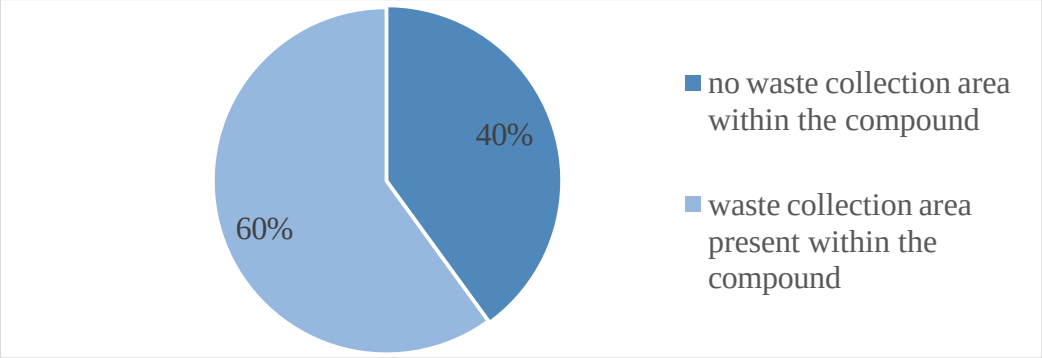


*Figure 4-30 Waste collection area existence with in the compound*

*Source: Computed by the author, 2024.*

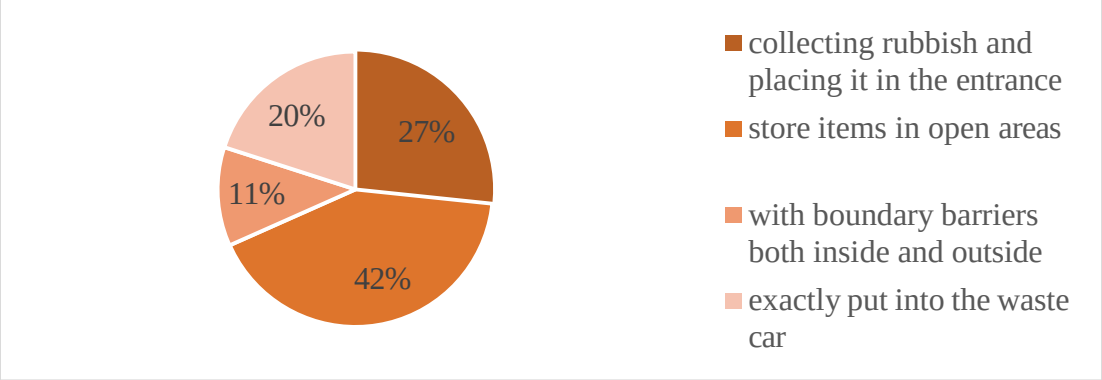


*Figure 4-31 waste collection area putting waste in different parts of the compound*

*Source: Computed by the author, 2024.*

Figure 4-32 shows a range of responses was provided by respondents on where they store their items when there is no specified area, with variations in practices observed. Storing items in open areas and collecting rubbish and placing it in the entrance and exactly put in to the waste vehicle were among the common practices reported by respondents.

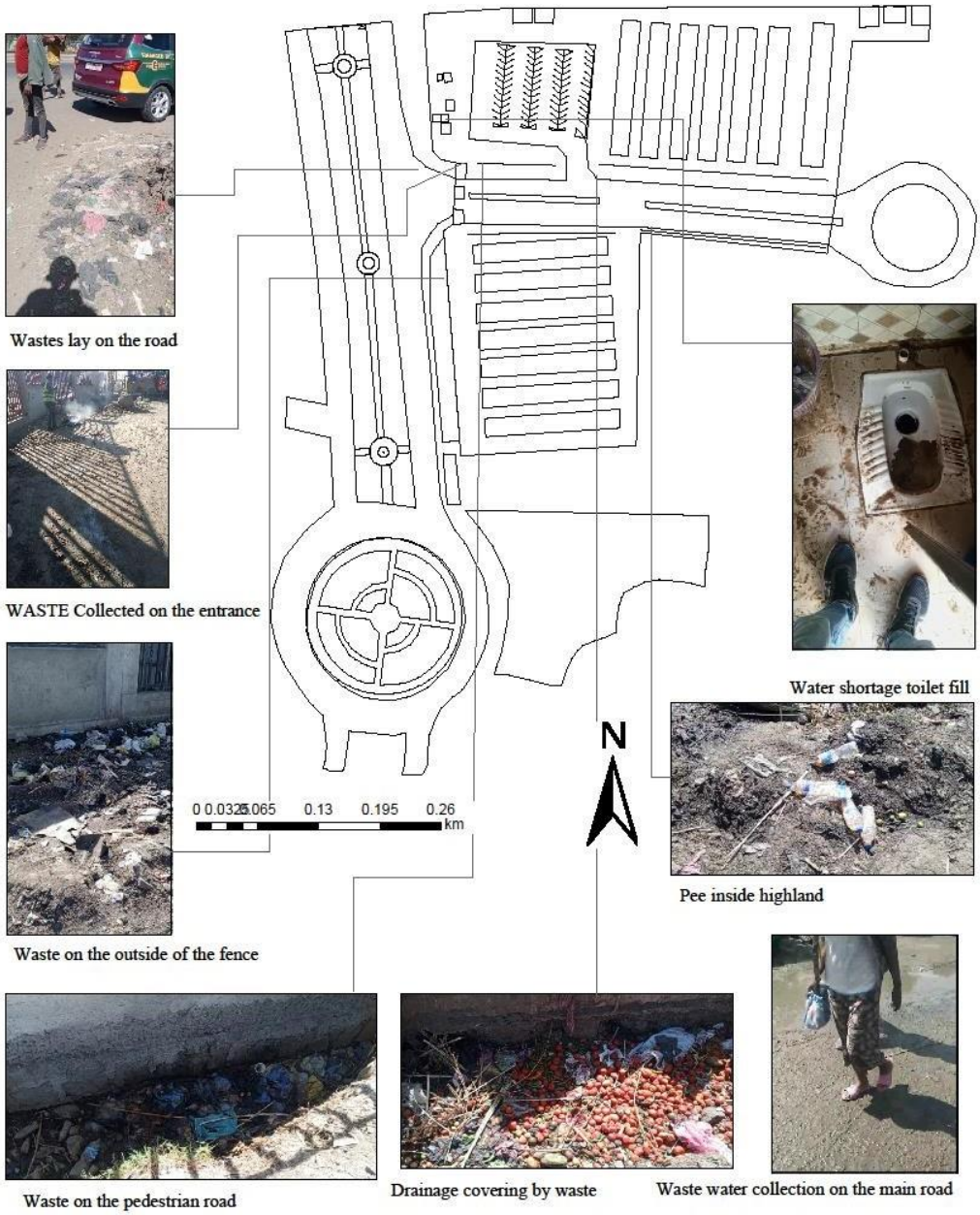


*Figure 4-32 solid and waste collection areas in side Lafto Vegetable Market Center*

*Source: Computed by the author 2024*

**b. Retailors dust bin usage**

The data suggests that while most respondents believe that merchants use dustbins somewhat frequently, a notable portion of respondents perceive merchants to use dustbins infrequently. Additionally, very few respondents believe that merchants use dustbins with a high frequency.

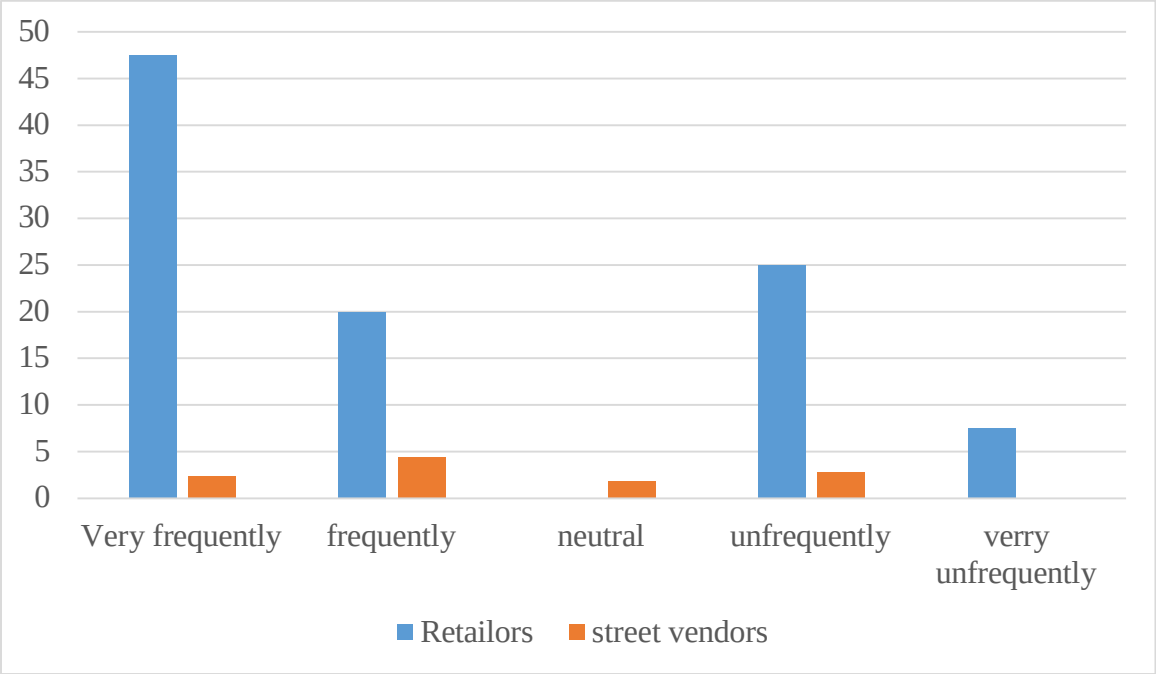


*Figure 4-33 responses regarding the practice of merchants using dustbins, categorized on a scale from very infrequently*

*(1) to very frequently (4).*

*Source: Computed by the author, 2024.*

**c. Management**

The figure below shows at most individuals in the sample visit the vegetable market area once daily, indicating a regular cleaning service frequency. A smaller percentage of individuals visit the vegetable market area twice per day, suggesting a higher frequency of visits.

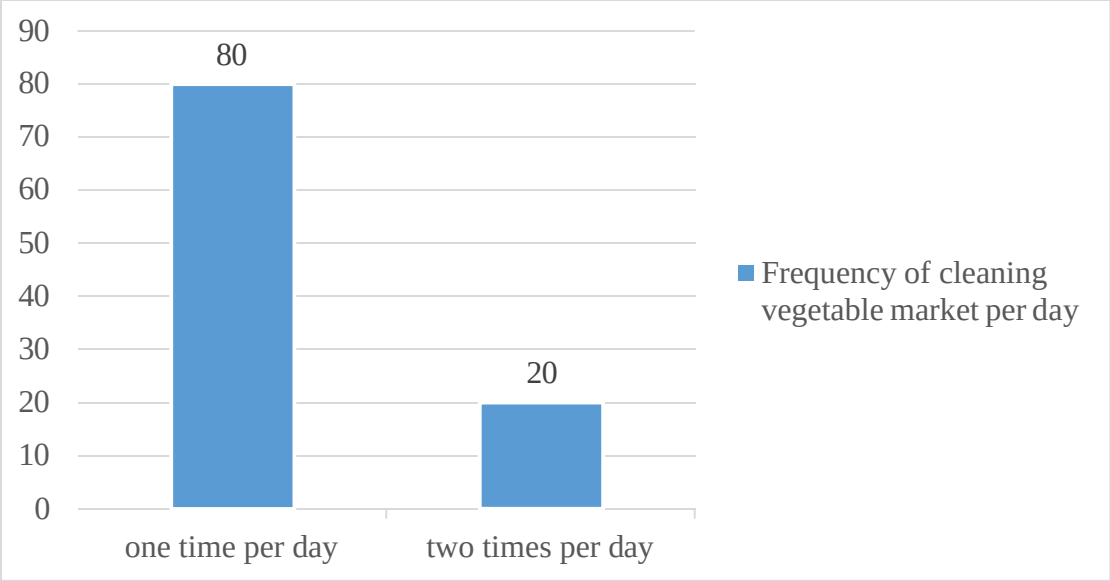


*Figure 4-34 the frequency table for how frequently individuals go to the vegetable market area*

*Source: Computed by the author, 2024.*

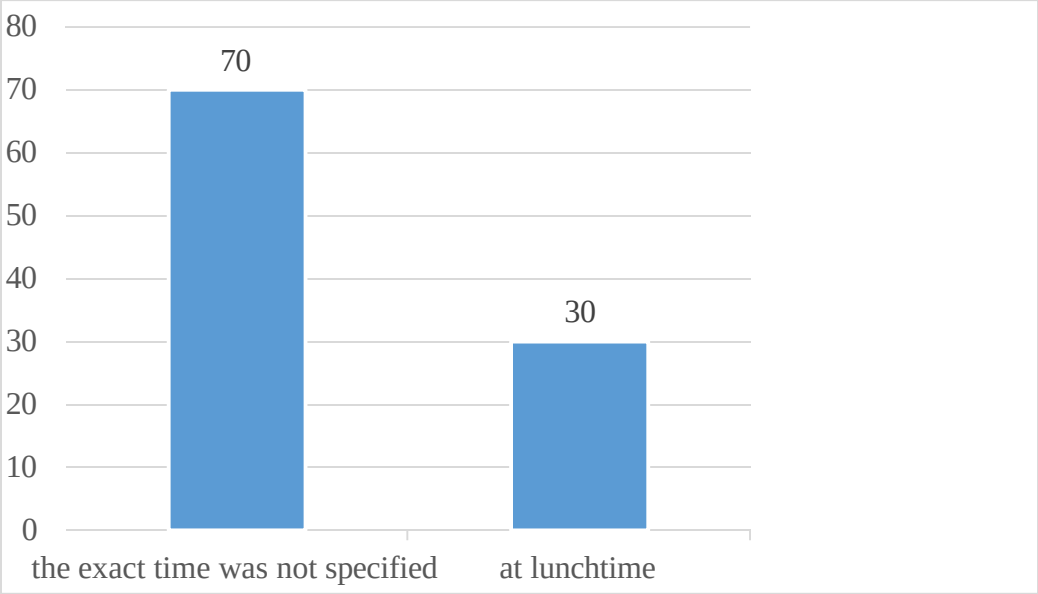


*Figure 4-35 specific time for cleaning the compound*

*Source: Computed by the author, 2024.*

Fig 4-35 indicates the majority of respondents acknowledged the presence of a specific time dedicated to cleaning the compound, highlighting a level of organization and routine in maintenance practices. A smaller percentage of respondents specified that cleaning takes place at lunchtime, suggesting a scheduled cleaning activity during midday.

**d. Obstacles encountered during cleaning**

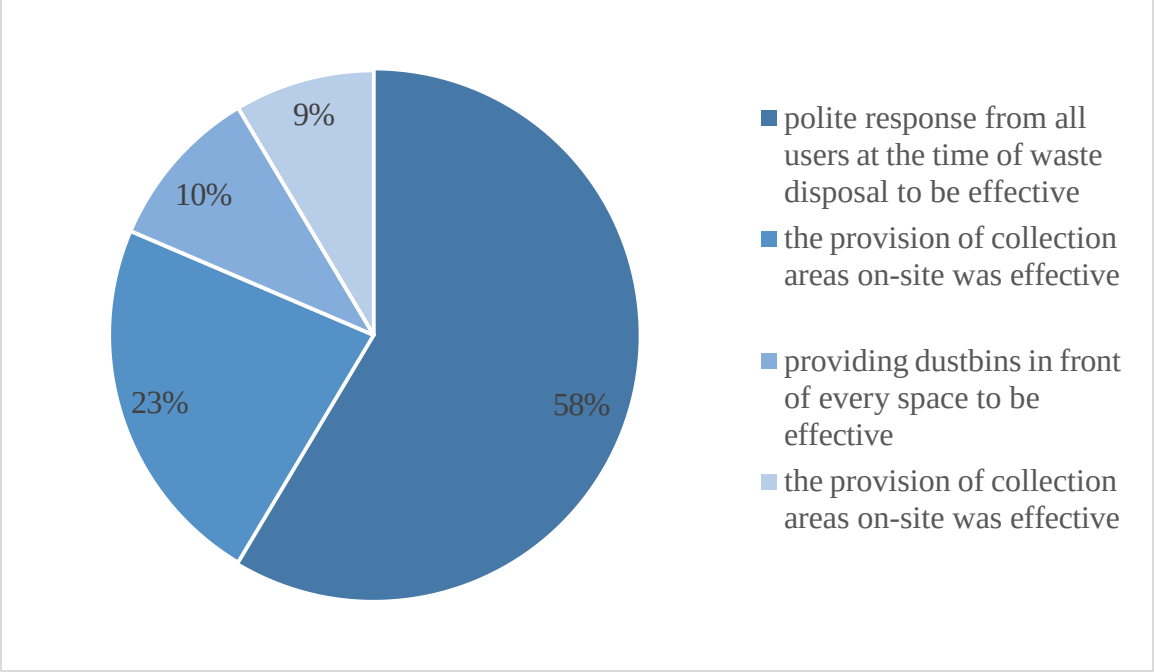


*Figure 4-36 regarding the perceived effectiveness of different initiatives in waste management: Different initiatives in waste management system*

*Source: Computed by the author, 2024.*

The majority of respondents (58%) identified providing dustbins in front of every space as the most effective initiative in waste management. A significant proportion of respondents (23%) appreciated both a polite response from all users at the time of waste disposal and the provision of collection areas on-site.

There are 90 cleaners and collectors of Atikilt Tera garbage, and 5 cars are utilized to collect and transport the waste from Atikilt Tera to Repi waste collection area, according to data gathered from Nifas Silk Lafto sub city dry waste management and Addis Ababa. Trade and Industry office. Every day, the site is cleaned. After being collected, the garbage will be composted and converted into electricity.

4.1.3.3. Challenge

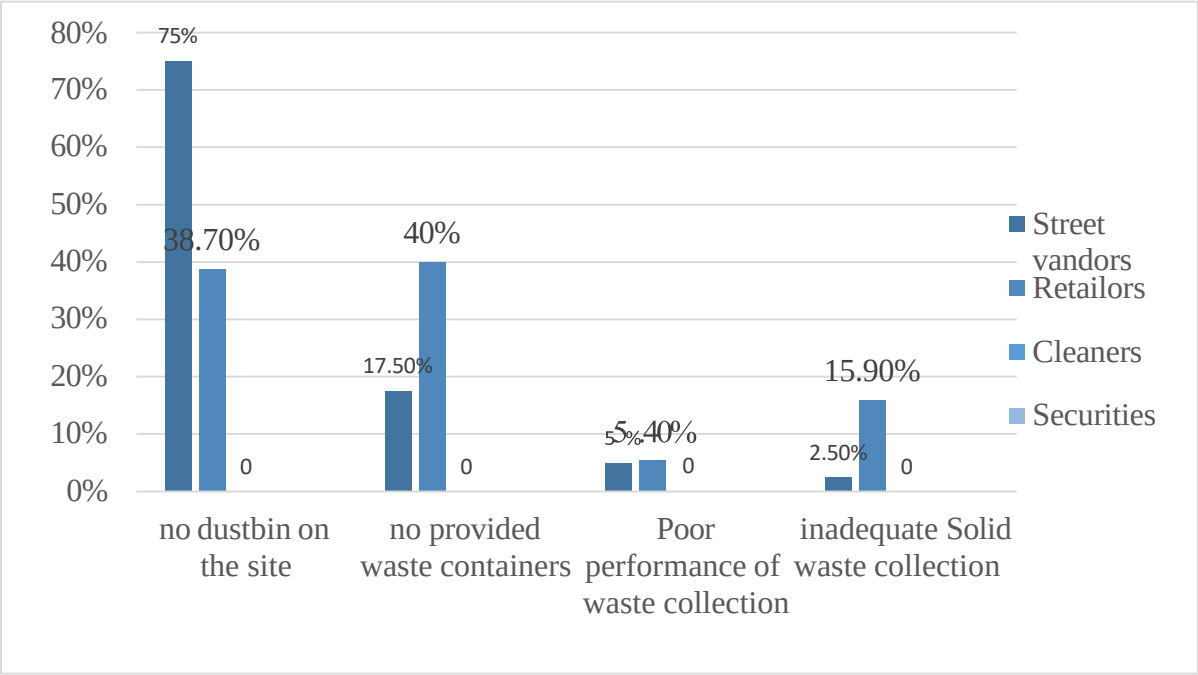


*Figure 4-37 provision of waste collection area dust bin on the study area/Challenges of waste management*

*Source: Computed by the author, 2024.*

**Challenges of waste management:** the majority (75%) of the sample respondents of vendors had no dust bins on the site; while 17.5% of respondents said there is no provided waste containers 5% of the other respondents because of poor performance of waste collection and the rest 2.5 % said in adequate solid waste collection. The study results also indicate that, most street vendors need dust bins to solve waste management systems.

The main challenges identified by respondents include inadequate dust bins, inadequate waste containers, inadequate solid waste collection, and poor performance of solid waste collectors. The most frequently mentioned challenge is inadequate waste containers, followed by inadequate dust bins and a combination of inadequate waste containers and inadequate solid waste collection.

The findings revealed that a significant portion of participants, approximately 37.57%, opted to dispose of vegetable waste by throwing it onto the road, while 27.57% had their own dustbins. Additionally, 25% of respondents admitted to tossing waste into open spaces, and 10% resorted to putting it into drainage lines.

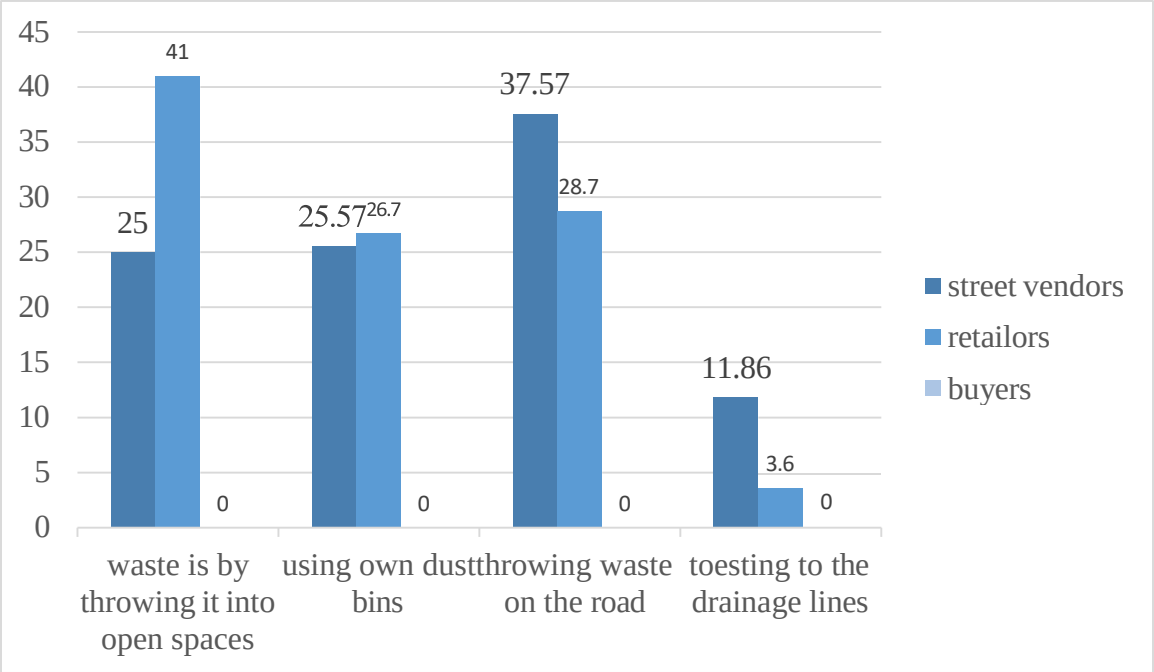


*Figure 4-38 provides information on the methods used by respondents to remove vegetable waste*

*Source: Computed by the author, 2024.*

The most common method reported by respondents for removing vegetable waste is by throwing it into open spaces, accounting for 30.0% of responses. This is followed by using own dust bins (16.7%) and throwing waste on the road (16.7%). A smaller percentage of respondents reported using dust bins provided by the municipal and engaging in other improper disposal methods, such as throwing waste on the road or in open spaces.

A staggering 87.5% of participants lacked access to provided dustbins from the municipality, highlighting a scarcity of proper waste disposal infrastructure in market areas. This lack of dustbins led to 87.5% of street vendors utilizing various makeshift containers for waste collection, with 15% using any available material, 5% employing baskets, and 10% utilizing pockets, while the majority (62.5%) did not use any receptacles at all.

Furthermore, a mere 5% of participants utilized dust collection materials placed in front of shops for waste disposal. Consequently, the majority (47.5%) of respondents expressed dissatisfaction with the current waste management practices, with 22.55% rating it as good, 27.5% as satisfactory, and only 2.5% deeming it excellent.

On the other hand 85% of participants did not offer any recommendations, while the remaining 15% suggested improvements to the waste management system such as distributing dustbins in all areas, ensuring the availability of waste containers, promptly removing waste, and encouraging individuals to gather and hand over their waste to cleaners for disposal.

Figure 4-39 below shows the vast majority of respondents (96.7%) reported that there are no dust bins provided by the government. Only a small percentage (3.3%) indicated the presence of government-provided dust bins.

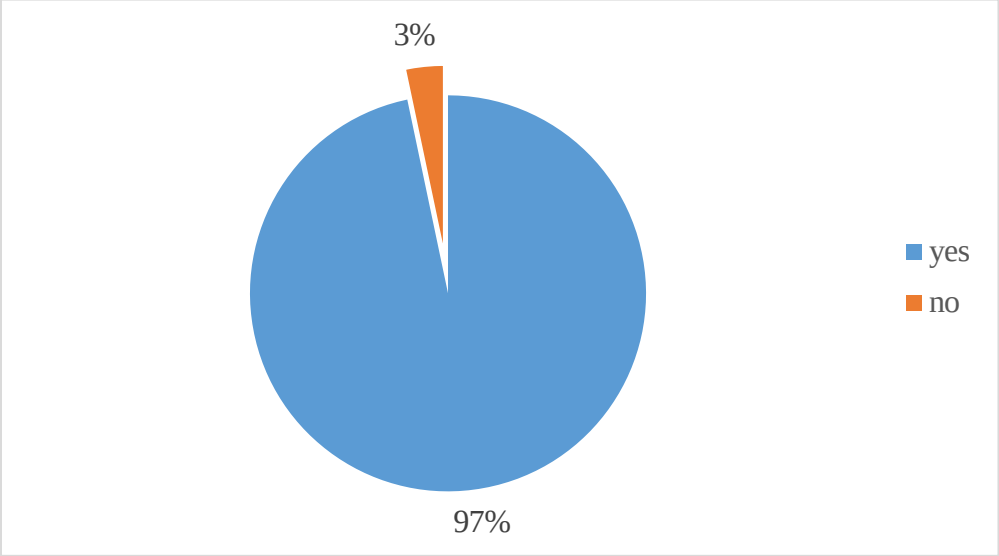


*Figure 4-39 the types of dust bins used by respondents who reported the availability of government-provided dust bins*

*Source: Computed by the author, 2024.*

Among respondents who reported the presence of government-provided dust bins, the majority (70.0%) stated that they did not use any dust bin at all. A smaller percentage reported using pocket (23.3%), any material (3.3%), or basket (3.3%) as their preferred type of dust bin.

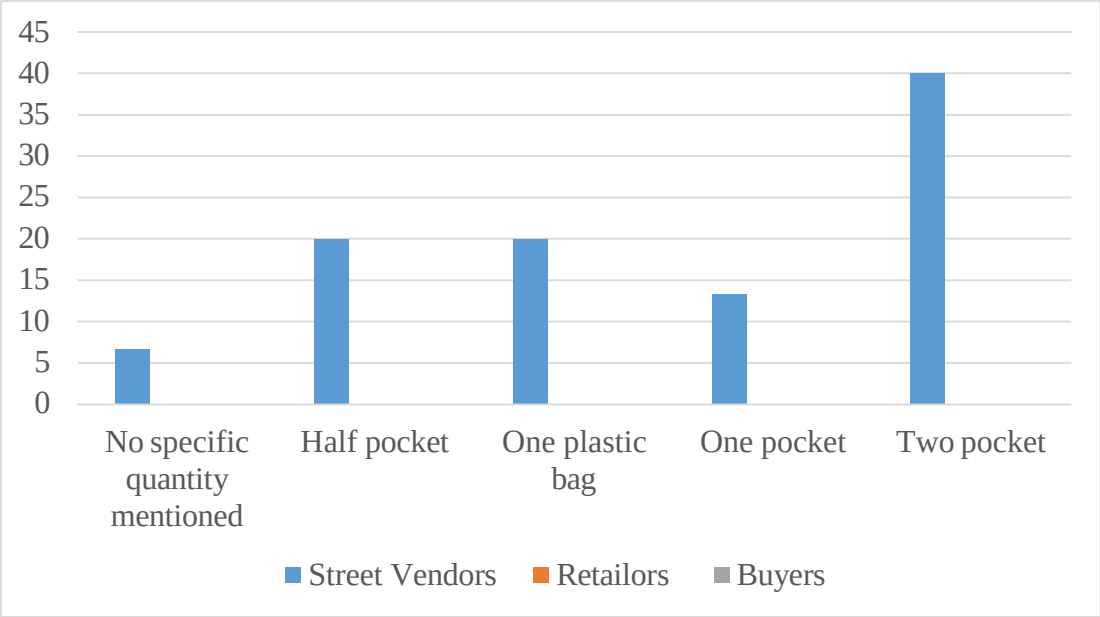


*Figure 4-40Rubbish produced in a single day from different respondents*

*Source: Computed by the author, 2024.*

Hence, the most common quantity of rubbish produced in a single day is reported as "two pocket," accounting for 40.0% of responses. This is followed by "half pocket" and "one festal other," each representing 20.0% of responses. "One pocket" is reported by 13.3% of respondents, while 6.7% did not specify a specific quantity.

Among respondents, 33.3% reported that dust bins are placed ahead of the stores, while 53.3% indicated that no dustpan was utilized. A smaller percentage (13.3%) mentioned that dust bins are placed within the retail stores.

In contrast, the data presents responses regarding whether the shop generates different waste: Among the respondents, 60.0% indicated that the shop does not generate different waste, while 40.0% reported that it does.

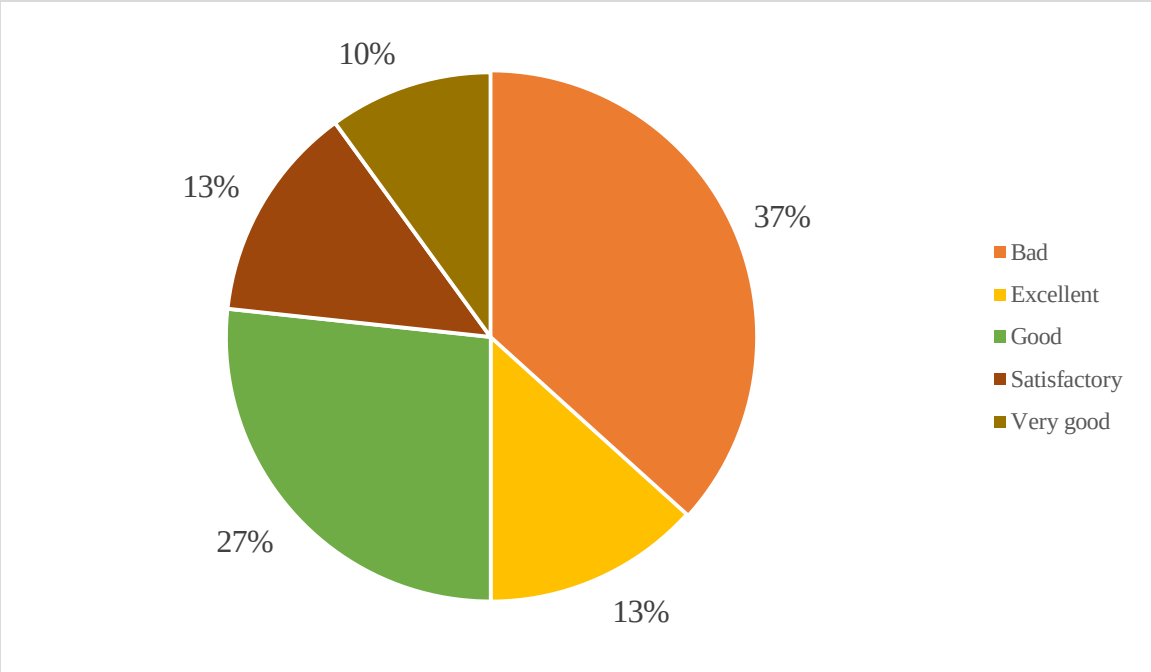


*Figure 4-41respondents' levels of satisfaction with the waste management system*

*Source: Computed by the author, 2024.*

Among respondents, 36.7% expressed dissatisfaction with the waste management system, rating it as "Bad." On the other hand, 26.7% rated it as "Good," 13.3% as "Excellent," 13.3% as "Satisfactory," and 10.0% as "Very good." The majority of respondents (86.7%) did not provide specific recommendations regarding the waste management system. However, a small percentage (13.3%) offered suggestions in Amharic, a language primarily spoken in Ethiopia.

### 4.1.4. Resilience Characteristics of the Study Area

#### 4.1.4.1. Diversity

The study area has small potential on handling different type of vehicles such vehicles are automobiles, taxis 3 wheel drives, large trucks at the same time. Consequently about 70% of respondents said that the causes for the shortage of parking is there is no consideration for different vehicles parking.

Hence, it is provided parking for the automobiles only the large vehicles park on the pedestrian road, on the main road and in every open space this leads to high congestion of traffic.

Moreover, the resilience of waste management has been placed in different place. Different waste collected on bare spaces and at the fence of the compound it leads to the presence of pleasant smell and sliding of floor.

4.1.4.2. Redundancy

The study area contains different users and street vendors are sit on different areas of the site with different sells. It includes leafy vegetables, fruits and roof vegetables, some vendors have objects different from vegetable and fruits. Hence it leads to sitting on the site of in different place around the parking area and entrance of the site.

**Vegetable Market Users**

The data provided by the vegetable market leader indicates that there are 548 shops in the Lafto vegetable market, with a minimum of two to five workers in each shop. The number of street vendors and other informal workers is also unknown. The buyers' experiences vary depending on the day of the week, whether it is a working day or not, and also depending on the time of day, such as morning, afternoon, and evening.

According to the sample survey conducted 58.49% of the respondents are customers while 18.86 % are street vendors, then 13.20% are retailors and the remaining 4.716% are cleaners and securities each.

The Figure 4-42 representing results of age group of Street vendors that, most (52.5%), of the participant respondents were within the age of 26 to 40 years followed by those within the range of 18 to 25 years (40%) and then (7.5%) are from 41to 55 years . Retailors: the majority of respondents fall within the 26-40 age group, comprising 66.7% of the total respondents. The 18-25 age group accounts for 26.7% of respondents, while the 41-55 age group represents only 6.7%. Then 10% of the individuals are in the age group 18-25. 70% of the individuals are in the age group 25-40. 10% of the individuals are in the age group 41-55. And the rest 10% are above 55 years are Securities Age result.


*Figure 4-42 Participants age on different Strata's*

*Source: Computed by the author, 2024.*

The graph above also shown as cleaners age group in percent 62.5% are in the age group of 26-40, There is representation from older age groups as well, with 12.5% of respondents in each of the 18-25 and 41-55 age ranges, and above 55 age range. Furthermore buyers 45.16% from 26-40 and 31.45% from 41-55, 15.32 were from 18-25 and greater than 55 age are 18.04. The data suggests that the sample is predominantly made up of individuals in the age range of 26-40 area are mostly young people.

**a. Type of work**

The study results show in the below figure 4.4. That the majority (50%) of the street vendor participant respondents are Fruit seller and (15%) of them are leafy vegetable sellers, whereas only (15%) of street vendors are different from vegetable vendors and (17.75%) of them are root vegetable sellers and (2.5%) are both root vegetable and leafy vegetable sellers. The results below show that the majority (70%) of the respondents are the whole day vendors; 5% are work in the morning; and 25% working in the afternoon. This suggests that selling fruit has been one of the major occupations for street vendors.

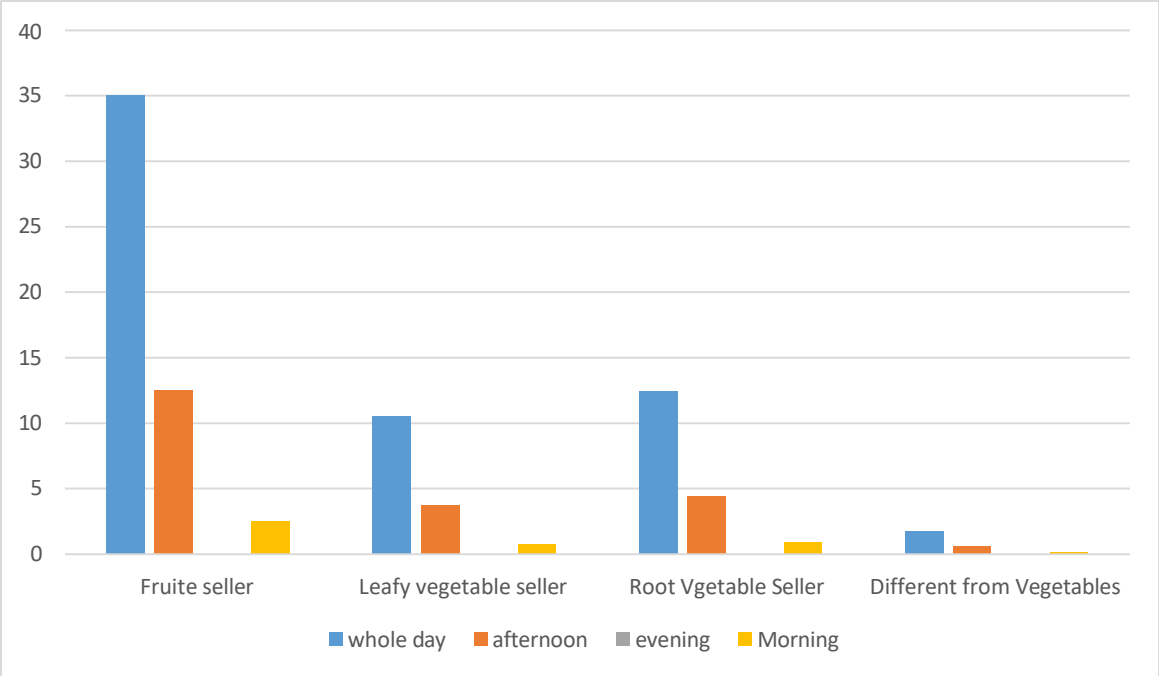


*Figure 4-43 The variety of vegetables supplied by street vendors as well as when they sell them*

*Source: Computed by the author, 2024.*

## 4.2. DISCUSSION

The major findings of this thesis will be covered in the part that follows, along with their corresponding objectives.

According to the literature review, the challenges related to loading and unloading tasks can impact productivity, efficiency, and the overall workflow within the workplace. Limited parking availability and inadequate parking provisions can further exacerbate logistical issues and create obstacles for employees.

In 2021, sustainability has also mentioned that Resilience is the capacity of a system, upon disturbance, to revert to its initial state or transition to a new, more desired one. The three aspects of resilience, robustness, agility/flexibility, and risk assessment—aren't well covered in existing literature. “Thus, research opportunities that consider this integration could generate efficient designs for facing disruptions and responding to changes” (Francis, 2021).

The discrepancy in responses regarding the accommodation of large trucks in the parking area suggests a potential gap in infrastructure provision or accessibility for certain types of

vehicles. Parking facilities that are not designed to accommodate large trucks may face challenges such as congestion, restricted maneuverability, and safety concerns. Inadequate parking provisions for large trucks can also impact supply chain logistics, delivery operations, and overall traffic management in the vicinity.

Furthermore, the majority of respondents (90.0%) did not provide specific suggestions for making the parking area accessible for large trucks. However, a small percentage (10.0%) proposed implementing modifications or accommodations, such as specific vehicle types or infrastructure changes.

The lack of specific suggestions from the majority of respondents indicates a potential gap in awareness or understanding of the measures needed to make the parking area accessible for large trucks. This highlights the importance of community engagement and stakeholder involvement in identifying and addressing infrastructure needs.

These challenges can impact the efficiency, safety, and accessibility of the location for both businesses and customers. Addressing these issues is crucial to improving the overall experience and functionality of Atakilt Tera.

Having a specific time for cleaning the compound can help establish a regular cleaning routine and ensure that maintenance tasks are systematically carried out. Cleaning at lunchtime may offer convenience for residents or align with a quieter time in the compound to minimize disruption.

A majority of respondents indicated that the above time is not used for cleaning waste, suggesting that there may be a lack of emphasis on waste management during that period. A smaller proportion of respondents mentioned that the above time is indeed utilized for cleaning waste, indicating some level of attention to cleanliness during that time.

Analyzing the data provided in the frequency table regarding the presence of a waste collection area within the compound: Storing items in open areas can lead to clutter, obstruction, and potential safety hazards within the living environment. Proper waste disposal practices are essential for maintaining cleanliness and hygiene within the compound.

Daily movement of items may reflect a need for flexibility and adaptability in managing storage spaces within the compound. Regular reorganization of storage areas can help optimize space utilization, enhance organization, and improve accessibility to stored items.

Moreover, collecting vegetable waste for removal is a proactive step towards proper waste management and environmental sustainability within the living environment. The collection of vegetable waste indicates an awareness and effort to segregate organic waste and dispose of it appropriately.

Furthermore, the data suggests that a significant portion of respondents believe that the shop does not generate different waste. This may imply that the waste generated by the shop is relatively uniform in nature or that there is no significant variation in the types of waste produced. However, the presence of a minority indicating that the shop does generate different waste suggests that there may be some diversity in the types of waste generated, albeit to a lesser extent.

On the other hand, it is well designed and new that the environmental sustainability of the site is highly affected by its use and user perception, hampered the collection efficiency of solid wastes, drainage line closes by solid wastes, presence of mud and waste collection in different places.

Hence, the sustainability of storm water management has been disadvantaged by lower level of vegetable cover, overcrowded patterns of the structure and un proper provision of drainage lines for storm water flow.

The resilience of redundancy features is reflected in the various types of cars parked in different areas, while different types of waste are managed through the provision of designated bins. Additionally, another aspect of robustness is taken into account regarding the duration of the vegetable market's operation.

# CHAPTER 5 CONCLUSION AND RECOMMENDATION

## 5.1. CONCLUSION

This research was created in response to the environmental and physical issues emerging in the vegetable market, with the goal of helping resolve them going forward. This study studies the physical and environmental aspects of the Lafto vegetable market region in terms of resilience and sustainability. Improvements to the waste management system and circulation infrastructure are required in light of the issue. After the intervention, this example is further examined to determine how to improve the vegetable market.

Hence, the three main sections of the research are arranged to accomplish the objectives of the study. A literature review is used to explore the theoretical framework in the first part. Data collection, analysis, and assessment are included in the exploratory and descriptive parts, which are followed by the discussion and results in the third part.

This thesis tried to determine to what extent does vegetable market in Lafto vegetable market area based on the data provided, it can be concluded that there are significant challenges related to parking, loading, and offloading processes in Atakilt Tera that need to be addressed.

Factors affecting physical sustainability of the current condition of the Lafto vegetable market: Inadequate drainage systems leading to waterlogging and flooding during heavy rainfall. Poor circulation patterns within the market, causing congestion and hindering access for vendors and customers. Insufficient road infrastructure and parking facilities leading to traffic congestion and lack of parking space.

In addition to major environmental sustainability issues of the vegetable market: Inadequate storm water management facilities leading to runoff pollution and flooding. Improper waste management practices contributing to environmental pollution and health hazards. Challenges faced by the market in achieving resilient practices: Lack of robust infrastructure that can withstand environmental challenges such as waste collection, drainage line absence, Storm water drainage shortage. Limited diversity in existence of consideration of different vehicles parking, in products and vendors, making the market

vulnerable to market fluctuations. Insufficient redundancy measures in place to ensure continuity of operations in case of disruptions.

Moreover, relating resilience characteristics for future accessibility and suitability of the Lafto vegetable market: Implementing robust infrastructure upgrades to withstand environmental challenges and ensure long-term sustainability. Promoting diversity in products and vendors to enhance market resilience against market fluctuations. Introducing redundancy measures such as backup systems for utilities to ensure continuous operation.

Furthermore, potential strategies for improving sustainability and resilience of the Lafto vegetable market: Implementing green infrastructure solutions for storm water management and waste reduction. Upgrading road infrastructure and parking facilities to improve circulation and accessibility. Diversifying parking for different vehicles and dust bin providing vendors to enhance market resilience. Developing a comprehensive disaster preparedness plan to address potential disruptions.

Limited Provision of Dustbins: The lack of sufficient dustbins provided by the municipality is a significant challenge leading to improper waste disposal practices among market vendors and visitors: Improper Waste Disposal Methods: The data indicates that a considerable number of participants resort to throwing waste on the road, in open spaces, or into drainage lines due to the absence of proper waste disposal infrastructure.

In summary, the data indicates the presence of challenges related to parking, loading, and offloading activities in Atakilt Tera, highlighting the need for proactive measures to address these issues and enhance the overall operations and experience within the compound.

The analysis underscores the multifaceted nature of challenges facing solid waste management, ranging from infrastructure deficiencies to operational issues. By addressing these challenges through targeted interventions and collaborative efforts involving government agencies, communities, and waste management stakeholders, it is possible to improve the overall management of solid refuse and create cleaner and healthier environments for all.

Furthermore, the data provides insights into the most congested areas during peak hours, highlighting the need for targeted interventions to address traffic congestion effectively. By implementing traffic management measures, infrastructure enhancements, promoting public transportation, and adopting smart transportation solutions, authorities can mitigate congestion and improve mobility, ultimately enhancing the quality of life for residents and commuters.

Even though, the data highlights the importance of assessing and improving the comfort and efficiency of loading and unloading procedures for retail stores. By addressing infrastructure needs, implementing traffic management measures, fostering stakeholder collaboration, and enhancing employee training, authorities can optimize logistics operations and create a more comfortable and conducive environment for retail businesses and customers.

Hence, the data underscores the importance of addressing challenges and implementing improvements to simplify loading and unloading activities while supplying marketing items for customers. By conducting comprehensive needs assessments, prioritizing infrastructure enhancements, ensuring regulatory compliance, and fostering community engagement, authorities can effectively address concerns and enhance the overall efficiency and convenience of these operations.

## 5.2. RECOMMENDATION

- The recommendations of this paper are forwarded with due emphasis on the analysis of the existing condition of Lafto vegetable market.at once, these recommendations are grounded in the physical conditions and environmental sustainability of the vegetable market.
- It is recommended to conduct a thorough assessment of the parking and logistics infrastructure in Atakilt Tera to identify practical solutions to improve the flow of vehicles and goods. Hence this paper recommends that implementing clear guidelines for parking, designated loading and offloading zones, and considering the needs of businesses and customers can help mitigate these challenges.
- It is also recommended that upgrade drainage systems to prevent waterlogging and flooding. Implement proper waste management practices to reduce environmental impact.

- Work with the municipality to provide an adequate number of dustbins in strategic locations within the market compound.
- It is also recommended that enhance road infrastructure and parking facilities for better circulation and accessibility. Introduce green infrastructure solutions for storm water management. Promote diversity in products and vendors to increase market resilience. Develop a disaster preparedness plan with redundancy measures for continuous operation during disruptions.
- Hence, establish a regular waste collection schedule to ensure that waste is promptly removed from the market area and disposed of appropriately. Encourage the use of proper waste disposal practices through incentives or penalties to promote compliance with waste management guidelines.
- Further recommendations need for Awareness and Education: Raising awareness among stakeholders about responsible waste management practices is essential to instill a sense of responsibility and encourage proper waste disposal habits. Conduct awareness campaigns and educational programs to inform market vendors and visitors about the importance of proper waste disposal and its impact on cleanliness and hygiene. Street vendors often use makeshift containers like baskets or pockets for waste disposal, which may not be adequate or hygienic, further contributing to the dissatisfaction with the waste management process.
- Further recommendation on waste collection, implementing regular waste collection services can help ensure that waste is collected and disposed of properly, reducing the likelihood of waste being left in inappropriate places.
- It is recommended that implement traffic management measures within the compound, such as designated parking areas, one-way traffic flow systems, and traffic calming measures, to improve internal circulation and reduce congestion during peak hours. Upgrade infrastructure around the roundabout and on the main street to accommodate increased traffic volumes and improve traffic flow. Consider measures such as widening roads, optimizing signal timings, and enhancing pedestrian facilities to alleviate congestion and enhance safety.

- It is also recommended that providing access to clean water and reliable power facilities not only enhances work support but also promotes health and safety in the workplace. Employers should prioritize compliance with relevant regulations and standards to ensure a safe and healthy working environment for all employees.
- Accessibility Improvements: Assess the accessibility of vegetable purchasing options, especially in areas where respondents find it difficult. Consider initiatives such as setting up farmer's markets, increasing the availability of fresh produce in grocery stores, or implementing mobile vegetable markets to reach underserved communities. Authorities can work towards ensuring that merchants consistently use dustbins for waste disposal, leading to cleaner and more hygienic commercial areas and contributing to overall environmental sustainability.
- Using this thesis as a base line, researchers can further develop the idea sustainability and resilience concepts. . Optimize Layout: Review the current loading and unloading areas layout to identify opportunities for reorganizing space more effectively. Consider implementing a layout that allows for smoother flow of vehicles, materials, and personnel.
- It is recommended that allocate resources towards expanding or upgrading loading and unloading facilities to accommodate growing demands. Investing in infrastructure enhancements, such as additional bays or designated areas, can alleviate space constraints and improve operational efficiency. Explore the use of technology, such as warehouse management systems (WMS) or real-time tracking solutions, to optimize loading and unloading operations. Automation and digital tools can help streamline processes and improve visibility.
- It is also recommended that competitive challenges are a common issue in any market, and the vegetable market is no exception. To address this, businesses can focus on differentiating their products through quality, variety, pricing, and customer service. Implementing competitive pricing strategies, offering unique products or varieties, and providing excellent customer service can help businesses stand out from competitors. Addressing Flexibility: Authorities and businesses should consider implementing more flexible working hours to accommodate the diverse needs of individuals. This could involve staggered work hours, remote work options, or flexible scheduling arrangements.

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# Appendices

## **Appendix A.** Publishable Article

## Challenges of environmental sustainability issues of vegetable market for solid waste management: *A study of Lafto Vegetable Market Center, Addis Ababa city*

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**ABSTRACT**

*The study focuses on solid waste management and stormwater management at the Lafto Vegetable Market Center in Addis Ababa, highlighting significant environmental sustainability concerns. Urban markets like Lafto generate substantial waste and face complex water management issues, adversely impacting the environment and public health. Key problems identified include inadequate waste collection and disposal systems, ineffective waste segregation, and increased pollutants, leading to health risks and operational challenges during heavy rainfall. Utilizing a mixed-method approach, the research examined municipal policies, conducted interviews with local authorities and vendors, and made field observations, particularly focusing on the drainage system, stakeholder perspectives, and current waste management practices. Data was collected using site observations, Google Earth images, and insights from key informants, analyzed with SPSS 26.1 software. Findings revealed that poor waste segregation contaminates garbage and hampers recycling efforts, while insufficient stormwater management contributes to frequent flooding and infrastructure damage. The study recommends several solutions: developing comprehensive waste collection systems, enhancing recycling and composting facilities, and improving garbage pickup schedules for solid waste management. For stormwater management, it suggests upgrading drainage infrastructure and implementing flood prevention measures. Additionally, enforcing environmental regulations and fostering stakeholder participation are crucial for effective implementation. The study provides valua ble insights for market operators, policymakers,*

*and urban planners aimed at improving public health and environmental quality in Addis Ababa's vegetable markets.*

*Key words: Environmental sustainability; Waste management; Storm water management; Vegetable market*

## 1. Introduction

In the context of vegetable markets, sustainability refers to the procedures and frameworks that guarantee these markets' long-term survival while reducing adverse effects on the environment, society, and the economy. Organic waste makes up a large portion of the garbage produced by vegetable markets, especially in urban areas. Adopting sustainable solid waste management techniques will significantly cut the quantity of garbage dumped in landfills and lower greenhouse gas emissions of methane (Jiang et al., 2020). These methods include waste segregation, recycling, and composting.

Furthermore, storm water management is necessary to stop organic and inorganic contaminants from being introduced into nearby water bodies by market runoff (Pires et al., 2019). Green infrastructure can reduce environmental harm and improve storm water absorption, such as bioswales and permeable pavements (Schueler, 1994).

A sustainable vegetable market supports local economies by providing vendors with a stable source of income and consumers with affordable, fresh produce. By adopting eco-friendly practices, such as reducing plastic use, promoting local sourcing, and utilizing renewable energy, markets can lower operational costs and enhance profitability. Moreover, sustainable waste management systems can create job opportunities in recycling, composting, and other environmental services (Pires et al., 2019).

Ecological Modernization Theory (EMT) suggests that environmental protection can be achieved without compromising economic growth. It focuses on technological innovation and institutional reform as key drivers for sustainable development in urban areas (Mol & Spaargaren, 2000). This theory applies to urban markets by advocating for: Utilizing environmentally friendly packaging, waste recycling systems, renewable energy sources, and eco-friendly waste systems are examples of sustainable technology.

The classic "take-make-dispose" linear economy paradigm is replaced with the Circular Economy model. The Ellen MacArthur Foundation (2013) states that its main goals are resource reuse and waste reduction in closed-loop systems. With Waste Minimization, urban marketplaces can use this strategy: Markets lessen the quantity of garbage that ends up in landfills by encouraging merchants to use biodegradable packaging and composting organic waste. Establishing mechanisms for the recovery and recycling of materials like cardboard, plastics, and metals is known as resource recovery (Geissdoerfer et al., 2017).

People can ensure long-term economic, social, and environmental well-being through their livelihoods, according to the Sustainable Livelihoods Approach (SLA). This implies for metropolitan markets: Facilitating sustainable livelihoods for vendors, especially small-scale and informal workers, through resource access, financial inclusion, and skill development is known as inclusive growth (Chambers & Conway, 1992). Keeping the environment clean and protecting future generations' means of subsistence by preventing market activities from depleting natural resources or aggravating environmental deterioration (Scoones, 1998).

The study of the interplay between power dynamics, sustainability, and urban settings is known as urban political ecology, or UPE. It highlights how political and economic inequality affect urban sustainability concerns like trash management in markets (Heynen et al., 2006). In metropolitan marketplaces, this theory recommends: Ensuring that all market participants have access to trash disposal facilities, clean water, and other environmental services is known as equitable resource allocation. Including excluded groups in choices about sustainable market operations, such as low-income neighborhoods and informal vendors, is known as inclusive policy-making (Swyngedouw & Heynen, 2003).

Environmental sustainability challenges in urban settings have become increasingly prominent as cities grow and industrialize. Among these challenges, solid waste management and stormwater management are critical areas of concern, particularly in bustling urban markets where high volumes of waste and runoff can exacerbate environmental issues.

Urban vegetable markets are essential for providing fresh produce to city populations but face significant environmental sustainability challenges, particularly in solid waste and stormwater management. These markets generate substantial amounts of organic and inorganic waste, including spoiled vegetables and packaging materials, which require efficient management to minimize environmental impact (Jiang et al., 2020). The effective handling of this waste is critical to reduce landfill use, mitigate pollution, and protect public health (Pires et al., 2019).

Solid waste management in vegetable markets is complicated by issues such as inadequate waste segregation, insufficient collection systems, and limited recycling facilities. Improper management can lead to increased environmental pollution, including contamination of soil and water resources, and can pose serious health risks (Yuan et al., 2018). Proper waste management strategies are essential for promoting recycling, composting, and reducing waste generation, which contribute to overall urban sustainability (Pires et al., 2019).

Solid waste management in urban areas, especially in markets, involves handling large quantities of organic and inorganic materials. Inefficient waste segregation, inadequate collection systems, and limited recycling facilities often lead to increased pollution and health risks (UNEP, 2021). Markets generate diverse waste types, including perishable goods and packaging materials, which require effective management to mitigate environmental impact and maintain public health (Khan et al., 2020). Proper waste management is essential for reducing landfill use, minimizing environmental contamination, and promoting sustainability (Zhang et al., 2010).

Inefficient drainage systems can lead to waterlogging, infrastructure damage, and the transport of pollutants into aquatic ecosystems, worsening environmental conditions (Klein et al., 2005). As urban areas face increased rainfall and climate variability, robust storm water management practices become even more essential (IPCC, 2021).

This research aims to explore these environmental challenges in urban vegetable markets, with a focus on identifying key issues in solid waste. By analyzing current practices and proposing improvements, the study seeks to enhance sustainability and resilience in urban

market settings. This focuses on minimizing negative environmental impacts through: Resource Management: Efficient use of water, energy, and materials in market operations. Emphasis is placed on using renewable energy sources (e.g., solar panels) and conserving water through rainwater harvesting (Geissdoerfer et al., 2017).

Additionally, Implementing recycling systems, composting organic waste, and reducing the use of non-biodegradable materials such as plastic (Ellen MacArthur Foundation, 2013). Pollution Control: Ensuring proper disposal of solid waste and wastewater to prevent soil and water pollution (UNEP, 2012).

However, providing clean, safe, and accessible spaces that promote the well-being of consumers and vendors by reducing pollution and ensuring good sanitation(WHO, 2010). Government policies should support sustainable practices through regulations on waste disposal, energy use, and market construction (UN-Habitat, 2010).

Inefficient Solid Waste Management

High Volume of Waste: Vegetable markets, such as the Lafto Vegetable Market Center, generate substantial quantities of organic and inorganic waste daily. The high turnover of perishable goods results in a significant amount of spoiled produce and packaging waste. Inefficient management of this waste can lead to environmental degradation and health issues (Jiang et al., 2020).

Inadequate Waste Segregation: Many markets struggle with proper waste segregation. Organic and inorganic waste often end up mixed, complicating recycling and composting efforts. This lack of segregation reduces the efficiency of waste processing and increases the burden on landfills (Yuan et al., 2018).

Limited Recycling and Composting Facilities: The absence of adequate recycling and composting facilities in many urban markets hampers effective waste management. Without these facilities, recyclable materials and organic waste often contribute to environmental pollution rather than being processed into valuable resources (Pires et al., 2019).

## 1.1. Climate Change Impacts

Increased Rainfall Intensity: Climate change is increasing the frequency and intensity of heavy rainfall events. This exacerbates existing issues with storm water management, leading to more severe flooding and runoff problems (IPCC, 2021).

Temperature Variability: Higher temperatures can accelerate the decomposition of organic waste, leading to increased waste volume and higher management challenges. This variability complicates efforts to maintain effective waste management systems (IPCC, 2021).

Addressing these problems requires a comprehensive approach that integrates improved waste management practices and modern storm water management infrastructure. Effective solutions will involve upgrading facilities, enhancing regulatory frameworks, and increasing stakeholder engagement to ensure sustainability and resilience in urban vegetable markets.

Environmental sustainability is concerned with issues such as: Long-term health of ecosystems. Safeguarding the long-term viability and health of resources to satisfy future societal and economic needs, such as safeguarding food supplies, agriculture, and fisheries. Renewable resources: Diversifying into energy sources that do not rely on non-renewable resources. For example, solar and wind power. Targeting social welfare/happiness and environmental sustainability above crude measures of progress such as GDP. Measures of economic welfare (Pettinger, 2018).

## 1.2. Solid Waste Management in Urban Markets

Solid waste management in urban markets is a critical concern due to the large volume of waste generated. Several studies highlight the inefficiencies and challenges associated with managing waste in these settings. According to Jiang et al. (2020), urban vegetable markets produce significant amounts of organic waste, which, if not properly managed, can lead to environmental pollution and health risks. This waste often includes spoiled produce and packaging materials, which require efficient segregation and processing to minimize impact.

Yuan et al. (2018) discuss the challenges faced by many urban markets in implementing effective waste segregation systems. The lack of proper waste sorting facilities results in mixed waste streams that complicate recycling and composting efforts. This inefficiency increases the reliance on landfills and contributes to environmental degradation. The study emphasizes the need for improved infrastructure and waste management practices to address these issues.

Pires et al. (2019) explore municipal solid waste management in developing countries, noting that many markets struggle with inadequate waste collection systems and limited recycling options. Their review highlights the necessity of integrating waste management solutions, such as increased recycling facilities and composting programs, to enhance sustainability.

Vermi-compost generated from vegetable and fruits waste can be utilized as bio-fertilizer. Farmers growing a particular fruit or vegetable can produce vermicompost at their farm itself and can utilized or sell to others also. Also, land pollution can be minimized as the waste is utilized at the farm itself (Patel, et al., 2015). The method used to collect the data in vermin composition is collecting of Vegetable market waste and cow dung, collection of earthworms and Vermicomposting-Experimental setup use. Recycling organic waste by composting two composting plants are known in Addis Ababa. Due to a lack of financial incentives, private sector initiatives have so far been limited (Yang et al., 2018).

### 1.3. Impact of Climate Change

The effects of climate change exacerbate existing challenges in waste and storm water management. The Intergovernmental Panel on Climate Change (IPCC, 2021) reports that increased rainfall intensity and temperature variability contribute to more severe flooding and accelerated decomposition of organic waste. These factors complicate waste and storm water management efforts, highlighting the need for adaptive strategies.

The current study builds on these findings by focusing specifically on the Lafto Vegetable Market Center in Addis Ababa. It aims to identify and analyze the solid waste and storm water management challenges unique to this market. By examining current practices and

proposing improvements, the study seeks to address the gaps identified in the literature and contribute to the development of sustainable solutions for urban vegetable markets.

Therefore, this study fills this gap by determining the factors that affect the environmental sustainability issues of Vegetable market. This study organized in the following sections introduces the research materials and methods used to identify the solid waste management system and stormwater management of Lafto vegetable markets and tools used in the data analysis included in section 2 and section 3 to explore relevant literature. Summarizing the research environmental issues that influence the sustainability of the vegetable market in the Lafto sub-city is used as an example described in section 4. Finally, results and discussions are explained and interpreted, additionally, the final section includes recommendations and provides a useful summary of the study and research findings.

## 2. Materials and Methods

To address the identified research gaps in solid waste and storm water management at vegetable markets, this study will employ a combination of qualitative and quantitative methods. The chosen methods aim to provide a comprehensive analysis and practical solutions for the Lafto Vegetable Market Center in Addis Ababa.

This study examines the environmental sustainability challenges related to solid waste and stormwater management at the Lafto Vegetable Market Center in Addis Ababa. The methodology involves a mixed-method approach combining qualitative and quantitative techniques to provide a comprehensive analysis of the issues and propose actionable solutions.

### 2.1. Vegetable markets in Ethiopia

The Lafto vegetable market, which took place in 2020, is where the study area's history began. In previous decades, Atikilt Tera, a large open vegetable and fruit market that was first located in Piassa, temporarily relocated to the fields of Jan Meda, a sports area, in order to stop the spread of the Novel Coronavirus (COVID-19) pandemic. For more than five months, the market was located in Jan Meda. In the end, it was given a new location at the Lafto Vegetable & Fruit Market Centre in southwest Addis Ababa's Haile Garment area. The location surprised sellers and customers (Sileshi E., 2021).

## 2.2. Description of the case study area, Lafto Vegetable market center

Lafto Vegetable Market Center, a prominent urban market in Addis Ababa, serves as the focal point of this study. It was selected due to its significant role in the local food supply chain and the observable challenges related to waste and storm water management.

The study area is Located in Ethiopia's capital city, Addis Ababa, Nifas Silk lafto Sub-city Woreda 01. Lafto Vegetable Market is geographically located between is situated between the latitudes of 8° 55'33.59"N and 8° 55'36.88"N and 38° 44'12.55"E and 38° 44'4.48"E longitude with an elevation ranging from 2217 to 2232 m above sea Level. The study area covers about 3.5 hectares.

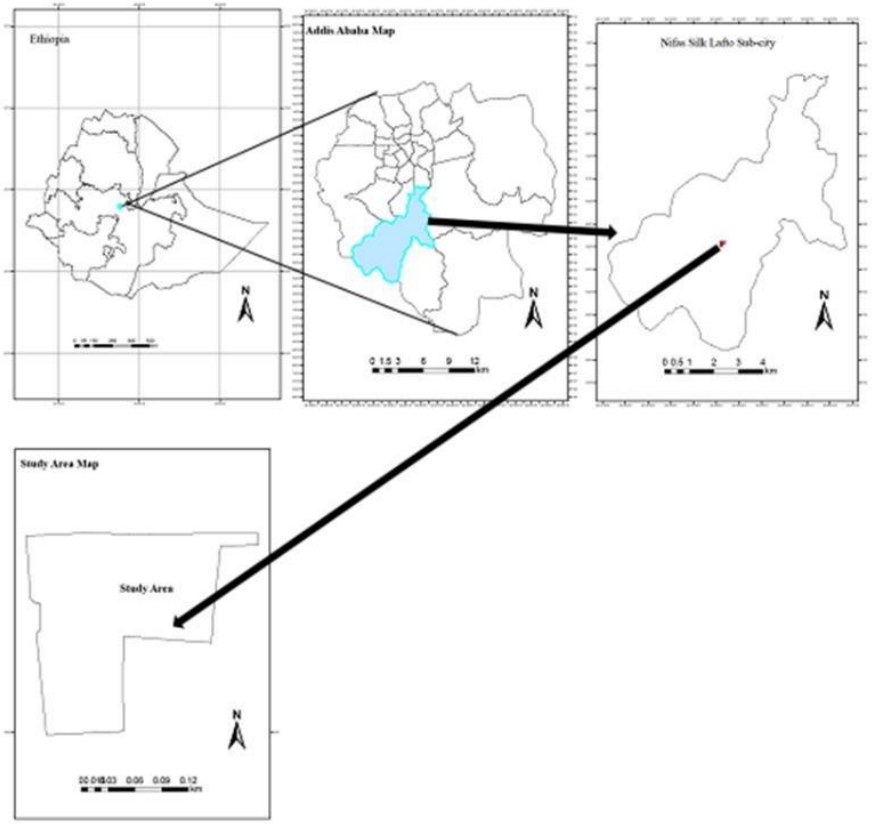


Figure 1 Location Map of the study area

Source: computed by GIS software, 2024.

## 2.3. Data Collection

### 2.3.1. Desk study

Field Observations: Direct observations were conducted at the Lafto Vegetable Market to assess waste generation, segregation practices, and stormwater management infrastructure. Observations focused on waste handling procedures, the condition of drainage systems, and the impact of stormwater runoff on market operations and surrounding areas.

Document Review: Relevant municipal documents, including waste management policies, stormwater management plans, and historical data on market waste and flooding incidents, were reviewed. This review helped contextualize the current practices and identify gaps in the existing systems (Yuan et al., 2018).

### 2.3.2. Key informant interviews

Surveys and Interviews: Structured surveys and semi-structured interviews were administered to market vendors, waste management personnel, and local authorities. The surveys aimed to gather quantitative data on waste volumes, management practices, and perceptions of current systems. Interviews provided qualitative insights into the challenges and effectiveness of existing waste and storm water management practices (Creswell & Poth, 2018).

Semi-structured interviews will be conducted with various stakeholders, including market vendors, waste management staff, and local government officials. These interviews will explore perceptions of current waste, challenges faced, and suggestions for improvement. Thematic analysis will be used to identify common themes and insights from the interviews (Braun & Clarke, 2006). In-depth, semi-structured interviews may be conducted with street vendors and key informants such as local business owners, lawmakers, and law enforcement personnel. Through interviews, researchers can gather in depth knowledge about these people's perspectives, motivations and experiences (Bromley, 2000).

## 2.4. Samples size determination

Then systematic and stratified sampling was used from 548 shops the selected needed for the sample were randomly selected from 1 to 7. Select 5 start with the fifth person in every

block. Then from the total of 548 shops that building signs from A to N, 55 retailers which is 10% of each retailer have been taken as a representative of the retailer's population.

A lot of populations were included in this research, so we use 5 % from each group. Tschirhart, N., Sevcikova, H., & Young, L. (2016) have written this method: Capture-Recapture method: This method involves capturing a sample of street vendors, marking them, releasing them back into the population, and then capturing another sample. By comparing the marked and unmarked vendors in the second sample, the total population size can be estimated. A systematic and stratified random sampling method has been employed to choose the households from which the data is to be collected. Hence, a representative sampling of 10% has been applied where every tenth household (Maru, 2012).

### 2.5. Data analysis

Data from surveys were analyzed using statistical methods to identify trends and patterns in waste generation, management efficiency, and stormwater impacts. Descriptive statistics were employed to summarize waste volumes, recycling rates, and frequency of flooding events (Field, 2013).

Qualitative Analysis: Interview transcripts and field notes were analyzed thematically to identify common issues and perceptions related to waste and storm water management. Thematic analysis was used to categorize and interpret qualitative data, providing a deeper understanding of the challenges faced by market stakeholders (Braun & Clarke, 2006).

#### 2.5.1. SPSS based factor analysis

The descriptions and arrangement of the interviews with managers, directors, department heads, and team leaders will yield insightful information in addition to qualitative data. Data on many variables pertaining to physical and environmental issues and their impact on sustainability and resilience were also presented and interpreted using descriptive analysis. The statistical software for social science (SPSS) will be utilized to analyze the data.

## 3. Results

### 3.1. Results from key informant interview

The key informant interviewers noted several issues, including the dispersal of garbage, a lack of accountability and responsibility for the workspace, and government-provided restrooms with egotistical patrons. Summertime issues include the requirement for energy to remove waste and clears the air, the need for food, a distinct odor, pneumonia, and other related lung problems will also be present.

Table 1The key informant interviewers noted several issues

| No. | Key Informants | Experts | | Total |
|---|---|---|---|---|
| | | Office | Site | |
| 1. | vegetable market leader | 2 | 1 | 3 |
| 2. | Addis Ababa Solid Waste Management Authority | 1 | | 1 |
| 3. | Addis Ababa City Environment Protection Office | 1 | | 1 |
| 4. | Nifas Silk Lafto Sub City Design Permission and Plan Commission | 1 | | 1 |
| 5. | Nifas Silk Sub city Solid Waste Management Agency | 3 | | 3 |
| Total | | 13 | 2 | 15 |

Source: answer from questionnaire, 2024

### 3.2. Environmental sustainability issues of vegetable markets in Addis Ababa

The chart below regarding the issues with drainage systems in the market area shows that: 22.5% of participants reported that the drainage systems were clogged with solid wastes; 10% of respondents mentioned that there was no provision of drainage lines inside the roads; a significant majority of 67.5% highlighted the lack of drainage lines inside the roads as a major issue.

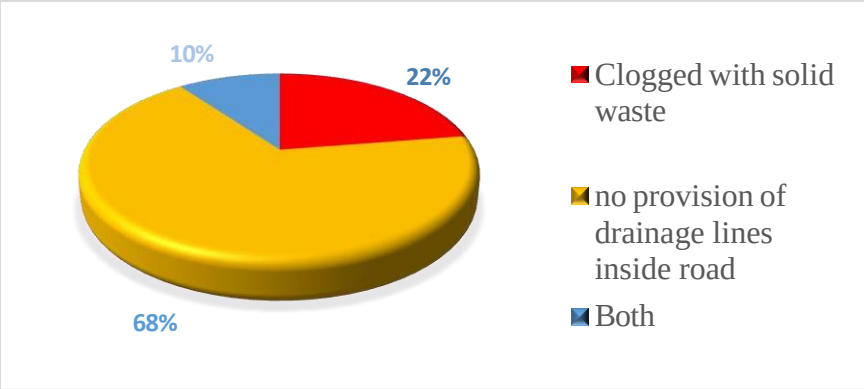


*Figure 2respondents' perceptions regarding the primary issues associated with drainage systems.*

Source: answer from questionnaire, 2024

### 3.3. Users perception towards the environmental issues of the market

Figure 3 indicates that the most common challenge experienced during rainy seasons, according to the responses, is water gathering everywhere, cited by 30.0% of respondents. This is followed by unpleasant odors emitted into the environment (26.7%), and the difficulty in removing wastes, which requires energy (16.7%). Falling due to slippery conditions is also noted as a challenge by 13.3% of respondents.

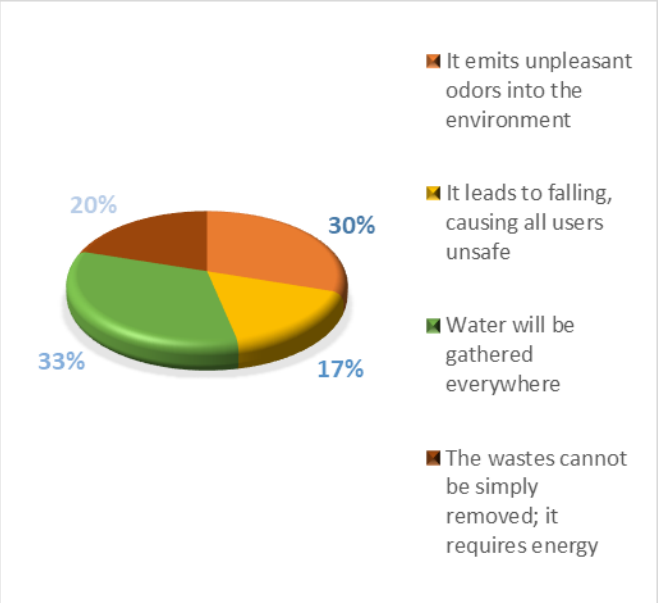


Figure 3 Respondents experiences of challenges during rainy season

Source: answer from questionnaire, 2024

### 3.3.1. solid waste management in Lafto vegetable market

The figure below shows that most respondents (60%) mentioned a waste collection area within the compound, indicating that waste management facilities are available. However, a significant portion (40%) noted the absence of a designated waste collection area, which may pose challenges for proper waste disposal and management.

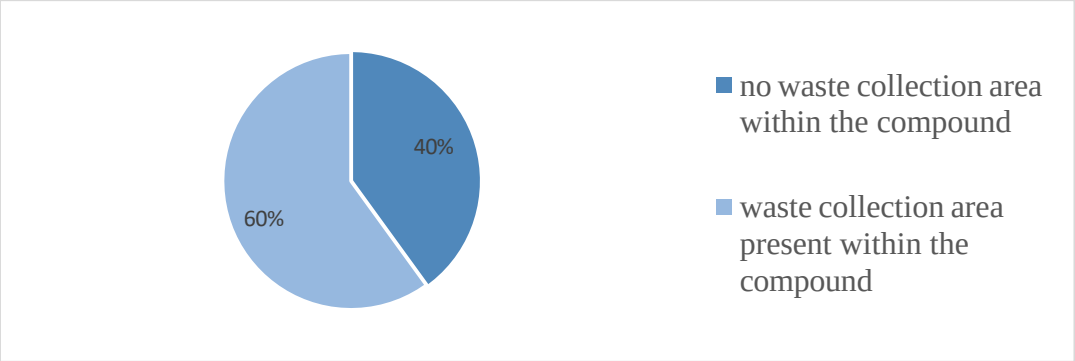


*Figure 4 Waste collection area existence with in the compound*

Source: answer from questionnaire, 2024

Figure 435 shows a range of responses was provided by respondents on where they store their items when there is no specified area, with variations in practices observed. Storing items in open areas and collecting rubbish and placing it in the entrance and exactly put in to the waste vehicle were among the common practices reported by respondents.

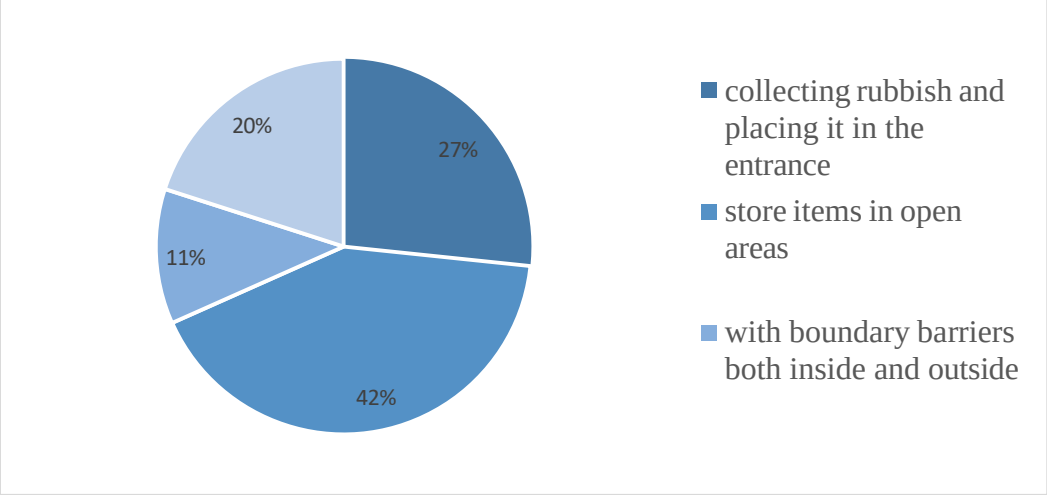

*Figure 5 waste collection area putting waste in different parts of the compound*

*Source: answer from questionnaire, 2024*

### 3.3.2. Type, condition and availability of drainage lines

The data suggests that while most respondents believe that merchants use dustbins somewhat frequently, a notable portion of respondents perceive merchants to use dustbins infrequently. Additionally, very few respondents believe that merchants use dustbins with a high frequency.

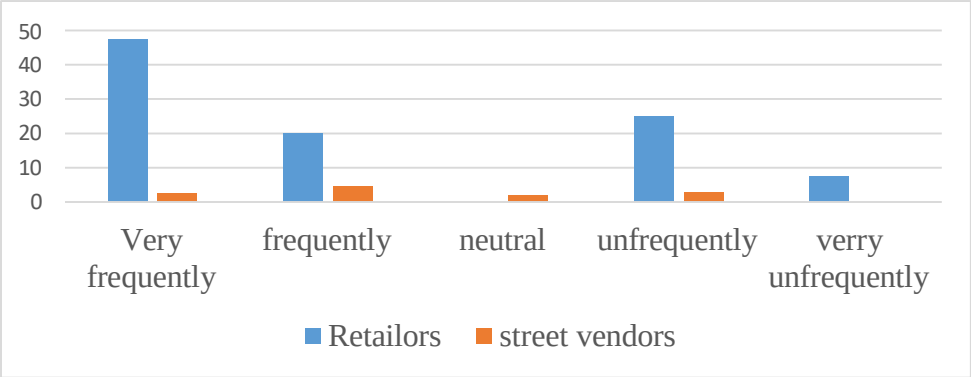


*Figure 6 responses regarding the practice of merchants using dustbins, categorized on a scale from very infrequently (1) to very frequently (4).*

*Source: answer from questionnaire, 2024*

*Figure 7 drainage covered by waste*

*Source: answer from questionnaire, 2024*

### 3.3.3. Solid waste management infrastructure

The majority of respondents (58%) identified providing dustbins in front of every space as the most effective initiative in waste management. A significant proportion of respondents (23%) appreciated both a polite response from all users at the time of waste disposal and the provision of collection areas on-site.

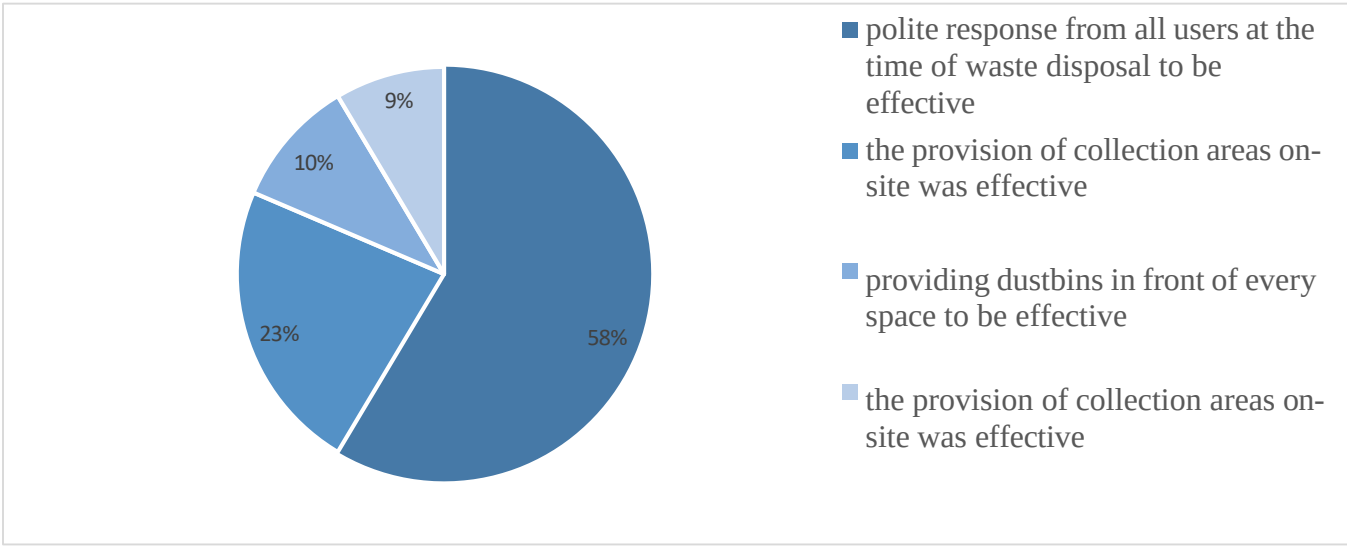


*Figure 8 regarding the perceived effectiveness of different initiatives in waste management: Different initiatives in waste management system*

*Source: answer from questionnaire, 2024*

There are 90 cleaners and collectors of Atikilt Tera garbage, and 5 cars are utilized to collect and transport the waste from Atikilt Tera to Repi waste collection area, according to data gathered from Nifas Silk Lafto sub city dry waste management and Addis Ababa. Trade and Industry office. Every day, the site is cleaned. After being collected, the garbage will be composted and converted into electricity.

### 3.4. Response to the vegetable market problems: Adaption measures

The majority (75%) of the sample respondents of vendors had no dust bins on the site; while 17.5% of respondents said there is no provided waste containers 5% of the other respondents because of poor performance of waste collection and the rest 2.5 % said in adequate solid waste collection. The study results also indicate that, most street vendors need dust bins to solve waste management systems.

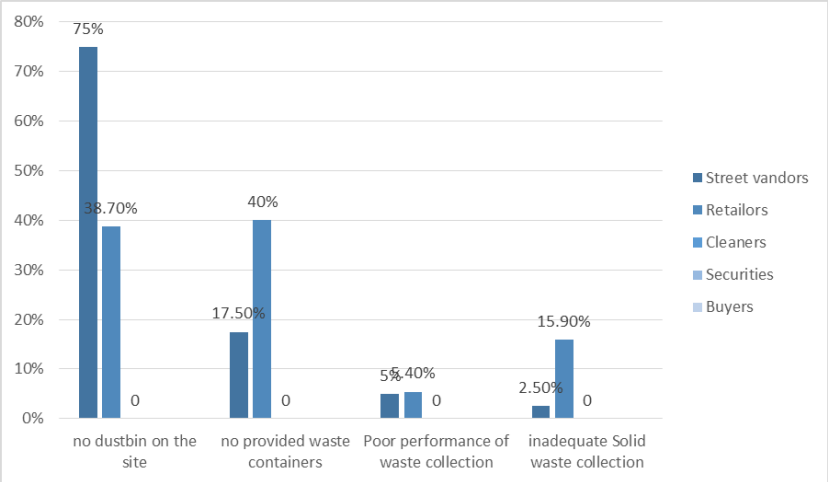


*Figure 9 provision of waste collection area dust bin on the study area/Challenges of waste management*

*Source: answer from questionnaire, 2024*

The main challenges identified by respondents include inadequate dust bins, inadequate waste containers, inadequate solid waste collection, and poor performance of solid waste collectors. The most frequently mentioned challenge is inadequate waste containers, followed by inadequate dust bins and a combination of inadequate waste containers and inadequate solid waste collection.

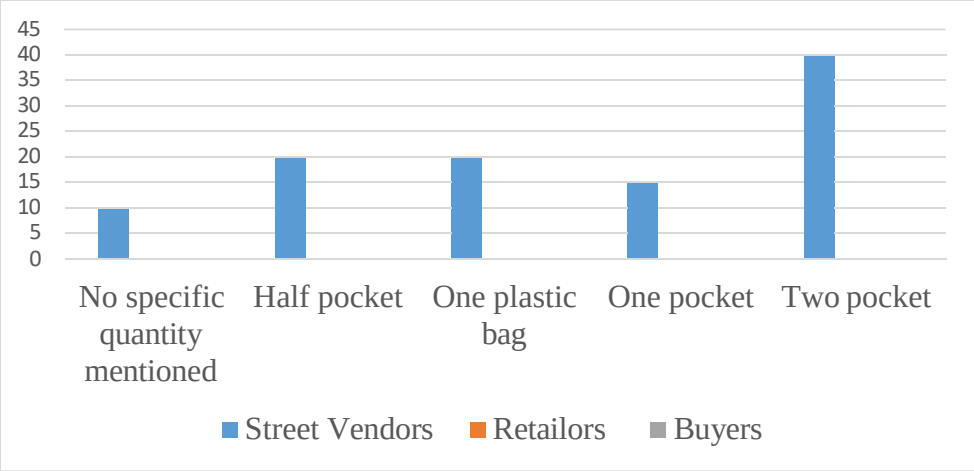


*Figure 10 Rubbish produced in a single day from different respondents*

*Source: answer from questionnaire, 2024*

## 4. Discussions

### 4.1. Implications for environmental sustainable issues

The findings highlight a clear need for improved waste segregation systems and organic waste management solutions, such as composting facilities. Composting could reduce the volume of waste going to landfills while generating useful products for local agriculture. Additionally, the market requires a more structured recycling program, coupled with awareness campaigns to educate vendors about the benefits of waste segregation and recycling (Schueler, 1994).

Water samples collected from the runoff showed high levels of organic and inorganic pollutants, including vegetable waste, plastic debris, and oils. These pollutants not only contaminate local water bodies but also contribute to blockages in the drainage system (Dunne & Leopold, 1978).

Market vendors and waste management personnel generally lack awareness of proper waste management techniques. Additionally, there is limited capacity among local authorities to enforce existing waste management regulations (Braun & Clarke, 2006).

Addressing these challenges will require capacity-building initiatives for market vendors and waste management staff. Educating stakeholders on the importance of proper waste

Management and storm water practices, alongside clearer delineation of roles and responsibilities, will be crucial for the successful implementation of the proposed interventions (Schueler, 1994).

Adapting to the impacts of climate change will require a forward-looking approach to upgrading the market's infrastructure. Investments in climate-resilient drainage systems, improved waste management practices, and green infrastructure are critical to reducing the environmental risks posed by these changes (Pires et al., 2019).

The introduction of segregated bins resulted in a 20% reduction in the amount of waste being sent to landfills, as more waste was composted and recycled. Upgrading the drainage system with permeable surfaces reduced flooding incidents by 30% during moderate rainfall events (Jiang et al., 2020). These results indicate that with continued investment and proper maintenance, the market can significantly improve its waste and storm water management practices. Long-term sustainability will require the scaling up of these interventions, combined with continued stakeholder engagement and monitoring (Garnier et al., 2018).

## 5. Conclusions

The study concludes that Lafto Vegetable Market faces significant challenges in managing solid waste and storm water. These challenges are driven by inadequate infrastructure, poor waste segregation practices, and limited stakeholder engagement. To improve environmental sustainability, the following recommendations are proposed:

Implementation of ISWM: Establishing a structured waste management system that prioritizes waste segregation, recycling, and composting is essential for reducing landfill use and improving environmental outcomes (Pires et al., 2019).

Stakeholder Education and Policy Enforcement: Strengthening public awareness and policy enforcement are critical for ensuring compliance with waste and storm water management regulations. Educating vendors and market officials on sustainable practices will foster better environmental outcomes (Creswell & Poth, 2018).

By addressing these challenges through an integrated and sustainable approach, the Lafto market can reduce its environmental footprint and improve public health and sanitation. The study concludes that Lafto Vegetable Market faces significant challenges in managing solid waste and storm water. These challenges are driven by inadequate infrastructure, poor waste segregation practices, and limited stakeholder engagement. To improve environmental sustainability, the following recommendations are proposed:

1. Implementation of ISWM: Establishing a structured waste management system that prioritizes waste segregation, recycling, and composting is essential for reducing landfill use and improving environmental outcomes (Pires et al., 2019).

3. Stakeholder Education and Policy Enforcement: Strengthening public awareness and policy enforcement are critical for ensuring compliance with waste and storm water management regulations. Educating vendors and market officials on sustainable practices will foster better environmental outcomes (Creswell & Poth, 2018).

By addressing these challenges through an integrated and sustainable approach, the Lafto market can reduce its environmental footprint and improve public health and sanitation.

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## **Appendix B.** Shops, roads, waste collection areas, Found in the study area

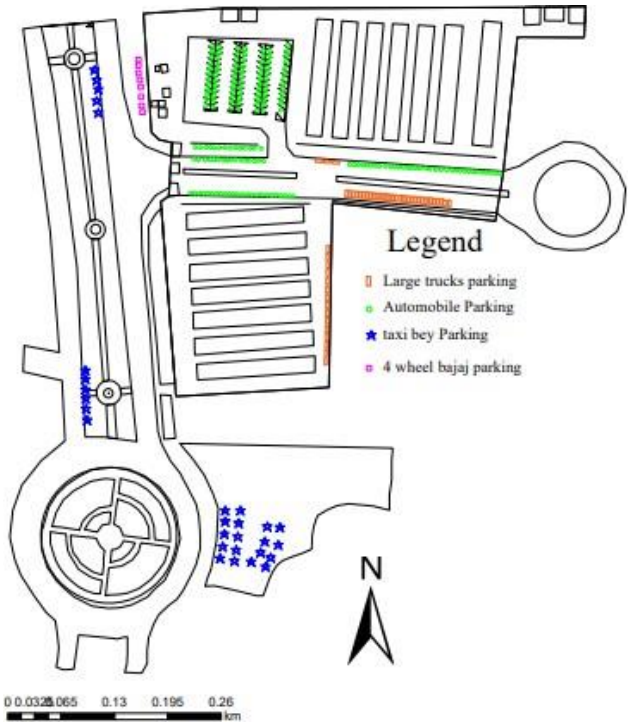
*Fig 1 study area map. Existing map of the study area* *Fig 2study area map*

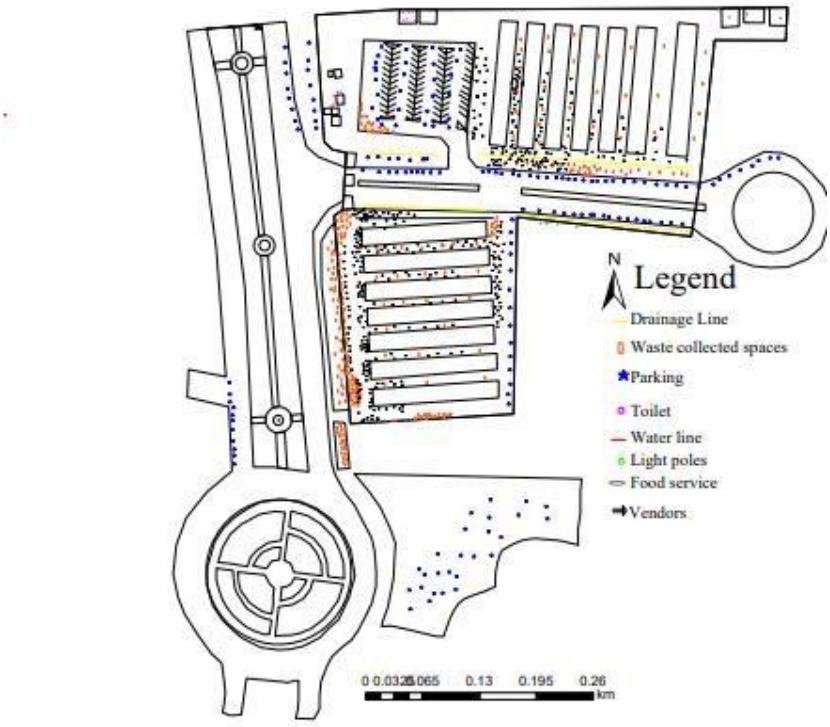
*Source: road map of Lafto sub-city computed by author*

*Table 1T*arget population

| S. no | Respondents | Study area | Target Population | Sample Population |
|---|---|---|---|---|
| 1 | Buyers | Lafto Vegetable Market | Unknown | 213 |
| 2 | Retailors | Lafto Vegetable Market | 548 | 55 |
| 3 | Street Vendors | Lafto Vegetable Market | Unknown/340 | 17 |
| 4 | Cleaners | Lafto Vegetable Market | 92 | 8 |
| 5 | Securities | Lafto Vegetable Market | 30 | 10 |
| 6 | Government Officials | Addis Ababa Trade and Industry bureau, Waste management Authority, and Traffic management Office, | many | 8 |

*Source: Own computation, 2024*


Legend
Large trucks parking
Automobile Parking
taxi bey Parking
4 wheel bajaj parking
N
0 0.032 0.065 0.13 0.195 0.26
km


N
Legend
Drainage Line
Waste collected spaces
Parking
Toilet
Water line
Light poles
Food service
Vendors
0 0.032 0.065 0.13 0.195 0.26
km

## **Appendix C.** Parking Data Collection

*Table 2 Parking data collection*

| No | Types of car | Inside the compound | | | | | | | | | Outside the compound | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Week day 1 | | | Week day 2 | | | Week end 3 | | | Week day 1 | | | Week day 2 | | | Week end 3 | | |
| | | Morning | Afternoon | Evening | Morning | Afternoon | Evening | Morning | Afternoon | Evening | Morning | Afternoon | Evening | Morning | Afternoon | Evening | Morning | Afternoon | Evening |
| 1 | Automobile | | | | | | | | | | | | | | | | | | |
| 1. | Taxi | | | | | | | | | | | | | | | | | | |
| 2. | Large trucks | | | | | | | | | | | | | | | | | | |
| 3. | Isuzu | | | | | | | | | | | | | | | | | | |
| 4. | Small Isuzu | | | | | | | | | | | | | | | | | | |
| 4. | 4 wheel Bajaj's | | | | | | | | | | | | | | | | | | |
| 5. | Ladas | | | | | | | | | | | | | | | | | | |

## **Appendix D.** Questionnaires

### Addis Ababa University

### College of Ethiopian Institution of Architectural Building construction and City Development

### School of urban and regional planning

### MSc. Program

### Schedule Prepared for Lafto vegetable market center users,

Dear respondent,

I am a graduate student in the department of Urban and Regional Planning, at Addis Ababa University. Currently, I am undertaking a research entitled on "Analyzing the physical and environmental sustainability and resilience of Lafto vegetable market in Addis Ababa. You are one of the respondents selected to participate on this study. Please assist me in giving correct and complete information to present a representative finding on the current status of the factors affecting the vegetable Marketing; the Case of Lafto vegetable Market users. Your participation is entirely voluntary and the schedules are completely anonymous. Finally, this all information will be used for academic purposes only and no individual's responses will be identified as such and the identity of persons responding will not be published or released to anyone.Thank you in advance for your kind cooperation and dedicating your time.

**Situational variables for street vendors**

**Part I: Socio Demographic Information of Respondents**

1. Gender: Male ☐ Female ☐
2. Age: Under 15 ☐ 16-25 ☐ 26-45 ☐ Above 45 ☐
3. Level of Education: have no formal education ☐ 1-8 ☐ 8-12 ☐
   Certificate and Diploma ☐ Bachelor's Degree and above ☐

**Part II: General Questions about vegetable marketing**

4. Type of work:

   ☐ Root vegetable vendor

   ☐ Leafy vegetable vendor

   ☐ Fruit vendor

   ☐ Different from vegetable vendor

   specify_____

5. During which hours do you often work here?

   ☐ Moring ☐ Afternoon ☐ Evening ☐ the whole day

   Specify_____

6. What are the major challenges concerning solid waste management.

   ☐ In adequate dust bins

   ☐ In adequate waste containers

   ☐ In adequate solid waste collection

   ☐ Poor performance of solid waste collectors

   If any other please specify? _____

7. Which of the following method do you use to remove the vegetable waste? (Tick all that apply).

   ☐ Using dust bins given by the municipality

   ☐ I have my own dust bin.

   ☐ I threw rubbish on the road

   ☐ I put into the drainage lines.

   ☐ I toss in open places.

   Other (please specify). _____

8. Does the government offer dust bins?

   ☐ Yes ☐ No

9. If so, what type of dust bin do you use?

☐ Basket ☐ any material ☐ in poket ☐ i do not use any dust bin

other, specify _____

10. Where are the dust bins put?

☐ Inside the retail shops

☐ In front of the shops

☐ No dust bin used

Other, specify _____

11. How satisfied were you with the waste management process?

☐ Bad ☐ Good ☐ Satisfactory ☐ ery good ☐ Excellent

12. What recommendations do you have for the waste management system?

_____

_____

13. What is the peak time of day? (Check the boxes if any of them are true).

☐ From 6:00 am to 9:00 am

☐ From 9:01 am to 12:00 pm

☐ From 12:01 pm to 3:00 pm

☐ From 3:01 pm to 6:00 pm

Other (please specify). _____

14. What are the most congested areas during peak hours in your opinion?

☐ Inside the compound

☐ Around the round about

☐ On the main street

☐ Throughout the compound.

Other (please specify). _____

15. What are the primary issues associated with drainage systems?

- ☐ Clogged with solid wastes
- ☐ No provision of drainage lines inside roads

If any other, please specify? _____

16. Does storm water flow correctly in the drainage lines?

☐ Yes ☐ No

17. What challenges do you experience during rainy seasons?

- ☐ The wastes cannot be simply removed; it requires energy
- ☐ It leads to falling, causing all users unsafe.
- ☐ It emits unpleasant odors into the environment.

If any other, please specify? _____

18. What are the main challenges associated with parking?

- ☐ The quantity does not fit the demand
- ☐ The parking spaces are not enough
- ☐ The design is not considerate of the future demand for the service
- ☐ Absence of segregated parking spaces for loading/ unloading, customers (visitors) etc.

If any other, please specify? _____

19. Does the parking area accommodate large trucks?

☐ Yes ☐ No

20. If not, what are your suggestions for making it accessible?

_____

21. Describe the main challenges on loading/ unloading ?

- ☐ Conflict of interest
- ☐ Poor space allocation for unloading distracting pedestrian ways
- ☐ Loading is designated outside the compound

If any other, please specify? _____.

22. What are the environmental issues you address in the vegetable market?

☐ Insufficient working space

☐ Insufficient market

☐ High competition

Other, specify_____

23. What are the marketing problems that you face?

☐ Competitive challenge

☐ Lack of encouraging response from customers

☐ Lack of storage space

Other, specify_____

24. What challenges have you faced with social securities?

☐ Harassment from officials and shopkeepers

☐ Problem of criminal activity

☐ Lack of flexibility during business hours

☐ Insecurities about oneself

Other, specify_____

25. Which of the following amenities are important for work support?

☐ Water facilities

☐ power facilities

☐ Workplace

Other, specify _____

26. It is easy for everyone to access transportation after purchasing vegetables.

☐ Strongly disagree

Disagree

Neutral

Agree

Strongly agree

27. There are parking areas for heavy trucks.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

28. Every merchant collects waste using dust bins.

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

**Part I: Socio Demographic Information of cleaners**

1. Gender: Male Female
2. Age: 18-25 25-40 41-55 Above 55
3. Level of Education: have no formal education 1-8 8-12 Certificate and Diploma Bachelor's Degree and above

**Part II: Situational variables**

4. How frequently do you clean the vegetable market area?

☐ One time per day
☐ Two times per day
☐ 1 times per 2 days
Other, specify_____

5. Is there any specific time to clean the compound?

☐ Yes ☐ No

6. If you have specific time, at what time of the day do you clan the compound?

☐ When the space is free
☐ When no one is there
☐ At lunch time
☐ The whole day
Other, specify_____

7. Is the above time comfortable for you to collect and clean the waste?

☐ Yes ☐ No

8. If no, what are the major challenges that you face at the time of cleaning and collecting?

☐ Congestion of users of the site in the compound
☐ The presence of parking out side the parking lot
☐ Cleaning during this time is challenging due to intense sunlight.
☐ absence of dust bins on every place
Other, specify_____

9. Does your work get affected when vehicles park outside of the parking lot?

☐ Yes ☐ No

10. If you answered "yes," how does it impact you when vehicles are parked outside of spaces?

☐ Hard to get adequate cleaning completed.

☐ Rubbish is gathered in redundant locations.

☐ Rainwater will be accumulated in every spot, creating a pleasant odor.

11. What challenges limit your ability to perform effectively at work?

☐ Due to limited parking availability, vehicles are not parked in the designated area.

☐ Loading and unloading to the shop at our working time

☐ There is no consideration parking provision for trash vehicles.

Other, specify _____

12. Does the compound have a designated waste collection area?

☐ Yes ☐ No

13. Where do you store collected rubbish if there is no specified area?

☐ On the open areas

☐ The boundary barriers, both inside and outside

☐ Near the gate, as it is convenient for easy and quick pick up.

☐ Collect rubbish and place it in the waste collector's van simultaneously.

Other, specify_____

14. How long does it take to drive from the above-mentioned rubbish collection areas to another?

☐ Twice every day.

☐ Every day

☐ Twice every week.

☐ Three times each week.

☐ One day per weak.

One day per weak.Other, specify _____

15. Do you apply a method to remove vegetable waste?

☐ Yes ☐ No

16. If yes then, What method do you use to remove vegetable wastes?

☐ burning

☐ burial

☐ composite

☐ collecting

17. What are your recommendations for improving cleaning and garbage collection effectiveness?

☐ Polite response from all users at the time of cleaning.

☐ Provision of collection area on the site till the garbage trucks arrive.

☐ Increasing the number of trucks that transport waste to the collecting place on a daily basis

Other, specify_____

18. Are dust bins available on-site?

☐ strongly disagree

☐ disagree

☐ Neutral

☐ agree

☐ strongly agree

19. Are different vegetable wastes treated differently?

☐ strongly disagree

☐ disagree

☐ Neutral

agree

strongly agree

**Part I: Socio Demographic Information of customers**

1. Gender: Male Female
2. Age: 18-25 26-40 41-55 Above 55
3. Level of Education: have no formal education 1-8 9-12 Certificate and Diploma Bachelor's Degree and above

**Part II: Situational variables**

4. How often do you come here to purchase vegetables?.

Every day

twice in a week

once in a week

1 day per month

twice in month

Other (please specify). _____

5. What type of vehicle do you use for loading?

Isuzu taxi auto Bajaj specify _____

6. What are the main challenges associated with parking?

The quantity does not fit the demand

The parking spaces are not enough

The design is not considerate of the future demand for the service

Absence of segregated parking spaces for loading/ unloading, customers (visitors) etc.

7. Do you take full advantage of the designated parking?

Yes No

8. If ‘No’ where do you park your car frequently?

   ☐ Inside the parking lot

   ☐ On the road

   ☐ In front of the shop

   ☐ On pedestrian road

   specify _____

9. Is the parking far from the shopping areas (Vegetable Shops)?

   ☐ Yes ☐ No

10. If yes, then how do you move the purchased vegetables from shop to the parking?

    ☐ By my own self

    ☐ I have my own servant

    ☐ I have loading customers

    specify _____

11. Do you think the parking service is appropriate for you?

    ☐ Yes ☐ No

12. If ‘no’, then what improvement do you suggest?

    _____

    _____.

13. Does the parking design take various vehicle types into consideration?

    ☐ Yes ☐ No

14. If ‘no’, then what will be your suggestion?

    _____

    _____.

15. What kind of cars make use of the designated parking spots?

    ☐ Automobile

    ☐ Taxi

☐ Isuzu

☐ High trucks

If other, Specify_____

16. Do all kinds of vehicles park in the designated area?

☐ Yes ☐ No

17. If the parking did not consider all types of vehicles then where do they park?

☐ On the walkway

☐ On the road

☐ On the edge of the fence

☐ Outside the compound

☐ On the open spaces

If other, Specify_____

18. What are the main parking-related troubles you have seen?

_____

_____

19. Do you believe that trucks with three wheels are essential on the vegetable market?

☐ Yes ☐ No

20. If you answer "yes," what are the main inquiries?

---

21. Is the taxi bay suitable for loading, in your opinion?

☐ Yes ☐ No

22. Where is the location of the taxi bay?

☐ outside the compound

☐ on the compound's side

☐ it is far from the compound

☐ in side the compound

23. What are the primary issues associated with drainage systems?

- ☐ Clogged with solid wastes
- ☐ No provision of drainage lines inside roads

If any other, please specify? _____

24. Both the internal road and the main road have drainage systems.

- ☐ strongly disagree
- ☐ disagree
- ☐ neutral
- ☐ agree
- ☐ strongly agree

25. Describe the main challenges on loading/ unloading ?

- ☐ Conflict of interest
- ☐ Poor space allocation for unloading distracting pedestrian ways
- ☐ Loading is designated outside the compound

If any other, please specify? _____.

26. What are the primary transportation-related issues in Atikilt Tera?

- ☐ There is a traffic jam during work hours.
- ☐ After purchasing the veggies, there is a lack of transportation.

27. When is the traffic expected to be highly congested?

- ☐ Morning
- ☐ Afternoon
- ☐ Evening

28. Where is the exact location of the congested area?

- ☐ Inside the compound

☐ On the main road outside the compound

☐ On the round about

Other, specify _____

29. What are the major challenges concerning solid waste management?

☐ In adequate dust bins

☐ In adequate waste containers

☐ In adequate solid waste collection

☐ Poor performance of solid waste collectors

If any other please specify? _____

30. Which of the following method do you think use to remove the vegetable waste? (Tick all that apply).

☐ By using dust bins that is provided from the municipal

☐ I use my own dust bin

☐ I put the waste on the road

Other (please specify). _____

31. To what extent were you satisfied with the waste management system looks like?

☐ Bad ☐ Good ☐ Satisfactory ☐ Very good ☐ Excellent

32. What are the major problems you observed in waste management system?

☐ Wastes are thrown on the sides of the fence

☐ Wastes are changed to mud and hard to clean easily

☐ Wastes affect the air and it leads to flue because of the smell

**Questionnaire For retailors**

**Part I: Socio Demographic Information of Respondents**

1. Gender: Male ☐ Female ☐
2. Age: 18-25 ☐ 26-40 ☐ 41-55 ☐ Above 55 ☐
3. Level of Education: have no formal education ☐ 1-8 ☐ 9-12 ☐
   Certificate and Diploma ☐ Bachelor's Degree and above ☐

**Part II: General Questions about vegetable marketing**

4. Type of work: Retailor ☐ vendor ☐ loading and unloading ☐ another specify _____
5. When do you work here the majority of the time?
   ☐ Moring ☐ Afternoon ☐ Evening ☐ the whole day
   Specify_____
6. What are the main challenges to the management of solid refuse?
   ☐ In adequate dust bins
   ☐ In adequate waste containers
   ☐ In adequate solid waste collection
   ☐ Poor performance of solid waste collectors
   If any other please specify? _____
7. Which of the following method do you use to remove the vegetable waste? (Tick all that apply).
   ☐ By using dust bins that is provided from the municipal
   ☐ I use my own dust bin
   ☐ I throw the waste on the road
   ☐ I throw into drainage lines
   ☐ I throw in to open spaces
   Other (please specify). _____

8. Are there any dust bins that the government provides?

☐ Yes ☐ No

9. If yes, then what type of dust bin you use?

☐ Basket ☐ any material ☐ pocket ☐ I used no dust bin at all.

other, specify _____

10. What quantity of rubbish is produced in a single day?

☐ half pocket ☐ one pocket ☐ two pocket ☐ one festal other, specify_____

11. Where do the dust bins get placed?

☐ Within the retail stores

☐ ahead of the stores

☐ No dustpan was utilized.

Other, specify _____

12. Does the shop generate different waste?

☐ Yes ☐ No

13. How do you separate vegetable waste from the other wastes if they are different?

☐ By placing various containers for decomposable and non-decomposable garbage,

☐ I combined everything into a single set.

Other, specify _____

14. What level of satisfaction did you have with the waste management system?

Bad ☐ Good ☐ Satisfactory ☐ Very good ☐ Excellent ☐

15. What are your recommendations that you have regarding to waste management system?

_____

_____

16. What is the peak time of day? (Check the boxes if any of them are true).

☐ From 6:00 am to 9:00 am

☐ From 9:01 am to 12:00 pm

☐ From 12:01 pm to 3:00 pm

☐ From 3:01 pm to 6:00 pm

Other (please specify). _____

17. What are the most congested areas during peak hours in your opinion?

☐ Inside the compound

☐ Around the round about

☐ On the main street

Other (please specify). _____

18. When it comes to loading retail stores, is the procedure for loading and unloading comfortable?

☐ Yes ☐ No

19. If it's uncomfortable, what changes would you recommend?

_____

_____.

20. Is it simple to load and unload items while supplying marketing items for customers?

☐ Yes ☐ No

21. If 'no', then what improvement do you suggest?

_____

_____.

22. What are the primary issues associated with drainage systems?

☐ Clogged with solid wastes

☐ No provision of drainage lines inside roads

If any other, please specify? _____

23. What challenges do you experience during rainy seasons?

☐ The wastes cannot be simply removed; it requires energy

☐ It leads to falling, causing all users unsafe.

☐ Water will be gathered everywhere.

☐ It emits unpleasant odors into the environment.

If any other, please specify? _____

24. What are the main challenges associated with parking?

☐ The quantity does not fit the demand

☐ The parking spaces are not enough

☐ The design is not considerate of the future demand for the service

☐ Absence of segregated parking spaces for loading/ unloading, customers (visitors) etc.

If any other, please specify? _____

25. Does the parking area accommodate large trucks?

☐ Yes ☐ No

26. If not, what are your suggestions for making it accessible?

---

27. Which of the following amenities is lacking in order to create a better atmosphere?

☐ Water facilities

☐ power facilities

☐ main road light and internal lights are not provided

☐ Workplace

28. The shop orientation provides comfort during loading and unloading.

☐ strongly disagree

☐ disagree

☐ neutral

☐ agree

☐ strongly agree

29. The accessibility of the vegetable market region is difficult with the current transportation systems.

☐ strongly disagree

☐ disagree

☐ neutral

☐ agree

☐ strongly agree

30. User-friendly locations for loading and unloading are superior.

☐ strongly disagree

☐ disagree

☐ neutral

☐ agree

☐ strongly agree

**Part I: Socio Demographic Information of cleaners**

1. Gender: ☐ Male ☐ Female
2. Age: ☐ 18-25 ☐ 26-40 ☐ 41-55 ☐ Above 55
3. Level of Education: ☐ have no formal education ☐ 1-8 ☐ 9-12 ☐ Certificate and Diploma ☐ Bachelor's Degree and above

**Part II: Situational variables**

4. What challenges exist in atakilt tera?

☐ Vehicles park in all areas in the compound outside of the parking lot due to a lack of parking space.

☐ Loading and offloading to shops during working hours

☐ There was no consideration of parking space for trash vehicles.

5. Between 12:00 and 3:00 a.m., there is traffic congestion in the compound.

☐ strongly disagree

☐ disagree

☐ neutral

☐ agree

☐ strongly agree

6. Between 3:00 and 6:00 a.m., there is traffic congestion in the compound.

☐ strongly disagree

☐ disagree

☐ neutral

☐ agree

☐ strongly agree

7. Between 6:00 and 9:00 a.m., there is traffic congestion in the compound.

☐ strongly disagree

☐ disagree

☐ neutral

☐ agree

☐ strongly agree

8. Parking for immense cars is available in the compound.

- ☐ strongly disagree
- ☐ disagree
- ☐ neutral
- ☐ agree
- ☐ strongly agree

9. Huge vehicle parking is available outside the compound.
   - ☐ strongly disagree
   - ☐ disagree
   - ☐ neutral
   - ☐ agree
   - ☐ strongly agree
10. Taxi stations and parking have an impact on traffic congestion.
    - ☐ strongly disagree
    - ☐ disagree
    - ☐ neutral
    - ☐ agree
    - ☐ strongly agree
11. Drainage lines are provided on all roads within the compound.Is there any specific time to clean the compound?
    - ☐ strongly disagree
    - ☐ disagree
    - ☐ neutral
    - ☐ agree
    - ☐ strongly agree

12. The shop orientation provides comfort during loading and unloading.

- ☐ strongly disagree
- ☐ disagree
- ☐ neutral
- ☐ agree
- ☐ strongly agree

13. Where is the congested area during the peak working hours?

- ☐ surrounding the square within the compound
- ☐ Near the main road square.
- ☐ on the major road beyond the boundary
- ☐ Throughout the site

14. What challenges did you encounter during the rainy season?

☐ To remove garbage, energy is required.

☐ It is not safe; it may result in a fall to the earth.

☐ It produces an unpleasant odor on the compound.

15. What are the main challenges related to parking?

- ☐ The quantity does not fit the demand
- ☐ The parking spaces are not enough
- ☐ The design is not considerate of the future demand for the service
- ☐ Absence of segregated parking spaces for loading/ unloading, customers (visitors) etc.

16. Does the parking lot allow large vehicles?

☐ yes ☐ no

17. If you answered no, what is your recommendation for further consideration?

_____

## Appendix E.*Interview questions*

***Addis Ababa University***

**College of Ethiopian Institution of Architectural Building Construction and City Development**

**School of Graduate Studies**

**MSc. Program**

Hello, I am Neima Jemal, a Masters student at Addis Ababa University. I am conducting a pilot study that aims to analyze the physical and environmental sustainability and resilience of Lafto vegetable market in Addis Ababa, Ethiopia. The purpose of this study is to evaluate the current state of the market in terms of sustainability and resilience. It also seeks to identify key environmental sustainability issues, factors affecting physical sustainability, and resilience characteristics of the vegetable market. Furthermore, the study aims to identify the challenges the market faces in achieving sustainable and resilient practices, as well as exploring potential strategies for improving the sustainability and resilience of Lafto vegetable market. Below are survey questions that you will be required to respond to. I kindly ask you to provide accurate information, as it will only be used for this MSc research and kept confidential. I thank you for your cooperation in advance.

Instructions to the interviewer:

- Please introduce yourself first, and then clarify the purpose of the study.
- Ask each question in written form.
- Ensure that all questions are answered by the respondents.
- Give respondents enough time to search their thoughts and answer questions thoroughly
- Most questions will require respondents to select the answer(s) by ticking (√), while only a few questions will require short responses to be filled in.

**Interview questions**

Interview questions with (Key- informants).

For vegetable market leader

What are the main problems and challenges you currently face at Lafto vegetable market?

2. Do you believe that you have the capacity to solve the issues at the vegetable market? Please answer with either "Yes" or "No". If your answer is "No", then who do you think is capable of addressing these problems?

3. How do you go about ensuring the security of the vegetable market?

4. Do you think the vegetable market area considered future expansion of the city of Addis Ababa?

5. Would you say that the current parking spaces provided adequately cater to all types of vehicles?

6. Can you explain how you manage the current parking system?

7. Are there any potential issues with a shortage of parking spaces, and if so, when would these problems likely occur?

8. What suggestions do you have for improving security and addressing other problems at the market?

9. In your opinion, are all essential amenities provided within the market area for users?

10. As you are well aware know, there is a traffic congestion at peak hours. What is your contribution to solve this problem?

**For Addis Ababa Solid Waste Management Authority**

1. What challenges have you faced in regard to solid waste management within the Lafto vegetable market area?

2. Are you aware of how the solid waste generated by the vegetable market is currently being managed?

3. Do you believe that all retail vendors have their individual dust bins for waste disposal?

4. What methods do you use for waste disposal, such as burning, burying, composting, or any other methods? Please specify.

5. What recommendations do you have concerning the management of vegetable waste within the vegetable market area?

**For Addis Ababa City Environment Protection Office?**

1. Does the presence of Lafto vegetable market have any environmental impact, and if so, how do you address it?

2. What steps have you taken to minimize pollution resulting from the management of vegetable waste in the market?

3. What suggestions or recommendations do you have to enhance the environmental protection of the vegetable market?

4. How do you ensure food safety and environmental protection within the vegetable market?

5. Are you aware of the factors that potentially affect environmental sustainability within the vegetable market area?

For **Nifas Silk Lafto Sub City Design Permission and Plan Commission**:

1. Is the Lafto vegetable market placed properly according to the master plan's land use?

2. Does the plan consider the future expansion and urbanization of Addis Ababa?

3. Does the plan consider all types of vehicles, and is it appropriate?

4. Does the plan consider a waste management area or collection area on the site?

5. If there isn't a waste collection area on the site, where is the waste collection area that's used for LVMW?

6. Is the vegetable market accessible from all parts of Addis Ababa?

7. What are your recommendations for solving traffic congestion and transportation problems on the site, especially on peak hours?

8. What are the current potentials of Lafto vegetable market?

9. What are your recommendations regarding the plan of vegetable market?

For **Nifas Silk Sub city Solid Waste Management Agency**:

1. What problems have vegetable market users faced regarding marketing their product at Lafto vegetable market?

2. Is there a waste collection space on the site?

3. Do you know where the waste collection area is, and how frequently the waste needs to be removed from the collection area?

4. What type of method do you use for waste management? Is there a place for collecting waste?

5. Is there any consideration for the market's relation to flooding and landslides?

6. How do you control for food safety and environmental protection in vegetable markets?

7. What are your recommendations related to Lafto vegetable market's solid waste management system?

**For Traffic and Management Officials:**

1. Does the vegetable market have an effect on traffic congestion?

2. How can you manage the traffic congestion?

3. Do you have any plans or initiatives to improve the sustainability and resilience of the vegetable market?

4. What traffic congestion and transportation problems have been faced at Lafto vegetable market, and what are your recommendations for solving these problems?

5. Do you know where and when the traffic congestion occurs?

6. Do you think traffic congestion can be managed easily?

7. What are your recommendations for solving the traffic congestion and transportation problems at peak hours at Lafto vegetable market?

**For Nifas Silk Lafto Environment Office**:

1. What problems have vegetable market users faced regarding marketing their product at Lafto vegetable market?

2. How do you control the food safety and environmental protection in vegetable markets?

3. Do you know what factors influence the environmental sustainability of the vegetable market center?

For **Addis Ababa Trade and Industry Office**:

1. What problems have vegetable market users faced regarding marketing their product at Lafto vegetable market?

2. What are your recommendations for solving the problems faced on the vegetable market?