Assessing the Impact of Urban Open Spaces on Environment and Social Well-Being in the Inner Older Parts of the City: The Case of Aba Geda Sub-City, Adama City, Oromia Region, Ethiopia.

Abera Aurgha Jimma

A Thesis Submitted to the department of Architecture,

Collage of Civil Engineering and Architecture (COCEA)

Presented in Partial Fulfillment of the Requirement for the Degree of Master's in Urban Planning and Design.

Office of Graduate Studies

Adama Science and Technology University

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Adama, Ethiopia.

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DECLARATION

I hereby declare that this Master Thesis entitled "**Assessing the Impact of Urban Open Spaces on Environment and Social Well-Being in the Inner Older Parts of the City: The Case of Aba Geda Sub-City, Adama City, Oromia Region, Ethiopia.**" is my original work. That is, it has not been submitted for the award of any academic degree, diploma or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation.

Name of the student	Signature	Date

RECOMMENDATION

I/we, the advisor(s) of this thesis, hereby certify that I/we have read the revised version of the thesis entitled "**Assessing the Impact of Urban Open Spaces on Environment and Social Well-Being in the Inner Older Parts of the City: The Case of Aba Geda Sub-City, Adama City, Oromia Region, Ethiopia."** prepared under my/our guidance **Abera Aurgha Jimma** submitted in partial fulfillment of the requirements for the degree of Maters of Science in Urban Planning and Design.

Therefore, I/we recommend the submission of revised version of the thesis to the department following the applicable procedures.

_____	_____	_____
Major Advisor	Signature	Date
_____	_____	_____
Co-advisor	Signature	Date

APPROVAL OF M.SC. THESIS

I/we, the advisors of the thesis entitled "Assessing the Impact of Urban Open Spaces on Environment and Social Well-Being in the Inner Older Parts of the City: The Case of Aba Geda Sub-City, Adama City, Oromia Region, Ethiopia." And developed by (name of student) Abera Aurgha Jimma, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

Major Advisor	Signature	Date
Co-advisor	Signature	Date

We, the undersigned, members of the Board of Examiners of the thesis by **Abera Aurgha Jimma** have read and evaluated the thesis entitled "**Assessing the Impact of Urban Open Spaces on Environment and Social Well-Being in the Inner Older Parts of the City: The Case of Aba Geda Sub-City, Adama City, Oromia Region, Ethiopia**." and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in Urban Planning and Design.

Chairperson	Signature	Date
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Final approval and acceptance of the thesis is contingent upon submission of its final copy to the Office of Postgraduate Studies (OPGS) through the Department Graduate Council (DGC) and School Graduate Committee (SGC).

Department Head	Signature	Date
Collage Dean	Signature	Date
Office of Postgraduate Studies, Dean	Signature	Date

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ABSTRACT

This thesis looks at the multifaceted impact of urban open spaces on environmental sustainability and social well-being in the Aba Geda Sub-city of Adama, Ethiopia, a rapidly urbanizing city that is struggling to balance infrastructural development with adequate green space provision. The study used a mixed-methods research methodology, combining quantitative data acquired through structured questionnaires with qualitative data obtained through in-depth interviews and focus group discussions. This method tries to capture both the objective characteristics of open spaces and the subjective experiences and perceptions of inhabitants about their accessibility, quality, and impact on their everyday lives. The study examines the open space provision in Aba Geda sub city, comparing it to established standards and evaluating its impact on environmental and social well-being indicators like air quality and community cohesion. It also examines individuals' perceptions of safety, cleanliness, facilities, and the importance of open spaces in communal life, providing a comprehensive understanding of the complex relationship between urban growth, open space supply, and social well-being. The findings of the study reveal a significant disparity in urban open spaces in Aba Geda Sub-city, with under-maintained green spaces lacking essential services and being inaccessible to many residents. This insufficiency leads to environmental discomfort, such as temperature anomaly and air pollution, and negatively impacts social interaction, community participation, and overall well-being. Challenges such as limited financial resources, insufficient community involvement, and lack of coordinated planning hinder the development and administration of these spaces. Based on these findings, the thesis provides insights for policymakers, urban planners, and community stakeholders to improve urban open space planning, development, and management. It emphasizes participatory planning, long-term funding models, and community-led projects. By following these recommendations, Adama City can address open space shortages and create a sustainable, equitable urban environment. The study underscores the importance of urban open spaces in establishing resilient, vibrant communities in rapidly growing environments.

Keywords: ***Urban Open Spaces, Social Well-being, Environmental Sustainability, Aba Geda Sub City***

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LIST OF ACRONYMS AND GLOSSARY OF LOCAL TERMS

WHO – World Health Organization

ECPI - The Ethiopian Cities Sustainable Prosperity Initiative

OS - Open Spaces

CABE - The Commission for Architecture and the Built Environment (England)

UHI effect - Urban Heat Island effect

UN-Habitat - United Nations Human Settlements Programme

KIIs - Key Informant Interviews

NGOs - Non-Governmental Organizations

FGDs - Focus Group Discussions

GPS devices - Global Positioning System devices

GIS - Geographic Information System

dB - Decibel

°C - Degrees Celsius

PM2.5 (µg/m³) - Particulate Matter 2.5 micrometers or smaller (micrograms per cubic meter)

PM10 (µg/m³) - Particulate Matter 10 micrometers or smaller (micrograms per cubic meter)

CO2 (ppm) - Carbon Dioxide (parts per million)

GLOSSARY OF LOCAL TERMS:

Gebyas: Traditional Market Squares

Adebabays: Gathering Spaces or Public Squares

CHAPTER ONE

INTRODUCTION

1.1.Background of the Study

Urban open spaces play a crucial role in modern city development, particularly in rapidly urbanizing areas. These spaces, which include parks, gardens, green corridors, and public plazas, offer a variety of ecological, social, and psychological benefits that significantly enhance the quality of life for urban residents. However, as cities grow, particularly in regions of the developing world, challenges surrounding the availability, maintenance, and effective use of urban open spaces intensify. Adama City, located in Ethiopia's Oromia Region, serves as a prime example of these challenges. As a rapidly growing urban center, Adama is grappling with the difficulties of balancing urban expansion with the preservation and development of urban open spaces.

Historically, urban planning in Ethiopia has concentrated on infrastructure, housing, and economic development, often neglecting the role of open spaces in urban settings. This trend is not unique to Ethiopia. Scholars have noted that many rapidly urbanizing regions around the world face similar issues, where urbanization pressures, coupled with limited financial and human resources, result in a decreased focus on green spaces (Ayenew, 2018; Wolch, Byrne, & Newell, 2014). While the infrastructure and economic growth of cities like Adama are vital in creating employment and fostering economic resilience, the role of green spaces in contributing to environmental sustainability and social well-being is often overlooked.

The ecological benefits of urban open spaces are manifold. Vegetation within urban spaces helps to reduce air pollution by absorbing pollutants such as carbon dioxide, sulfur dioxide, and nitrogen oxides. Additionally, trees and other green areas help mitigate the urban heat island effect, where cities tend to have higher temperatures than surrounding rural areas due to human activities, building materials, and reduced vegetation (Gill et al., 2007). In cities like Adama, where rapid urbanization often leads to unplanned expansion, such ecological benefits are becoming increasingly necessary to combat rising pollution levels and the adverse effects of climate change.

From a social perspective, urban open spaces offer venues for recreation, relaxation, and social interaction. Studies have shown that access to green spaces is positively correlated with improved mental and physical health (Maas et al., 2006).

In rapidly urbanizing cities, where space is often constrained and stress levels are high due to overcrowding, access to parks and recreational areas is essential. These spaces allow city dwellers to escape the pressures of urban life, exercise, and connect with nature. Moreover, they serve as communal spaces where social interactions take place, fostering a sense of community and social cohesion (Gehl, 2010).

In the case of Adama, the older parts of the city have experienced significant degradation of existing green spaces due to urban expansion, infrastructural development, and a lack of proper maintenance. This decline in green spaces is a common issue in many cities across the world, particularly in developing countries, where the rapid influx of rural populations to urban areas strains available resources (Dewan, Yamaguchi, & Rahman, 2012). Adama is no exception. Its growing population has placed increased pressure on available land, driving up demand for housing and commercial spaces at the expense of open green areas. Moreover, the city's older neighborhoods, which were once characterized by relatively ample public spaces, have seen these areas reduced or repurposed to accommodate new developments (Ayenew, 2018).

Despite global recognition of the benefits of urban open spaces, cities like Adama continue to struggle with the challenge of balancing growth with environmental sustainability. Research has shown that the integration of green spaces in urban planning not only benefits residents but also improves the overall economic value of urban areas. For instance, housing located near parks and green spaces tends to appreciate in value, thereby enhancing the economic viability of neighborhoods (Jim & Chen, 2006). This insight underscores the importance of adopting a more integrative approach to urban planning, one that considers the multifaceted benefits of open spaces alongside infrastructural development.

Urban open spaces are also vital for addressing environmental justice concerns. In many cities, access to green spaces is unequally distributed, often concentrated in wealthier neighborhoods, while poorer, more densely populated areas are left with little to no open space (Wolch et al., 2014). In Adama, this disparity is becoming increasingly evident. The inner older parts of the city, which house a significant portion of the population, have fewer green spaces compared to newly developed areas. This unequal distribution exacerbates

social inequalities, as residents of underprivileged neighborhoods face higher pollution levels, greater overcrowding, and fewer opportunities for recreation and social interaction.

In summary, urban open spaces are indispensable to the health, well-being, and sustainability of any city. The challenges faced by Adama City in maintaining and expanding its green spaces are illustrative of broader global trends in rapidly urbanizing regions. Addressing these challenges will require a comprehensive and integrative approach to urban planning, one that prioritizes not only economic growth and infrastructure but also the benefits that urban open spaces offer to residents and the environment.

1.2. Statement of the Problem

The urban landscape of Adama City, situated in the Oromia Region of Ethiopia, is experiencing profound challenges in the development, management, and preservation of urban open spaces. These challenges are deeply rooted in the complex interplay of rapid urbanization, limited urban planning resources, and the evolving socio-economic dynamics of the region.

The inadequate integration of open spaces in urban planning represents a critical problem that threatens the environmental sustainability and social well-being of Adama's residents. Research by Abebe and Megento (2017) reveals that Ethiopian cities consistently prioritize infrastructural development over green space preservation, resulting in a significant deficit of functional urban open spaces. This trend is particularly pronounced in Adama, where the inner older parts of the city suffer from a critical shortage of accessible and meaningful public spaces.

The Ethiopian National Urban Green Infrastructure Standard (2015) recommends that urban areas should allocate 15-20% of their total land area to urban open spaces and maximum walkable distance 500 m a neighborhood park of a size of at least 0.3 hectares. However, empirical studies by Woldegerima et al. (2019) demonstrate that Adama falls dramatically short of this standard, with less than 5% of urban land dedicated to functional green spaces. This deficiency is not merely a quantitative issue but represents a fundamental challenge to urban livability and environmental quality.

The historical development of Adama has been characterized by unplanned urban expansion, where economic imperatives have consistently overshadowed environmental considerations. Gebre and Van Rooijen (2020) highlight that the city's growth has been driven by rapid

population increase and economic development, resulting in a fragmented urban landscape that marginalizes open spaces.

Traditional community gathering areas have been systematically replaced by commercial and residential developments, eroding the social and ecological fabric of the urban environment. Environmental implications of this open space deficit are profound and multifaceted. Tessema et al. (2021) argue that the lack of green spaces directly contributes to urban heat island effects, decreased air quality, and reduced biodiversity. In Adama's older urban areas, the absence of vegetation and public spaces exacerbates environmental degradation, creating microclimates characterized by higher temperatures and increased pollution levels.

The social dimensions of this problem are equally significant. Urban open spaces are not merely aesthetic additions but critical infrastructure for community well-being. Research by Woldegiorgis (2020) emphasizes that open spaces serve as vital platforms for social interaction, cultural expression, and community building. The current structure plan on working does not give emphasis to urban open space these leading to fragmented communities and reduced social cohesion (Adama City Structure Plan,2018).

Moreover, the problem is deeply intertwined with issues of environmental justice and social equity. Bekele (2020) documents significant disparities in access to green spaces across different socio-economic groups within the city. Marginalized communities in the older parts of Adama are disproportionately affected by the lack of open spaces, experiencing reduced quality of life and limited opportunities for recreation and community engagement.

The Ethiopian Cities Sustainable Prosperity Initiative (2019) recognizes these challenges but highlights the complexity of addressing them within constrained financial and institutional frameworks. Limited municipal budgets, weak institutional capacities, and competing urban development priorities further complicate efforts to integrate and develop urban open spaces.

This research seeks to address these multifaceted challenges by comprehensively examining the current state of urban open spaces in Adama's inner older parts. By analyzing the environmental, social, and planning dimensions of this problem, the study aims to provide actionable insights that can inform more sustainable and inclusive urban development strategies.

The significance of this research lies in its potential to contribute to a more nuanced understanding of urban open space development in rapidly growing Ethiopian cities.

By focusing on Adama as a case study, the research can generate knowledge that is not only locally relevant but potentially applicable to other similar urban contexts in Ethiopia and other developing regions.

Ultimately, the problem extends beyond mere spatial planning. It represents a critical challenge in reimagining urban spaces as integrated, sustainable environments that balance economic development with ecological integrity and social well-being.

The current trajectory of urban development in Adama risks creating a fragmented, environmentally degraded urban landscape that fails to meet the complex needs of its residents.

1.3.Research Objective

1.3.1. Main Objective

The primary objective of this research is to assess the impact of urban open spaces on environmental and social well-being in the inner older parts of Adama City.

1.3.2. Specific Objectives

1. To evaluate the current state of urban open spaces in the inner older parts Adama City.

2. To analyze the environmental benefits of urban open spaces in the inner older parts of Adama City.

3. To assess the social benefits of urban open spaces in the inner older parts of Adama City:

4. To analyze the planning and management strategies for urban open spaces in the inner parts of Adama City.

1.4. Research Questions:

1. What is the current state of urban open spaces in the inner older parts of Adama City?

2. What environmental benefits do urban open spaces provide in the inner older parts Adama City?

3. How do urban open spaces contribute to social interaction and community engagement in the inner older parts of Adama City?

4. How are the planning and management strategies for urban open spaces in the inner older parts of Adama City?

1.5. Scope of the Study

This research focuses on assessing the impact of urban open spaces on environmental sustainability and social well-being in Aba Geda Sub-city, one of the administrative units of Adama City, Oromia Region, Ethiopia. The study is thematically concerned with examining the current state of urban open spaces, their environmental and social implications, community utilization patterns, and the challenges associated with planning and management of these spaces. By addressing these themes, the study seeks to provide empirical evidence and actionable insights that contribute to sustainable urban development strategies in Ethiopia.

Spatially, the research is confined to Aba Geda Sub-city, which spans 1,729.16 hectares and houses a diverse and densely populated urban environment. Within this area, 459.356 hectares form the core urban zone, where a significant proportion of the population resides amidst intensive commercial activities and administrative offices. Despite this density, the sub-city has only two designated open spaces: one is a very small recreational area, while the other remains an ongoing project. To provide a localized analysis, the research focuses on three major neighborhoods within the sub-city: Badhatu, Oda, and Buta. These neighborhoods represent a combined population of over 87,000 residents, distributed across areas with varying population densities, ranging from 140 to 337 persons per hectare. This population distribution underscores the high demand for functional open spaces to support environmental and social well-being.

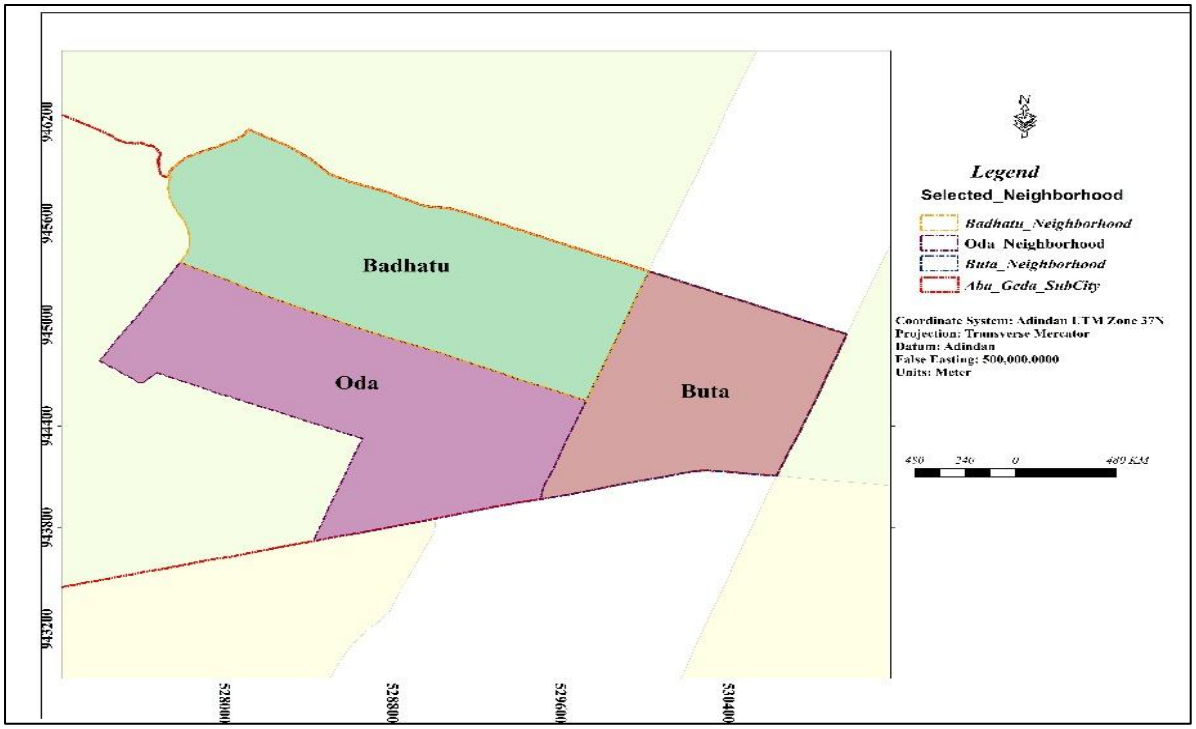

Figure 1: Selected three major neighborhoods within the sub-city: Badhatu, Oda, and Buta

1.6. Significance of the Study

The significance of this study lies in its potential to generate new knowledge, inform urban planning, and address pressing urban challenges. Academically, the research contributes to the growing body of literature on urban open spaces, particularly in the context of rapidly urbanizing Ethiopian cities. By providing empirical evidence on the environmental and social implications of limited open spaces, the study offers insights into the dynamics of urbanization and its impact on environmental sustainability.

Practically, the findings of this research are relevant for urban planners, policymakers, and local government authorities. The study provides evidence-based recommendations to inform urban planning decisions and improve the integration of open spaces into city development frameworks. It addresses critical environmental concerns, such as the urban heat island effect, air quality degradation, and limited climate resilience, while also highlighting the social dimensions of open spaces, including their role in fostering community cohesion, recreation, and equitable access. By identifying gaps in planning, management, and resource allocation, the research offers actionable solutions for enhancing the functionality and accessibility of open spaces in Aba Geda Sub-city.

The justification for this study is rooted in the urgent need to address the challenges posed by rapid urbanization in Adama City. This research aligns with national urban development priorities, including the Ethiopian Cities Sustainable Prosperity Initiative and the Green Legacy Initiative, which emphasize the importance of sustainable and inclusive urban growth. Moreover, the study responds to community needs by addressing the disparities in access to open spaces, particularly in lower-income neighborhoods, and advocating for equitable and inclusive urban planning practices.

Beyond its local relevance, the study has broader implications for urban development in Ethiopia and other developing countries. By highlighting the interplay between environmental sustainability and social well-being in urban open spaces, the research contributes to achieving sustainable development goals, particularly those related to resilient cities, environmental protection, and social inclusion.

Its findings provide a basis for improving local policies, enhancing community participation, and fostering innovative approaches to urban planning and management. In doing so, this study offers valuable insights for building more sustainable, resilient, and equitable urban environments in Ethiopia and beyond.

1.7. Limitation and Delimitation of the Study

While the study is designed to comprehensively address its objectives, certain limitations are acknowledged. Resource availability restricts the use of advanced equipment for environmental assessments. The study is geographically delimited to Aba Geda Sub-city and thematically focused on the environmental and social dimensions of urban open spaces. Economic aspects, while important, are beyond the scope of this research and are left for future studies. These delimitations ensure that the study remains focused and manageable while addressing its core objectives.

This comprehensive methodology ensures a rigorous, replicable, and contextually relevant study. By integrating robust data collection techniques, analytical tools, and ethical considerations, the research will generate valuable insights for improving the planning and management of urban open spaces in Aba Geda Sub-city and beyond.

1.8. Operational Definitions

The following concepts are defined operationally for the purposes of this research:

- ***Urban Open Spaces:*** refers to any publicly accessible urban areas, such as parks, gardens, plazas, and green corridors, that are set aside for social, recreational, or environmental reasons.
- ***Inner Older Parts of the City:*** refers to the older and central parts of Adama City's Aba Geda Sub-City, which are distinguished by its dense population, dilapidated infrastructure, and restricted availability of urban open spaces.
- ***Environmental Well-Being:*** refers to the physical environment's quality and how it affects residents' health and well-being. This includes elements like noise pollution, air quality, and access to green spaces.
- ***Social Well-Being:*** refers to the standard of living and interpersonal connections among neighborhood residents, encompassing elements like social interaction, community cohesion, and availability to recreational amenities.

1.9. Organization of the Thesis Paper

In order to thoroughly examine the research issue, this thesis is organized into six chapters. The problem, objectives, significance, operational definitions, and general structure of the study are all outlined in Chapter 1, which also introduces the research. With an emphasis on the Ethiopian setting, Chapter 2 reviews the body of research on the effects of urban open spaces on social and environmental well-being. The methodology used is described in full in Chapter 3, along with the research design, data gathering techniques, and data analysis protocols. In Chapter 4, the study's results, which include findings from surveys, interviews, and observational studies, are presented. These findings are interpreted, their ramifications are discussed, and future research directions are suggested. Chapter 5 wraps up the thesis by restating the research objectives, summarizing the key findings, and making suggestions for policymakers, urban planners, and other pertinent parties.

CHAPTER TWO

LITERATURE REVIEW

2.1. Theoretical Literature Review

2.1.1. Theories of Urban Open Spaces

2.1.1.1. Social-Ecological Theory

The social-ecological framework emphasizes the interdependent relationship between societal systems and ecological systems. According to Andersson et al. (2014), urban open spaces serve as crucial interfaces where these interactions manifest most visibly, providing ecosystem services such as air and water purification, climate regulation, and biodiversity preservation. In the context of Adama City, open spaces are not only natural assets but also areas that contribute to urban resilience by supporting ecological functions (Barthel et al., 2018).

Recent studies have further explored how the integration of green infrastructure in urban settings can enhance ecological resilience. For example, Tzoulas et al. (2020) illustrate how green corridors in European cities have successfully increased biodiversity and improved connectivity between fragmented habitats, offering lessons applicable to cities like Adama.

In the Ethiopian context, urban open spaces play a vital role in regulating microclimates and enhancing the quality of life for residents. Abebe and Megento (2017) argue that Ethiopian cities, including Addis Ababa and Adama, can improve urban resilience by integrating more green spaces. These spaces can provide ecological services, such as flood control, which are essential in cities like Adama, where rapid urbanization and inadequate drainage infrastructure have exacerbated flooding risks.

2.1.1.2. Urban Planning Theory

Urban planning theory has evolved to incorporate sustainability and resilience as core objectives. Alexander (2022) argues that modern urban planning requires a shift towards more inclusive, adaptable, and participatory practices that prioritize green spaces as essential urban infrastructure. The "smart growth" approach, which focuses on sustainable urban development, underscores the importance of preserving and integrating green spaces to improve urban livability (Ewing & Hamidi, 2015).

For instance, Singapore's "City in a Garden" vision aims to harmonize urban development with nature by integrating parks, vertical gardens, and green rooftops throughout the city (Tan

et al., 2013). This model demonstrates how strategic planning can enhance urban environments and serve as a blueprint for Adama's development initiatives.

In Ethiopia, urban planning has historically focused more on housing and infrastructure, often neglecting green spaces (Ayenew, 2018). However, recent urban development frameworks, such as the Adama City Structure Plan (Adama City Administration, 2018), aim to incorporate more open spaces to improve the city's livability. The Ethiopian Cities Sustainable Prosperity Initiative (Cheru, 2013) further emphasizes the need for urban green infrastructure as part of creating sustainable and resilient cities.

2.1.1.3. Environmental Justice Theory

Environmental justice theory highlights the need for equitable access to environmental goods and services across different social groups. Recent research by Agyeman et al. (2016) emphasizes the disparities in access to urban green spaces, which are often more prevalent in affluent neighborhoods compared to marginalized areas. This inequality contributes to environmental and health disparities, as seen in cities like Los Angeles and New York (Boone et al., 2009; Rigolon et al., 2018).

In Ethiopia, unequal access to green spaces is also a critical issue. Gebre and Van Rooijen (2020) found that in Addis Ababa, wealthier neighborhoods have greater access to parks and recreational areas compared to poorer communities. This disparity is evident in Adama City as well, where the older, inner parts of the city home to lower-income households have fewer and lower-quality green spaces than newer developments on the city's outskirts. Addressing this inequality is essential for ensuring social inclusion and improving urban well-being.

In developing cities such as Adama, addressing these disparities requires intentional policies that prioritize equitable distribution and access to green spaces, ensuring all residents benefit from their social and environmental advantages.

2.1.1.4. Social Capital Theory

Social capital theory examines how networks and relationships within communities contribute to societal well-being. Urban open spaces are integral to building social capital by providing venues for community interactions and activities.

Studies by Kazmierczak and James (2020) demonstrate that neighborhoods with well-maintained parks and recreational facilities report higher levels of social cohesion, trust, and community engagement.

In Ethiopia, traditional community spaces, such as "Addis Gebya" (public squares), have historically fostered strong community ties (Gebre, 2020). In Adama, enhancing existing parks and public areas can help strengthen social capital by providing inclusive spaces where residents can gather, interact, and build networks. This is particularly important in rapidly urbanizing areas, where social ties may be weakened due to migration and shifting demographics.

In cities like Adama, investing in urban open spaces can enhance social capital by offering inclusive environments where residents from diverse backgrounds can gather, interact, and participate in community-building activities.

2.1.2. Conceptual Framework of Urban Open Spaces

2.1.2.1. Definitions and Classifications

Urban open spaces encompass a wide range of areas, including parks, gardens, playgrounds, greenways, and plazas, each serving different functional and aesthetic purposes (Carmona et al., 2010). These spaces are classified based on size, function, accessibility, and degree of urban integration. For example, urban parks are larger and serve broader recreational and ecological functions, while pocket parks cater to localized needs within neighborhoods (Nordh & Østby, 2013).

The Ethiopian National Urban Green Infrastructure Standard (2015) expands this definition to include spaces like riverbanks, traditional communal areas, and religious open spaces (e.g., areas around churches and mosques). Woldegerima et al. (2019) further classify these spaces in Ethiopian cities based on their ecological, social, and cultural functions.

In Adama City, the classification of open spaces under the Structure Plan (2018) includes city-wide parks, neighborhood parks, and smaller green spaces integrated into residential and commercial areas. However, Abebe and Megento (2017) criticize this classification for overlooking informal and traditional spaces, such as public squares ("Adebabay"), which play an essential role in Ethiopian social life.

2.1.2.2. Functions and Benefits

Urban open spaces provide multifaceted benefits, including ecological services such as carbon sequestration, stormwater management, and habitat provision (Chiesura, 2014). Socially, they promote physical and mental health, facilitate social interactions, and enhance community identity (Peters et al., 2010; Mitchell et al., 2015).

Economically, proximity to green spaces can increase property values and attract tourism, contributing to local economies (Jim & Chen, 2006). Cities like Melbourne and Vancouver have capitalized on these benefits by investing in comprehensive green infrastructure strategies that prioritize open space development (Thompson, 2017).

In Ethiopia, green spaces provide additional cultural functions. According to Gebre and Van Rooijen (2020), traditional urban open spaces serve as venues for religious and cultural ceremonies, reinforcing the social and spiritual identity of communities. In Adama, open spaces such as Meskel Square are used for religious gatherings and national celebrations, indicating the cultural importance of these areas.

2.1.2.3. Planning and Design Principles

Effective planning and design of urban open spaces require principles such as accessibility, connectivity, diversity, and sustainability (Thompson, 2002). Accessibility ensures that all residents can reach and use open spaces, while connectivity integrates these areas into broader urban networks, enhancing ecological and social interactions (Ahern, 2013).

Diversity in design accommodates various user needs, from active recreation to quiet contemplation, while sustainability principles guide the ecological management and long-term resilience of these spaces (Pauleit et al., 2017). Cities like Copenhagen exemplify these principles through their Green Structure Plan, which prioritizes interconnected and multifunctional green spaces (Haaland & van den Bosch, 2015).

In Ethiopia, the challenge lies in ensuring that urban open spaces are designed in a way that balances modern urban planning practices with traditional Ethiopian spatial organization. Adama's Structure Plan (2018) attempts to integrate open spaces into residential areas, but local researchers like Woldegerima et al. (2019) argue that more attention must be given to community participation in the design process to ensure spaces are socially relevant and well-utilized.

2.1.3. Conceptual Framework of Urban Open Spaces in the Ethiopian Context

2.1.3.1. Definitions and Classifications in Ethiopian Urban Settings

In the Ethiopian context, urban open spaces are defined through both traditional and modern perspectives. According to the Ethiopian National Urban Green Infrastructure Standard (2015), urban open spaces encompass public parks, street greenery, riverside developments, and traditional communal spaces and urban areas should allocate 15-20% of their total land

area to urban open spaces and maximum walkable distance 500 m a neighborhood park of a size of at least 0.3 hectares. Woldegerima et al. (2019) note that Ethiopian cities historically featured distinct types of open spaces, including:

- Traditional market squares (Gebyas)
- Religious open spaces around churches and mosques
- Informal gathering spaces (Adebabays)
- Natural green corridors along rivers

In Adama specifically, the city's structure plan categorizes open spaces into hierarchical levels: city-wide parks, neighborhood parks, and street-level green spaces (Adama City Administration, 2018). However, Abebe and Megento (2017) argue that these classifications often fail to acknowledge indigenous spatial organizations and traditional use patterns.

2.1.3.2. Functions and Benefits in the Ethiopian Urban Context

Urban open spaces in Ethiopian cities serve multiple functions that reflect both universal and culturally specific benefits. According to Cheru (2013) The Ethiopian Cities Sustainable Prosperity Initiative (ECPI) identifies several key functions:

1. Environmental Functions:

- Climate regulation in Ethiopia's varied climatic zones
- Stormwater management during intense rainfall periods
- Air quality improvement in rapidly motorizing cities

2. Social Functions:

- Venues for traditional ceremonies and celebrations
- Spaces for informal economic activities
- Community gathering areas for social events

3. Cultural Functions:

- Preservation of traditional practices
- Integration of religious activities
- Maintenance of historical identity

2.1.4. Urban Sustainability Theories

2.1.4.1. Environmental Sustainability

Environmental sustainability in urban areas focuses on preserving natural resources, reducing pollution, and enhancing biodiversity (McGranahan & Satterthwaite, 2014). Urban open spaces contribute to this by serving as carbon sinks, temperature regulators, and habitats for urban wildlife.

Recent research by Neto et al. (2017) highlights the role of urban forests in mitigating urban heat islands and improving air quality. In cities like Adama, incorporating green spaces into urban planning can significantly enhance environmental sustainability by addressing climate-related challenges and improving ecological health.

In Ethiopia, cities like Addis Ababa have recently adopted the "Green Legacy Initiative," which aims to increase urban green cover by planting trees and creating parks (Ethiopian Environmental Protection Authority, 2021). Adama City can similarly contribute to environmental sustainability by expanding its green spaces and integrating them into the city's drainage and flood management systems, as recommended by the Ethiopian National Urban Green Infrastructure Standard (2015).

2.1.4.2. Social Sustainability

Social sustainability emphasizes the well-being and quality of life of urban residents. It encompasses equitable access to resources, social inclusion, and community development (Dempsey et al., 2011). Urban open spaces play a vital role in promoting social sustainability by providing inclusive spaces for leisure and interaction.

Empirical studies have shown that urban green spaces reduce stress, enhance mental health, and foster social interactions, contributing to higher life satisfaction and community resilience (Mouratidis, 2018; Sugiyama et al., 2014).

Cities like Amsterdam have prioritized social sustainability by integrating community gardens and public spaces that promote inclusivity and social cohesion (Kleinhans et al., 2015).

In Ethiopia, urban open spaces are often used for both formal and informal social activities. For example, the open squares in Addis Ababa and Adama serve as meeting places, markets, and venues for cultural and religious events (Gebre & Van Rooijen, 2020).

Ensuring equitable access to these spaces is essential for promoting social sustainability in Ethiopian cities,where disparities in access often reflect broader social inequalities (Woldegerima et al., 2019).

2.1.4.3. Economic Sustainability

Economic sustainability pertains to the long-term economic viability and resilience of urban areas. Urban open spaces can boost economic sustainability by attracting tourism, enhancing property values, and reducing healthcare costs through improved public health (CABE, 2005).

Research by Crompton (2019) demonstrates that investments in urban green spaces yield significant economic returns, with benefits far outweighing the costs. Cities like Portland have successfully leveraged green spaces to stimulate local economies and enhance urban competitiveness (Harnik & Welle, 2011).

In Ethiopia, efforts to improve the economic sustainability of cities are increasingly being tied to urban green development. According to Cheru (2013) The Ethiopian Cities Sustainable Prosperity Initiative (ECPI) highlights the potential to integrate open spaces into city planning as a means of stimulating local economies. For example, the redevelopment of parks in Addis Ababa has attracted both tourists and local businesses, demonstrating the economic potential of green spaces in Ethiopian cities.

2.2. Empirical Literature Review

2.2.1. Environmental Impact Studies

2.2.1.1. Air Quality and Pollution

Urban open spaces contribute to improved air quality by filtering pollutants and reducing particulate matter (Nowak et al., 2014).

Studies in cities like Shanghai and Sydney have shown that urban vegetation reduces air pollution levels, enhancing public health outcomes and urban livability (Yin et al., 2018; Irga et al., 2015).

In Adama City, incorporating more green spaces could mitigate air pollution challenges, improving air quality and public health for its residents. This approach aligns with findings from other cities, where strategic green infrastructure development has significantly lowered pollution levels (Baró et al., 2019).

In Ethiopia, air pollution has become a growing concern in rapidly urbanizing cities like Addis Ababa and Adama. Yeshitela et al. (2020) argue that integrating more green spaces into urban planning can help mitigate air pollution, particularly in densely populated areas. A study by Woldegerima et al. (2019) on Addis Ababa found that urban forests help filter pollutants and improve air quality, suggesting that similar interventions could be beneficial in Adama.

2.2.1.2. Urban Heat Island Effect

Green spaces mitigate the urban heat island effect by providing shade and cooling through evapotranspiration (Bowler et al., 2010). Research in cities like Tokyo and Chicago demonstrates that increasing vegetation cover can significantly reduce urban temperatures, improving thermal comfort for residents (Yoshida et al., 2016; Ziter et al., 2019).

For Adama City, expanding urban green spaces offers a viable solution to combat rising temperatures and enhance climate resilience, aligning with successful strategies implemented in other global cities (Gunawardena et al., 2017).

In Adama City, where temperatures can be significantly elevated, expanding green spaces could help reduce the UHI effect. Studies by Gebre et al. (2020) highlight that city in Ethiopia, notably Addis Ababa, could benefit from the strategic placement of green spaces to mitigate rising temperatures. Similar interventions could be adopted in Adama, particularly in inner, older parts of the city where green space is limited.

2.2.1.3. Biodiversity and Ecosystem Services

Urban open spaces support biodiversity by offering habitats for various species and promoting ecological interactions (Goddard et al., 2010). These spaces enhance ecosystem services such as pollination, soil stabilization, and water regulation, crucial for urban sustainability (Haase et al., 2014).

Studies in cities like Berlin and Curitiba have shown that urban green spaces can significantly enhance biodiversity, providing refuges for native species and promoting ecological resilience (Kabisch et al., 2016; Oliveira et al., 2017). Adama can benefit from similar strategies, enhancing its urban ecosystem health and resilience.

Woldegerima et al. (2019) found that urban green spaces in Addis Ababa support a diverse range of species, including birds, insects, and small mammals. These green spaces also provide ecosystem services, such as regulating water flow and supporting pollination.

In Adama, expanding and enhancing urban green spaces could similarly contribute to biodiversity conservation and ecosystem resilience.

2.2.1.4. Climate Change Resilience

Green spaces increase urban resilience to climate change by mitigating extreme weather impacts, enhancing flood control, and promoting sustainable water management (Gill et al., 2007). Cities like Rotterdam and Singapore have integrated green infrastructure into their climate adaptation strategies, demonstrating the potential of urban open spaces to enhance urban resilience (Jongman et al., 2014; Tan et al., 2013).

In Ethiopia, where climate change is already impacting weather patterns and food security, urban green spaces can play a critical role in enhancing urban resilience. The Ethiopian National Urban Green Infrastructure Standard (2015) recommends integrating green spaces into flood management systems to reduce the risk of urban flooding. In Adama, where flash floods are a recurrent problem, implementing green infrastructure solutions could help manage stormwater and mitigate climate-related risks. For Adama City, adopting similar approaches can bolster its capacity to adapt to climate variability and extreme weather events, securing a more sustainable urban future.

2.2.2. Social Impact Studies

2.2.2.1. Community Cohesion

Access to urban open spaces fosters social interaction and community cohesion, contributing to a sense of belonging and community identity (Peters et al., 2010). Studies in cities like London and Barcelona have demonstrated that communities with accessible parks and recreational areas exhibit higher levels of trust and cooperation among residents (Kazmierczak, 2013; Dinnie et al., 2013).

In Ethiopian cities, green spaces serve as important venues for community-building activities. Gebre and Van Rooijen (2020) found that in Addis Ababa, communal spaces such as Meskel Square foster strong social bonds, enabling residents to participate in religious and cultural events. In Adama, enhancing public spaces could similarly create opportunities for community engagement and cohesion. In Adama, enhancing urban open spaces can strengthen social cohesion by providing inclusive environments for diverse communities to gather, interact, and participate in shared activities.

2.2.2.2. Public Health Outcomes

Urban open spaces have a positive impact on public health by encouraging physical activity, reducing stress, and improving mental health (Mitchell & Popham, 2008). Research in cities like New York and Copenhagen has shown that individuals residing near green spaces experience lower levels of obesity, depression, and cardiovascular diseases (Maas et al., 2009; Stigsdotter et al., 2010).

In Ethiopia, studies by Tessema et al. (2021) highlight the health benefits of green spaces in cities like Addis Ababa, where parks and recreational areas encourage physical activity and reduce stress. In Adama, expanding and improving green spaces could similarly improve public health outcomes, particularly in densely populated neighborhoods where residents have limited access to recreational facilities. For Adama City, prioritizing the development of accessible green spaces can enhance public health outcomes, reducing healthcare costs and improving the quality of life for its residents.

2.2.2.3. Recreation and Leisure

Green spaces provide opportunities for recreation and leisure, essential for urban residents' well-being (Veal, 2017). These spaces support various activities, from walking and jogging to organized sports and cultural events, catering to diverse interests and age groups (Cohen et al., 2007).

Cities like Stockholm and Sydney have successfully integrated recreational spaces into their urban landscapes, promoting active lifestyles and enhancing the quality of life (Thompson & Aspinall, 2011; Gidlow et al., 2012). Adama can leverage similar strategies to promote recreational and leisure opportunities for its residents.

In Adama, access to well-maintained recreation areas is limited, particularly in older parts of the city. Enhancing these spaces could provide residents with opportunities for physical activity and relaxation, contributing to improved well-being. As noted by Gebre and Van Rooijen (2020), recreational spaces in Ethiopian cities are often underutilized due to poor maintenance and lack of amenities, highlighting the need for better planning and management.

2.2.2.4. Quality of Life Indicators

The availability and quality of urban open spaces are critical indicators of the quality of life in urban environments (Pacione, 2003).

Access to green spaces contributes to higher life satisfaction, greater happiness, and an overall better sense of well-being among urban dwellers (Kahana et al., 2015).

Studies in cities like Zurich and Vienna have demonstrated that well-maintained green spaces significantly enhance residents' quality of life, providing a valuable blueprint for Adama's urban development strategies (Nutsford et al., 2013; Carrus et al., 2015). In Ethiopia, the quality of open spaces varies significantly between cities and neighborhoods.

Woldegerima et al. (2019) found that in Addis Ababa, wealthier neighborhoods have better access to high-quality parks and recreational areas compared to lower-income neighborhoods. This disparity is also evident in Adama, where newer developments on the outskirts of the city have more green spaces compared to the older, inner parts. Addressing this inequality is essential for improving the quality of life for all residents.

2.2.3. Urban Planning and Management

2.2.3.1. Policy Implementation

Effective urban planning and policy implementation are essential for the successful integration and management of open spaces (Beatley, 2016). Policies that prioritize green infrastructure and community involvement lead to more sustainable and resilient urban environments (Sandström et al., 2006).

Cities like Toronto and Melbourne have implemented comprehensive green infrastructure policies that emphasize community participation and long-term sustainability (Krellenberg et al., 2013; Sturiale & Scuderi, 2019). These examples offer valuable insights for Adama City in developing effective urban planning strategies.

In Ethiopia, the government has recently prioritized urban green development through initiatives like the Green Legacy Initiative, which aims to increase forest cover and green space in cities (Ethiopian Environmental Protection Authority, 2021). The Adama City Structure Plan (2018) also emphasizes the need for more green spaces, but implementation has been slow, and many planned spaces have not yet materialized. This highlights the gap between policy formulation and actual implementation in Ethiopian cities.

2.2.3.2. Maintenance Strategies

Sustainable maintenance strategies are critical to ensure the continued functionality and appeal of urban open spaces (Miller, 2005). Regular upkeep, community engagement, and

innovative funding mechanisms are key to maintaining high-quality green spaces in cities (Pincetl, 2010).

In Ethiopia, green spaces often suffer from poor management and lack of maintenance. Gebre (2020) notes that many parks and recreational areas in Addis Ababa are underutilized due to inadequate infrastructure and poor maintenance. Adama faces similar challenges, where existing parks are often neglected, reducing their appeal and usability. Addressing these challenges requires more effective management strategies and increased investment in maintenance. For Adama, adopting maintenance strategies from cities like Seattle and Amsterdam can enhance the effectiveness and sustainability of its urban open spaces, ensuring their long-term viability and community value (Harnik & Simms, 2004; van den Berg et al., 2017).

2.2.3.3. Community Participation

Community participation in the planning and management of urban open spaces fosters a sense of ownership and responsibility among residents (Arnstein, 1969). Studies in cities like Berlin and Cape Town have shown that involving communities in decision-making processes leads to more successful and inclusive green space projects (Fors et al., 2015; Frantzeskaki et al., 2018).

In Ethiopia, community participation in urban planning is often limited. However, initiatives such as the Ethiopian Urban Green Development Program (2019) have begun to involve local communities in tree-planting and park maintenance projects, particularly in Addis Ababa. In Adama, involving residents in the planning and management of open spaces could enhance their sustainability and ensure that these spaces meet the needs of the community.

In Adama, fostering community participation can enhance the effectiveness and sustainability of urban open spaces, ensuring they meet the needs and preferences of local residents.

2.2.3.4. Case Studies from Different Cities

Case studies from cities around the world provide valuable insights into effective strategies for urban open space management (Wolch et al., 2014). Examples include the transformation of Seoul's Cheonggyecheon Stream and New York City's High Line, which highlight the potential of innovative urban planning (Cho & Choi, 2014; Hammond, 2016).

These case studies demonstrate the transformative potential of urban open spaces, offering valuable lessons for Adama City in enhancing its urban landscape and quality of life.

Urban green space management practices vary across Ethiopian cities. In Addis Ababa, the city has made significant investments in the redevelopment of parks, such as Friendship Park and Unity Park, as part of the Green Legacy Initiative (Tessema et al., 2021).

These projects have not only improved the city's aesthetic appeal but also attracted tourists and revitalized local economies.

a b

Figure 2: (a) Cheonggyecheon stream in Seoul, Korea (Source: https://www.archdaily.com/.) (b) New York City, The High Line (Source: https://travel.usnews.com/.)

In contrast, cities like Adama face greater challenges in implementing similar projects due to limited financial resources and competing urbanization pressures. Nevertheless, lessons from Addis Ababa and other Ethiopian cities can inform future green space development in Adama, particularly regarding community involvement and public-private partnerships.

2.2.4. Challenges and Opportunities

2.2.4.1. Urbanization Pressures

Rapid urbanization poses significant challenges to the preservation and expansion of urban open spaces (UN-Habitat, 2016). As cities grow, competing demands for land and resources often lead to the neglect of green spaces in urban planning (Angel et al., 2018).

In Ethiopia, rapid urbanization in cities like Addis Ababa and Adama has led to a decline in green spaces as land is repurposed for commercial and residential developments (Abebe & Megento, 2017). Addressing these pressures requires policy interventions that prioritize green space preservation and integration into urban development frameworks. According to Cheru (2013) The Ethiopian Cities Sustainable Prosperity Initiative (ECPI) provides a framework for balancing urban growth with environmental conservation, which could be applied to

Adama's urban planning efforts. In Adama, addressing urbanization pressures requires strategic planning and policy interventions that prioritize green space preservation and integration into urban development frameworks.

2.2.4.2. Resource Constraints

Limited financial and human resources hinder the development and maintenance of urban open spaces in many cities (Pincetl, 2010). Innovative funding models and partnerships are needed to overcome these constraints and ensure sustainable green space management (Bell et al., 2016).

Cities like Rio de Janeiro and Nairobi have successfully leveraged public-private partnerships and community-based initiatives to enhance urban green spaces, offering valuable insights for Adama's development efforts (Makworo & Mireri, 2011; Silva & Puppim de Oliveira, 2016).

In Ethiopian cities, funding for green space development is often limited, and local governments struggle to allocate resources for the maintenance of parks and recreational areas (Gebre, 2020). However, public-private partnerships and community-based initiatives can help address these resource constraints. For example, in Addis Ababa, private companies have partnered with the city government to fund the redevelopment of public parks, demonstrating a successful model that could be replicated in Adama.

2.2.4.3. Innovation in Design

Innovative design approaches can enhance the functionality and appeal of urban open spaces (Thompson & Travlou, 2007).

Incorporating elements of nature-based solutions, multifunctionality, and adaptive design can create more resilient and sustainable urban environments (Pauleit et al., 2017).

For Adama, drawing inspiration from cities like Singapore and Paris can enhance its urban open spaces, promoting resilience and sustainability through innovative design (Tan et al., 2013; Manso & Castro-Gomes, 2015).

In Ethiopia, there is a growing recognition of the need for innovative design in urban green spaces. The redevelopment of Meskel Square in Addis Ababa, for example, incorporates both recreational and ecological functions, serving as a model for multifunctional urban spaces (Gebre & Van Rooijen, 2020). Adama could benefit from similar design innovations, particularly in areas prone to flooding, where green spaces could be designed to manage stormwater and provide recreational opportunities.

2.2.4.4. Sustainable Solutions

Sustainable solutions for urban open spaces involve integrating ecological, social, and economic considerations into planning and design (Beatley, 2016).

Examples include green roofs, vertical gardens, and eco-corridors that enhance urban biodiversity and resilience (Katzschner, 2011).

Cities like Copenhagen and Portland have successfully implemented sustainable solutions that enhance urban livability and resilience, offering valuable lessons for Adama's urban development strategies (Hartig et al., 2014; Macdonald et al., 2018).

In Ethiopia, the government's Green Legacy Initiative (2019) promotes sustainable urban development by encouraging the creation of green spaces in cities. This initiative has already led to the planting of millions of trees nationwide, with the goal of enhancing urban resilience to climate change. Adama could leverage this initiative to expand its green spaces and promote sustainable urban development.

2.3. Summary of the Literature Review

The literature review highlights the critical role of urban open spaces in enhancing environmental sustainability and social well-being. Theoretical perspectives, including social-ecological, urban planning, environmental justice, and social capital theories, provide a foundation for understanding the multifaceted benefits of these spaces. Empirical studies demonstrate the positive impacts of urban open spaces on air quality, climate mitigation, biodiversity, public health, and community cohesion.

In the Ethiopian context, cities like Addis Ababa and Adama face significant challenges in developing and maintaining urban open spaces due to rapid urbanization, resource constraints, and disparities in access. However, initiatives like the Green Legacy Initiative and the Ethiopian Cities Sustainable Prosperity Initiative offer promising frameworks for expanding green infrastructure and addressing these challenges.

By integrating both global and local perspectives, this review underscores the importance of urban open spaces for promoting sustainable urban development in Adama and similar cities. Addressing the challenges outlined in this review will require innovative planning, sustainable management practices, and active community engagement to maximize the potential of urban open spaces in enhancing the quality of life for all residents.

However, challenges such as urbanization pressures, resource constraints, and inequitable access remain significant barriers to the successful integration of green spaces in urban environments.

Addressing these challenges requires innovative planning, sustainable management practices, and active community engagement to maximize the potential of urban open spaces for enhancing the quality of life in cities like Adama.

2.4. Research gaps

This study fills in a number of important research gaps about urban open spaces that are identified by the literature assessment. Theoretically, current frameworks frequently fall short of integrating the two facets of social and environmental well-being, which restricts a comprehensive comprehension of the effects of urban open spaces. Furthermore, the majority of theoretical models are based on Western contexts, which might not adequately capture the particular difficulties encountered in developing nations such as Ethiopia. Empirically, there is a significant lack of research on urban open spaces in Ethiopia, particularly in the core older parts of cities, which are frequently underexplored. Furthermore, earlier research has focused exclusively on quantitative data, ignoring the community's perspectives and lived experiences with these spaces.

By offering a comprehensive understanding of urban open spaces in Aba Geda Sub-City, Adama City, while also taking into account the power dynamics at work and incorporating community voices, this study seeks to close these gaps by offering an integrated analysis of how urban open spaces affect social cohesion and environmental sustainability, contextualized within the Ethiopian urban landscape.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Description of the Study Area

Adama City, a significant urban center in the Oromia Region of Ethiopia, is situated approximately 100 kilometers southeast of the capital, Addis Ababa. Within this rapidly developing city, Aba Geda Sub city stands out as a densely populated area characterized by high levels of commercial activity, administrative functions, and residential development. Aba Geda Sub-City is located in Adama City, which is about 99 kilometers southeast of Ethiopia's capital, Addis Ababa. Adama City is located between latitudes 8°26'34" and 8°36'1" N and longitudes 39°13'9" and 39°21'3" E. Its elevation ranges from 1590 to 1770 meters above sea level. Aba Geda Sub-City, one of six sub-cities in Adama City and with a total area of 110 km2, it contributes significantly to the urban fabric. With 89,127 dwellings spread across six sub-city administrations, including Aba Geda, and a projected population of 374,332 as of 2021, it plays a significant role in the city's spatial dynamics.

3.1.1. Geographic Context

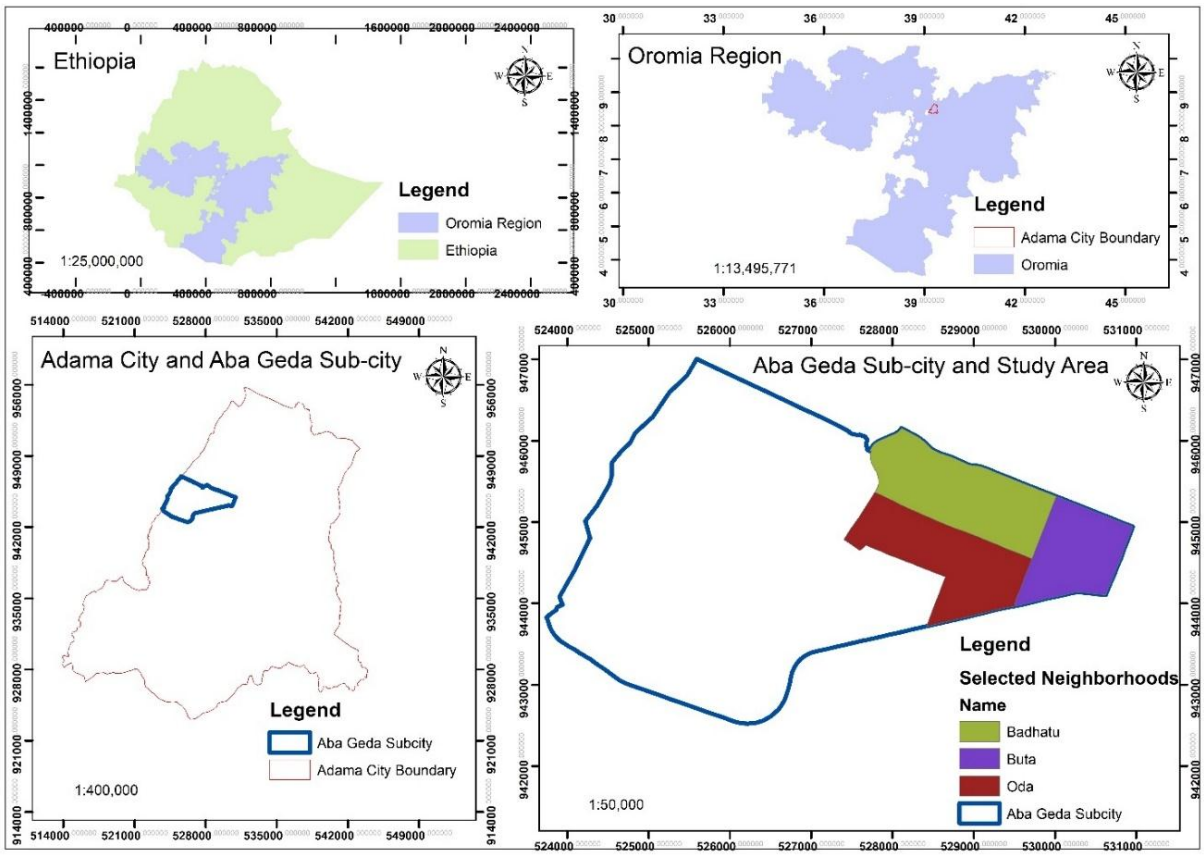

Figure 3: Relative Location Map of the Study Area, Aba Geda Subcity, Adama City

3.1.2. Study Area Selection

In order to explore thoroughly into the multifaceted relationship between urban open spaces, environmental sustainability, and social well-being, three key neighborhoods within Aba Geda Sub city were selected.

Table 1: Selected Study Neighborhood Districts (Badhatu, Oda and Buta)

Neighborhood	**Population (households)**	**Area (hectares)**
Badhatu	6,294	179.934
Oda	5,945	164.980
Buta	9,628	114.442

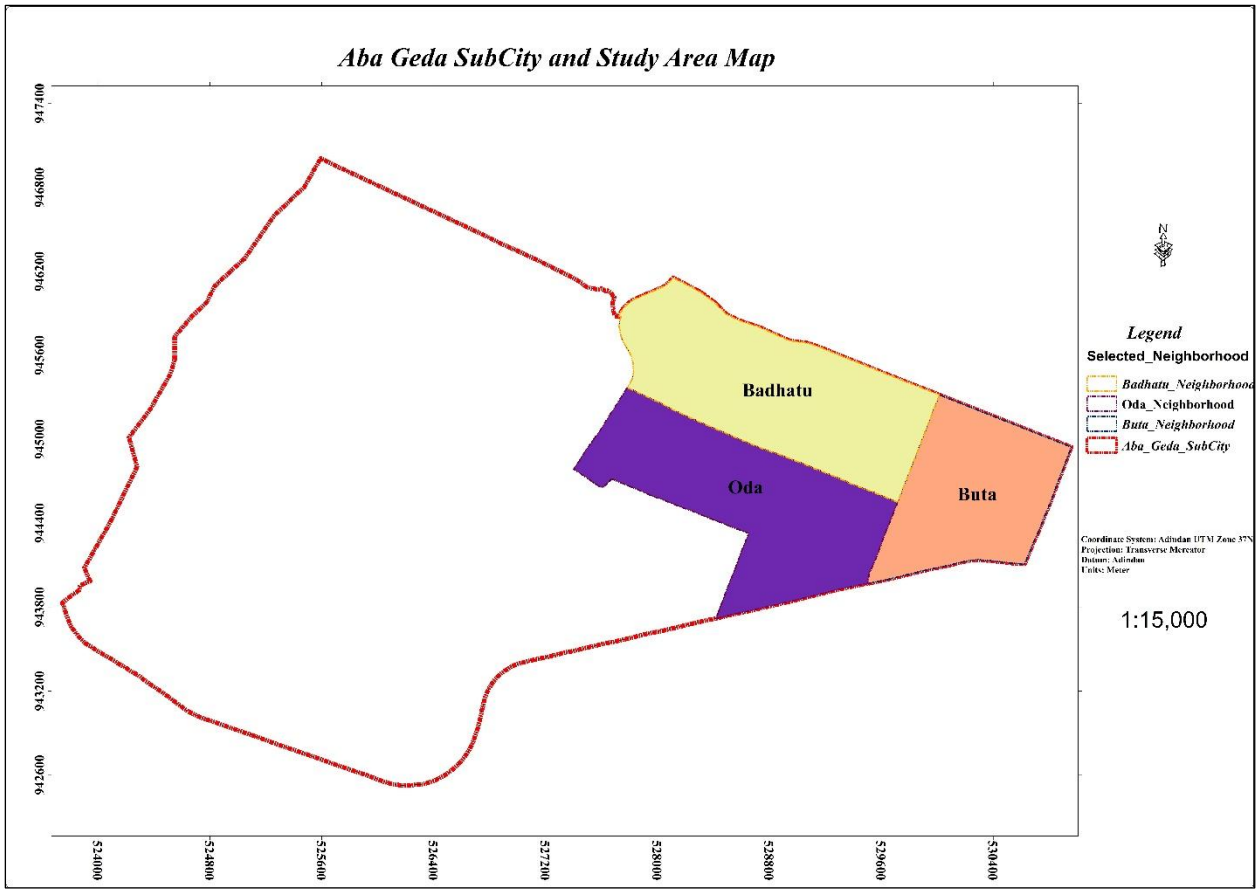

Figure 4: Selected Study Neighborhood Districts (Badhatu, Oda and Buta)

These neighborhoods were strategically chosen due to their high population density, diverse land use patterns, and significant commercial and administrative activities. By focusing on these areas, the study aims to capture the multifaceted impacts of urban open spaces on environmental sustainability and social well-being within a rapidly urbanizing context.

3.1.3. Climate and Topography

Adama City, including Aba Geda Sub city, experiences a warm, semi-arid climate with distinct wet and dry seasons. The topography of the region is generally flat, contributing to the urban development pattern.

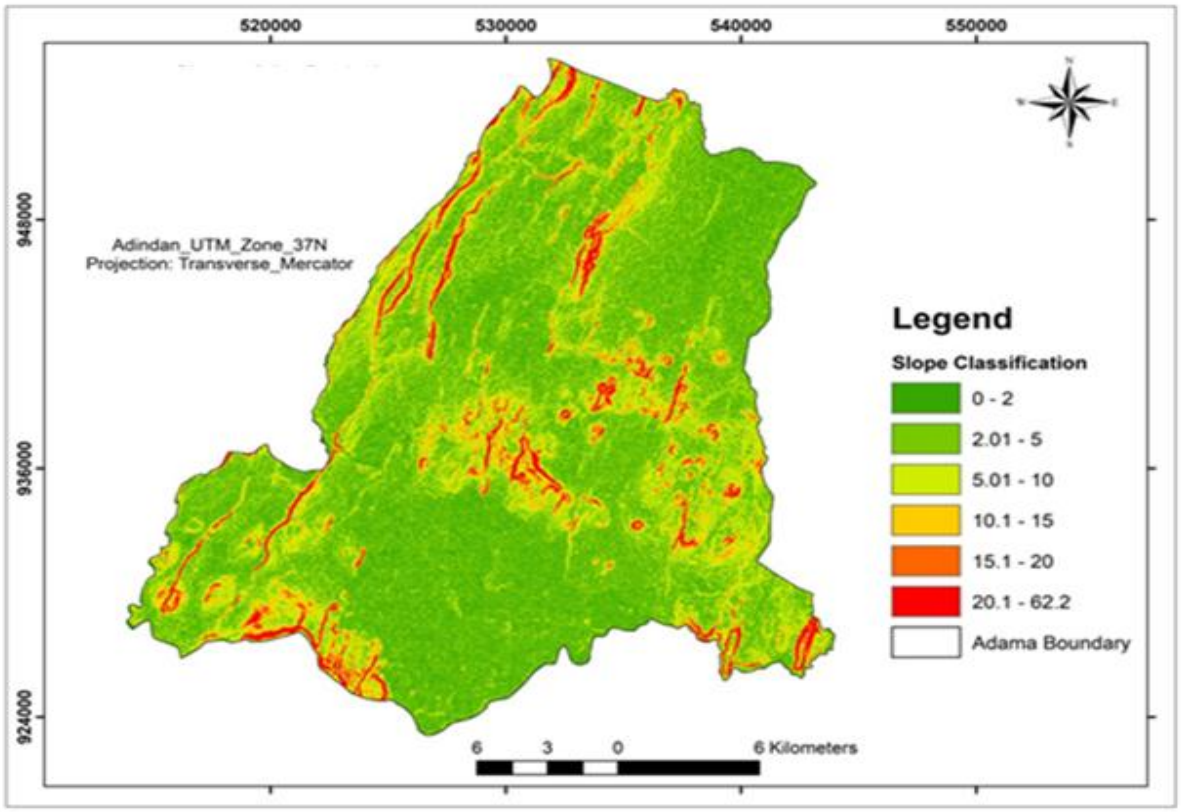

Figure 5: Slope Analysis Map of Adama City

From the analysed data the major slope category 0-1% accounts about 75.74% which is suitable for building /construction.

Table 2: Slope Classification of Adama City

Slope Category (%)	**Description**	**Development Suitability**
0-1	Generally flat	Highly buildable
1-5	Generally flat	Highly Buildable
5-10	Gently rolling	Moderately Buildable
10-15	Gentle to mild slopes	Moderately difficult to build
15-20	Mild to steep slopes	Difficult to Build
20 and above	Harsh, steep slopes	Unbuildable

3.2. Research Approach and Design

This study employed a mixed-methods research design approach to thoroughly evaluate the impact of urban open spaces on environmental sustainability and social well-being in Aba Geda Sub-city, Adama City. The mixed-methodologies technique combines quantitative and qualitative research methods, to provide a comprehensive analysis that meets the study's objectives and research questions. This design is appropriate for grasping the complicated and multi-layered subjects surrounding urban open spaces in a swiftly urbanizing setting such as Adama, where both measurable environmental impacts and subjective social experiences must be studied.

The quantitative component focuses on collecting numerical data and conducting statistical analysis to evaluate the physical characteristics of open spaces, population or demographic patterns, and environmental variables. Data gathered from surveys, environmental evaluations, and geographical analysis provide objective insights into the availability, accessibility, and environmental roles of open spaces in Aba Geda Sub-city. These methods enable for accurate measurements and foster cross-neighborhood comparisons, which are critical for comprehending inequalities in access and distribution within the sub-city.

The qualitative component aims to capture the inhabitants' lived experiences, perceptions, and views of residents, as well as the perspectives of urban planners and other stakeholders. Through key informant interviews, focus group discussions, and field observations, this part of the study investigates the social and cultural relevance of open spaces. It also emphasizes planning and management difficulties that cannot be fully conveyed using quantitative data. The qualitative method enhances the quantitative findings, allowing for a more thorough understanding of the issues and their implications or ramifications.

This dual method ensures that the study takes into account both the measurable environmental and social outcomes of urban open spaces, as well as inhabitant's subjective, context-specific experiences. The integration of these approaches facilitates triangulation, enhancing the reliability and validity of the findings.

By integrating statistical rigor with in-depth narratives, this research design is well-suited to address the central research objectives and questions, providing actionable understandings for improving urban planning and environmental management in Aba Geda Sub-city.

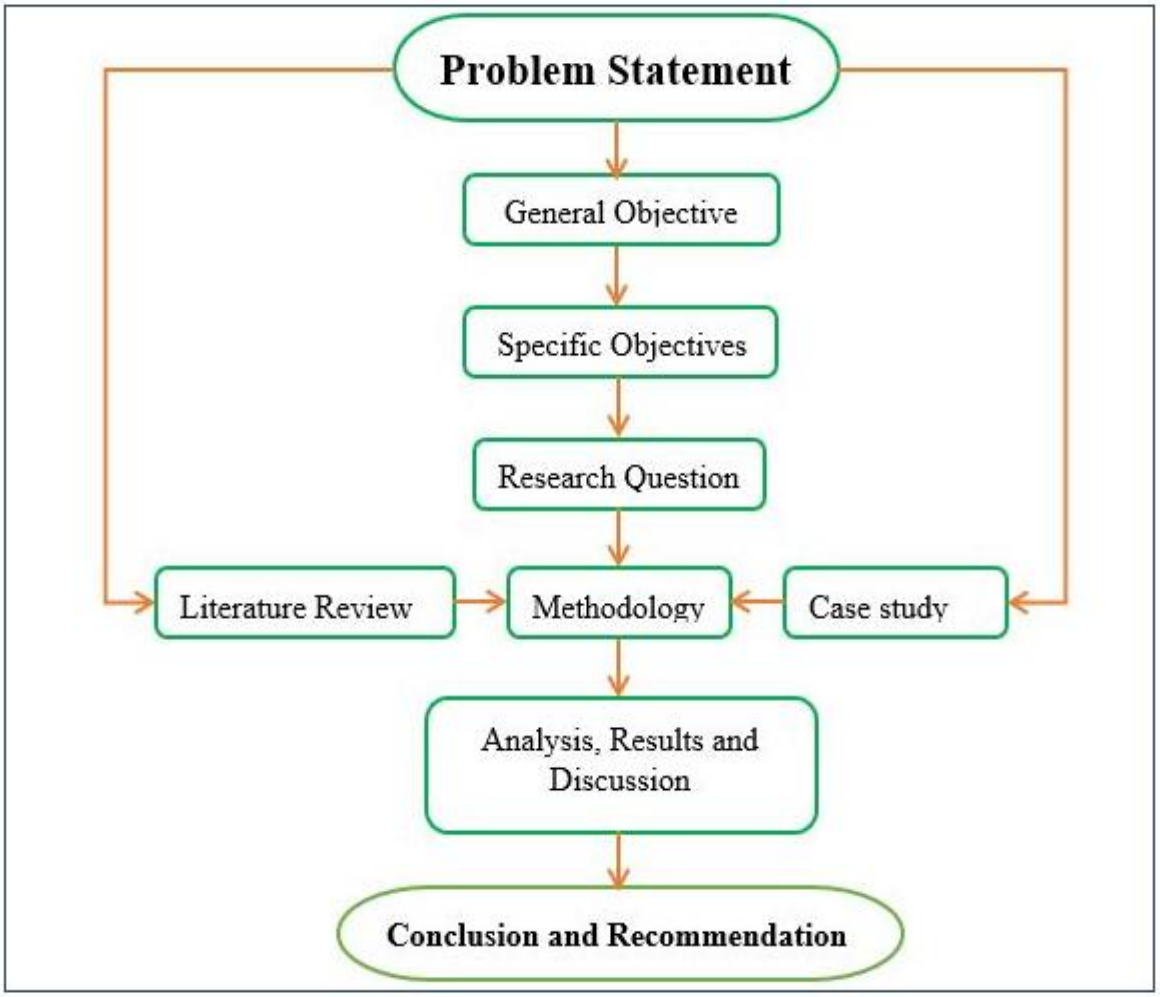

Figure 6: Conceptual framework of research Design

Table 3: Research Design and Design Approach

Component	Description
Research approach	Mixed-methods (quantitative and qualitative)
Objectives	Assess the impact of urban open spaces on environmental sustainability and social well-being in Aba Geda Sub-city, Adama City
Data Collection Methods	1. **Primary Data**
	▪ Household Surveys
	▪ Key Informant Interviews
	▪ Focus Group Discussions
	▪ Physical Observation and Mapping
	2. Secondary Data
	▪ Urban Planning Documents
	▪ Demographic Data
	▪ Environmental Reports
	▪ Spatial Data

	▪ Relevant Literature
Data Analysis Methods	1. **Quantitative Analysis**
	▪ Descriptive statistics
	▪ Inferential statistics
	▪ Correlation and regression analysis
	▪ Spatial data analysis
	2. Qualitative Analysis
	▪ Thematic content analysis
	3. Environmental Analysis
	▪ Air quality analysis
	▪ Noise level analysis

3.3. Data Sources and Collection Methods

This study uses both primary and secondary data to ensure a thorough grasp of the research problem. Primary data are gathered directly from sub-City's residents, stakeholders, and the physical environment of Aba Geda Sub-city, whilst secondary data are sourced from existing documents, reports, and spatial datasets. The combination of these data sources augments the study, providing both firsthand perspectives and historical or contextual information.

3.3.1. Primary Data Collection

Primary data collection encompasses household surveys, key informant interviews, focus group discussions, physical observations, and environmental assessments.

1. **Household Surveys**

The household surveys are conducted to collect quantitative data on residents' socio-demographic characteristics, usage patterns of open spaces, perceptions of environmental and social impacts, and satisfaction levels. A structured questionnaire is developed and pre-tested to ensure clarity and relevance. The survey targets 384 households, which are proportionally distributed across the three major neighborhoods Badhatu, Oda, and Buta based on their populations. Stratified random sampling is used to ensure that the sample is representative of the sub-city's diverse socio-economic and spatial contexts.

2. **Key Informant Interviews (KIIs)**

Key informant interviews are conducted from government structures of Aba Geda Sub city Administration office, Community leader and NGOs for the urban Open space development of the sub city.

The institutions were selected through purposive sampling, specifically seeking representatives of regulatory bodies and implementers of urban open spaces in the Aba Geda sub city. Interviewees include urban planners, environmental officers, community leaders, sub-city administrators, and representatives of environmental NGOs. A semi-structured interview guide is used to explore topics such as policy implementation, management challenges, and future development plans. These interviews provide valuable insights into systemic issues and institutional dynamics that shape the development and maintenance of open spaces.

Table 4: Key Informant Interview Distribution

No.	**Key Informant**	**Sampling Approach**	**Data collection Technique**	**Sample Size (person)**	**Source**
1.	Urban planners and architects	Purposive Sampling	Semi-structured interviews	3	Aba Geda Sub-City Administration
2.	Environmental officers	Purposive Sampling	Semi-structured interviews	2	Aba Geda Sub-City Administration
3.	Sub-city administrators	Purposive Sampling	Semi-structured interviews	2	Aba Geda Sub-City Administration
4.	Community leaders	Purposive Sampling	Semi-structured interviews	4	Residents
5.	Environmental NGO representatives	Purposive Sampling	Semi-structured interviews	2	The International Rescue Committee (IRC)
6.	Urban development experts	Purposive Sampling	Semi-structured interviews	2	Aba Geda Sub-City Administration
	Total			**15 people**	

3. Focus Group Discussions (FGDs)

Focus group discussions purposive sampling selected and held with diverse community groups, including youth, women, elders, environmental activists, business owners, and local organizations. The discussions aim to explore community needs, preferences, and concerns regarding open spaces, as well as their suggestions for improvement. Open-ended questions are used to facilitate dialogue and capture a wide range of perspectives.

Table 5: Focus Group Discussions (FGDs) Sample Distribution

No.	Community Groups	**Sampling technique**	**Number of Participants**	**Data Collection Techniques**
1.	Youth groups	Purposive Sampling	6	Open-ended questions
2.	Women's associations	Purposive Sampling	8	Open-ended questions
3.	Elderly residents	Purposive Sampling	6	Open-ended questions
4.	Local business owners	Purposive Sampling	8	Open-ended questions
5.	Environmental activists	Purposive Sampling	3	Open-ended questions
6.	Community organizations	Purposive Sampling	4	Open-ended questions
	Total		**35**	

4. Physical Observation and Mapping

Physical observations and mapping are used to document the current condition and spatial distribution of open spaces in the Aba Geda sub-city. This involves field visits to existing open spaces, where data on their size, infrastructure, vegetation, and overall condition are recorded. GPS devices are utilized to map the locations of open spaces and potential development sites. Observations also focus on usage patterns, such as who utilizes the spaces, for what purposes, and at what times.

5. Environmental Analysis

Environmental analysis is carried out to assess the ecological implications of inadequate open spaces. Potential key measurements consist of air quality, and noise pollution impact analysis. These indicators are critical for understanding the environmental challenges faced by Aba Geda Sub-city and the potential benefits of improved open spaces. (See appendix 2 up to 4 for more details on the environmental assessment).

To guarantee that the data gathered is representative and significant, a number of parameters were taken into account when choosing particular months for air quality assessments. For the following reasons, Aba Geda Sub-city's air quality was measured in October and November.

First of all, these months are important in places like Ethiopia because they are the time between the wet and dry seasons. By capturing data that reflects both the end of the wet season and the beginning of the dry season, this transitional time can shed light on how air

quality changes when the climate changes. This is crucial for comprehending seasonal fluctuations in air quality (Redi, 2024).

Second, compared to other months, October and November usually show more consistent weather patterns, making it easier to determine baseline air quality conditions free from the confounding influence of extreme weather events like intense heat waves or heavy rainfall, which can drastically change air quality readings (Echendu et al., 2022)

Thirdly, these months align with Ethiopia's prevailing urban activities, including construction and industrial operations, as well as ongoing agricultural activities. A thorough grasp of the sources and concentrations of air pollutants is made possible by monitoring during this period, which enables the evaluation of the effects of these activities on air quality (UN Environment, 2018).

October and November are especially pertinent for comprehending the health effects of air pollution during this crucial time because, from a public health standpoint, the change from wet to dry seasons can result in changes in respiratory health and other health outcomes due to variations in air quality (D'Amato et al., 2013).

The use of the AirScope mobile app every day during this period allows for the creation of a solid dataset that can be examined for trends, patterns, and correlations among different air quality parameters, including PM2.5, PM10, CO2, and temperature. Methodologically, choosing two consecutive months guarantees consistency in data collection procedures (Redi, 2024).

Additionally, this selection of months might coincide with other research or monitoring initiatives in the area, making it simpler to compare and integrate findings with previous studies and boosting the results' validity and generalizability (Redi, 2024).

i. **Air Quality Monitoring Methods**:

Environmental Data Summarization Methodology: Air quality and temperature data were generated using the following methods.

- Measuring Tool: AirScope mobile app
- Daily Measurements: At the two chosen locations near Oda Fountain and near Wonji Mazoria air quality measurements like PM2.5, PM10, CO2, and temperature were monitored every day using the AirScope mobile app.

- Recording Schedule: To account for diurnal fluctuations, measurements were made twice a day, in the morning and the evening. Two months (October and November) in a row were dedicated to data collection (See in Appendix 2 and 3 for more Details).
- Averaging Procedure: To provide a single value for every day, daily measurements were averaged. To determine a monthly mean for each metric, the daily averages were further averaged at the conclusion of each month.
- Selection of Representative Data: The average of the two monthly means for each parameter was computed in order to produce the summarized table (See under Chapter 4, Table 17). As a result, each parameter at every site had a single representative value.
- Comparison with WHO Standards: To identify any exceedances or adherence to air quality limits, the recorded values were compared to WHO standards.

ii. Monitoring of Noise Pollution

1. Measuring Tool: The Decibel X: dB Sound Level Meter app, which is popular for tracking noise levels on smartphones.

2. Locations:

- Oda Fountain Public Area
- Wonji Mazoria Public Area
- Built-up Area (by Oda Fountain)

3. Timetable for Measurements:

- Three times a day, in the morning (8:00 AM), afternoon (1:00 PM), and evening (7:00 PM), readings are taken.
- For seven days in a row, measurements were taken.

3.3.2. Secondary Data Collection

Secondary data were collected from various sources to complement the primary data. This included:

- Urban Planning Documents: Adama City Structure Plan (2018-2028), Ethiopian National Urban Green Infrastructure Standard (2015), and related urban policies.
- Demographic Data: Population statistics from the Central Statistical Agency and sub-city administration.

- Environmental Reports: Studies on urban heat islands, air quality, and vegetation coverage.
- Spatial Data: Satellite imagery, GIS layers, and images from observation.
- Relevant Literature: Published academic journals and grey literature focusing on urban open spaces in Ethiopia.

3.4. Sampling Design and Procedures

The study employs a multi-stage sampling technique to ensure representativeness and inclusivity. Stratified random sampling is used for household surveys, while purposive sampling is employed for key informants, focus group participants, and observation sites. This approach allows the study to capture both the diversity of residents' experiences and the expertise of stakeholders involved in urban planning and environmental management.

Table 6: Sampling Design and Procedures

Method	**Description**
Household Surveys	Stratified random sampling
Key Informant Interviews	Purposive sampling
Focus Group Discussions	Purposive sampling

3.4.1. Sample Size Determination

To determine the sample size for household surveys, Yamane's formula is applied with a 95% confidence level and a 5% margin of error. Based on the total population of Aba Geda Sub-city (87,467 residents), the required sample size is calculated to be 384 households. These households are proportionally allocated across the three neighborhoods Badhatu, Oda, and Buta based on their respective populations. Within each neighborhood, households are randomly selected to ensure that the sample is representative of the broader community.

Equation 1: Yamane's Formula……$n = \frac{N}{1+N(e)^2}$

Where:

- n = sample size
- N = total population (87,467 residents)
- e = margin of error (5%)

Table 7: Sample Size Distribution for selected Neighborhoods

Selected Neighborhoods	Area (Hectares)	Population	Number of Households	Sample Size (households)	Percentage (%)
Buta	114.442	38,512	9,628	135	43.88%
Oda	164.980	23,781	5,945	121	27.26%
Badhatu	179.934	25,174	6,294	128	28.86%
Total	**459.356**	**87,467**	**21,867**	**384**	**100.00%**

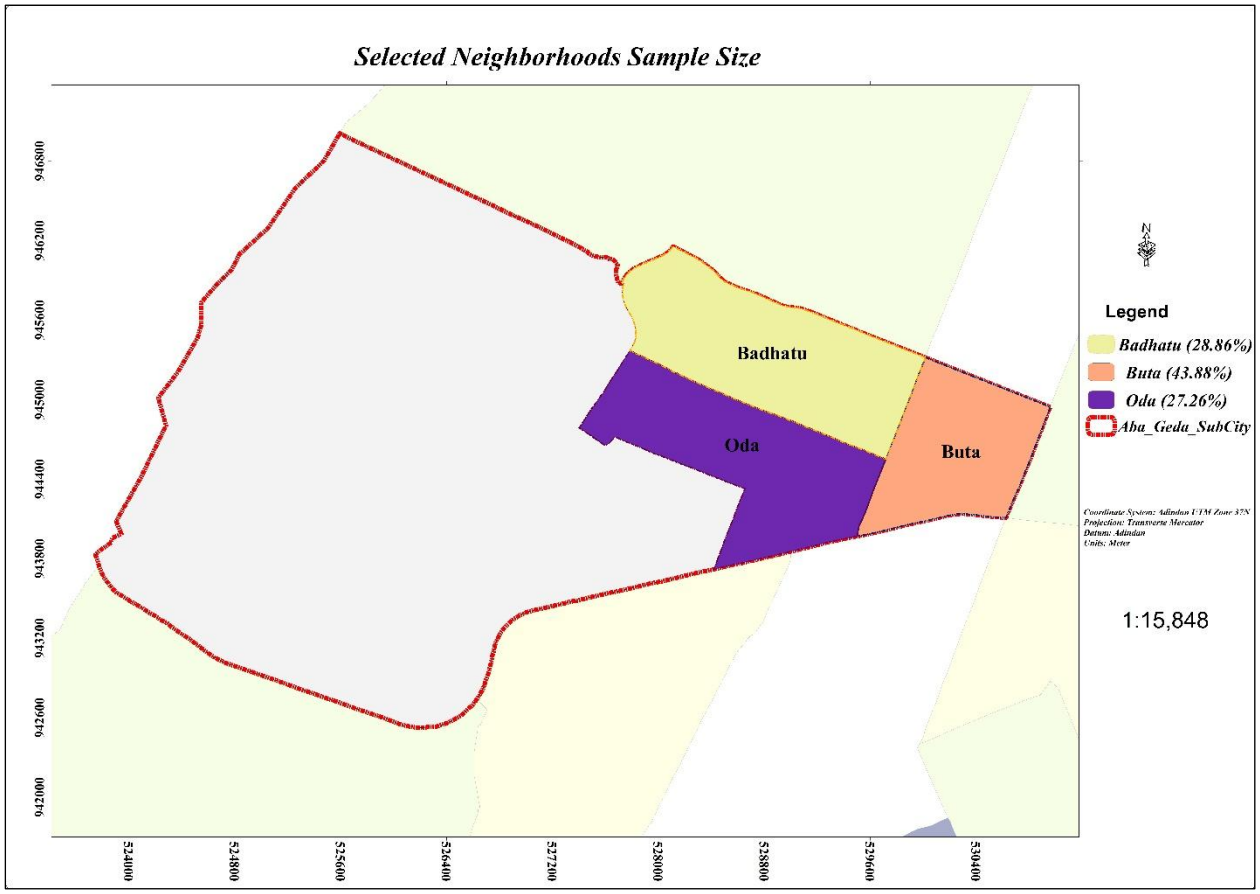

Figure 7: Map Showing Selected neighborhoods with their respective percentage distribution according to stratified random sampling and Yamane's formula.

For qualitative data collection, purposive sampling is used to select key informants and focus group participants who have relevant knowledge and experiences. Key informants include urban planners, environmental officers, community leaders, and NGO representatives, while focus groups are formed with diverse groups such as youth, women, and local business owners. This targeted sampling ensures that the study captures a wide range of perspectives and insights.

3.5. Data Analysis Methods

Data analysis in this study involves both quantitative and qualitative techniques to ensure a comprehensive interpretation of the findings.

Table 8: Data Analysis Methods

Method	Description
Quantitative Analysis	Statistical techniques (descriptive, inferential, spatial)
Qualitative Analysis	Thematic content analysis
Environmental Analysis	GIS-based analysis, air quality analysis, and noise analysis

3.5.1. Quantitative Analysis

Statistical techniques were used to analyze survey data:

- Descriptive statistics to summarize demographic data, usage patterns, and satisfaction levels using Excel.
- Correlation analysis to explore associations between open space use and environmental/social factors
- Spatial data were analyzed using GIS tools to map the distribution of open spaces and conduct density and proximity analyses

3.5.2. Qualitative Analysis

Qualitative data from interviews, FGDs, and observations were analyzed using thematic content analysis. Key themes were identified based on the research objectives, and data were coded and categorized to highlight patterns and insights. Excel software was used for data organization and thematic coding.

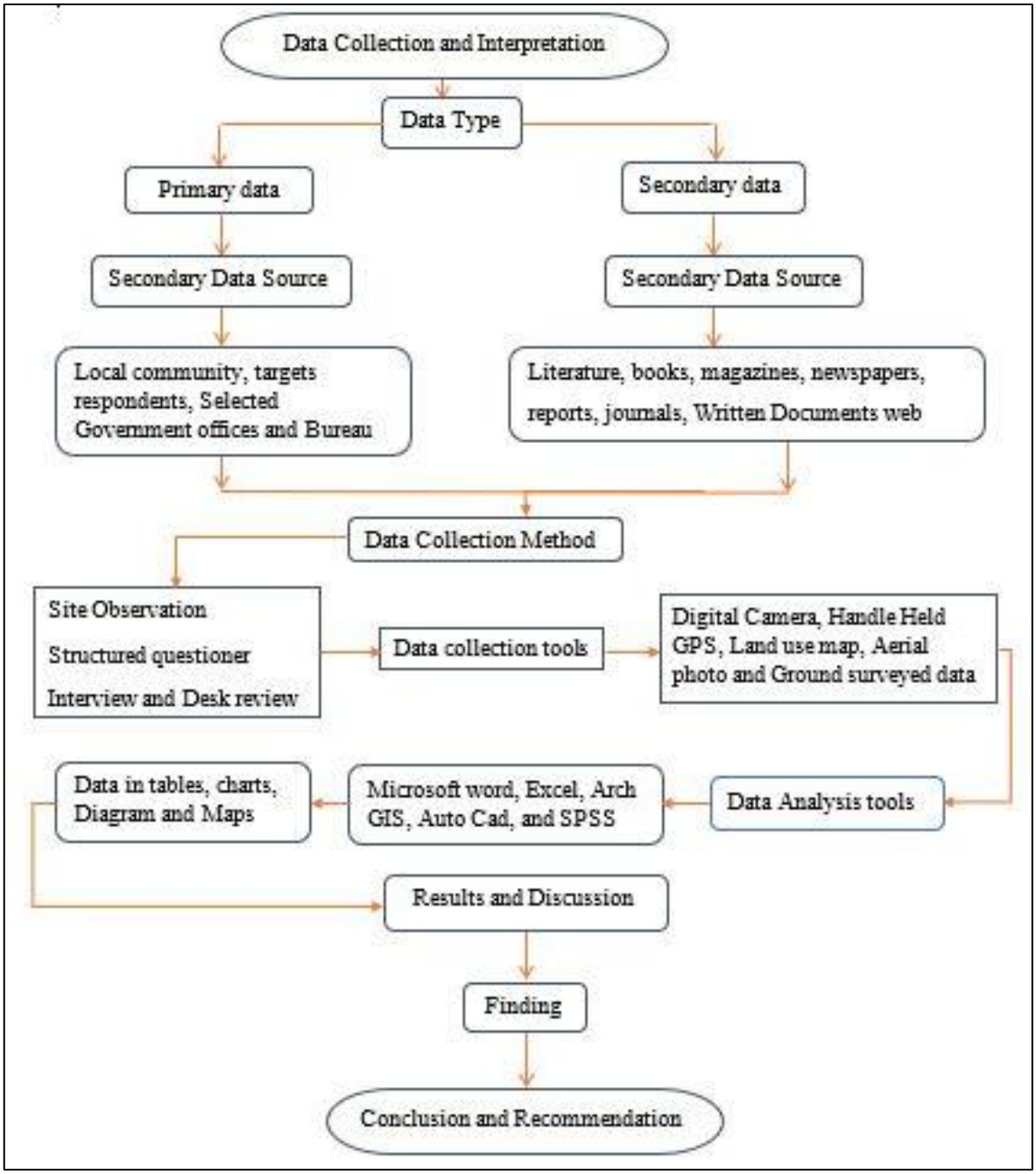

Figure 8: Flowchart of Data Analysis and Interpretation

3.6. Quality Assurance and Ethical Considerations

3.6.1. Quality Assurance

To ensure the accuracy and reliability of the data collected, a pilot test of the survey instrument was conducted with 20 households, which provided valuable insights for refinement. Additionally, field assistants received training on effective data collection methods to enhance the quality of the information gathered.

Throughout the process, data were cross-checked for consistency during both entry and analysis. Furthermore, to validate the findings, triangulation of primary and secondary data was employed, strengthening the overall reliability of the results.

3.6.2. Ethical Considerations

This study adhered to ethical research practices by taking several key measures to protect participants' rights and well-being. Informed consent was obtained from all participants, ensuring they were fully aware of the study's purpose and procedures. The confidentiality and anonymity of their responses were guaranteed, promoting a secure environment for open participation. Furthermore, participants were allowed to withdraw from the study voluntarily at any stage without any repercussions. Additionally, the research team was committed to respecting cultural norms and sensitivities within the study area, fostering a respectful and ethical approach throughout the research process.

3.7. Data Presentation

The findings are presented using a combination of tables, charts, maps, and narrative descriptions. Quantitative data are summarized in tables and graphs to facilitate easy interpretation, while spatial data are presented through maps and diagrams that illustrate the distribution of open spaces and environmental indicators. Qualitative data are presented thematically, with direct quotes and narratives providing rich insights into community experiences and stakeholder perspectives. Photographic documentation is included to visually illustrate the current state of open spaces and their usage patterns.

CHAPTER FOUR

RESULTS, FINDINGS, AND DISCUSSION

4.1. Introduction

This chapter provides a comprehensive analysis of the existing urban open spaces within the Aba Geda Sub-city of Adama. The analysis integrates quantitative data from 384 household surveys and qualitative data from 15 key informant interviews (KIIs, n=15) and 6 focus group discussions (FGDs, n=6). The findings are organized thematically to address the research objectives and examine the environmental and social implications of the current open space provision. This chapter concludes with a discussion of future development opportunities based on community feedback.

4.2. Description of selected neighborhoods

The research area consists of three neighborhoods: Badhatu, Oda, and Buta. These neighborhoods vary in population density and their socioeconomic status.

I. **Neighborhoods:** The study focuses on three neighborhoods within Aba Geda Sub-city: Badhatu, Oda, and Buta. These neighborhoods are characterized by their unique demographic and spatial characteristics.

- **Badhatu Neighborhood**: This neighborhood is one of the oldest and most densely populated areas in Aba Geda Sub-city. It covers an area of 179.934 hectares and has a population of approximately 25,174 residents.
- **Oda Neighborhood**: Located in the central part of Aba Geda Sub-city, Oda Neighborhood is known for its vibrant commercial activities and proximity to key urban amenities. It spans an area of 164.980 hectares and is home to about 23,781 residents.
- **Buta Neighborhood**: This neighborhood is the most populous among the three, with a population of around 38,512 residents. It covers an area of 114.442 hectares and is characterized by a mix of residential and commercial land use.

II. **Open Spaces:** The study area has two notable open spaces:

- **Oda Fountain Open Space**: This open space is located in the Oda Neighborhood, adjacent to Derartu Square (roundabout) in downtown Adama.

- It covers a small area of 0.0856 hectares and is impacted by high noise pollution due to its proximity to a busy taxi stop.
- **Wonji Mazoria Open Space**: Located approximately 1.5 kilometers west of Oda Fountain Open Space, this larger open space spans 0.88 hectares. It is situated at a distance of 1.02 kilometers from the center of Oda Neighborhood, 1.9 kilometers from the center of Badhatu Neighborhood, and 2.4 kilometers from the center of Buta Neighborhood.

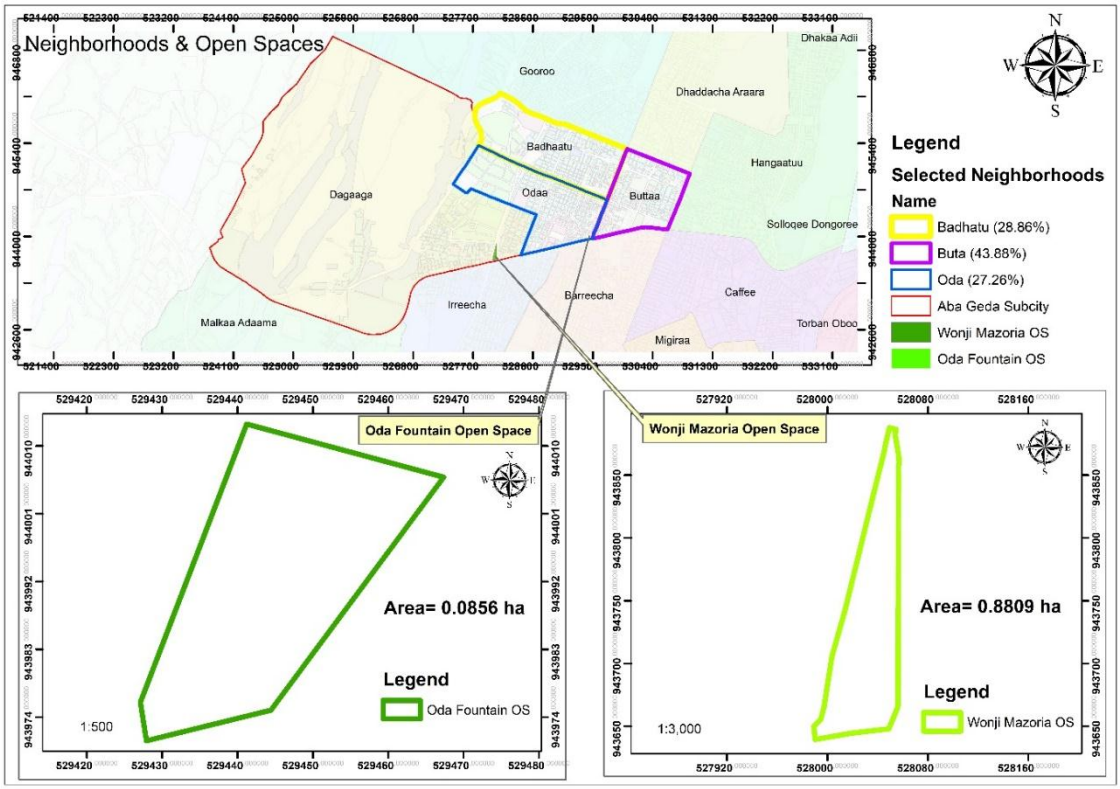

Figure 9: Map of Aba Geda Sub-city showing the three neighborhoods (Badhatu, Oda, and Buta) and the two open spaces (Oda Fountain Open Space and Wonji Mazoria Open Space)

The accessibility of these open spaces varies significantly. Oda Fountain Open Space, despite its central location, is limited by its small size and poor condition. Wonji Mazoria Open Space, while larger, is less accessible due to its distance from the residential areas.

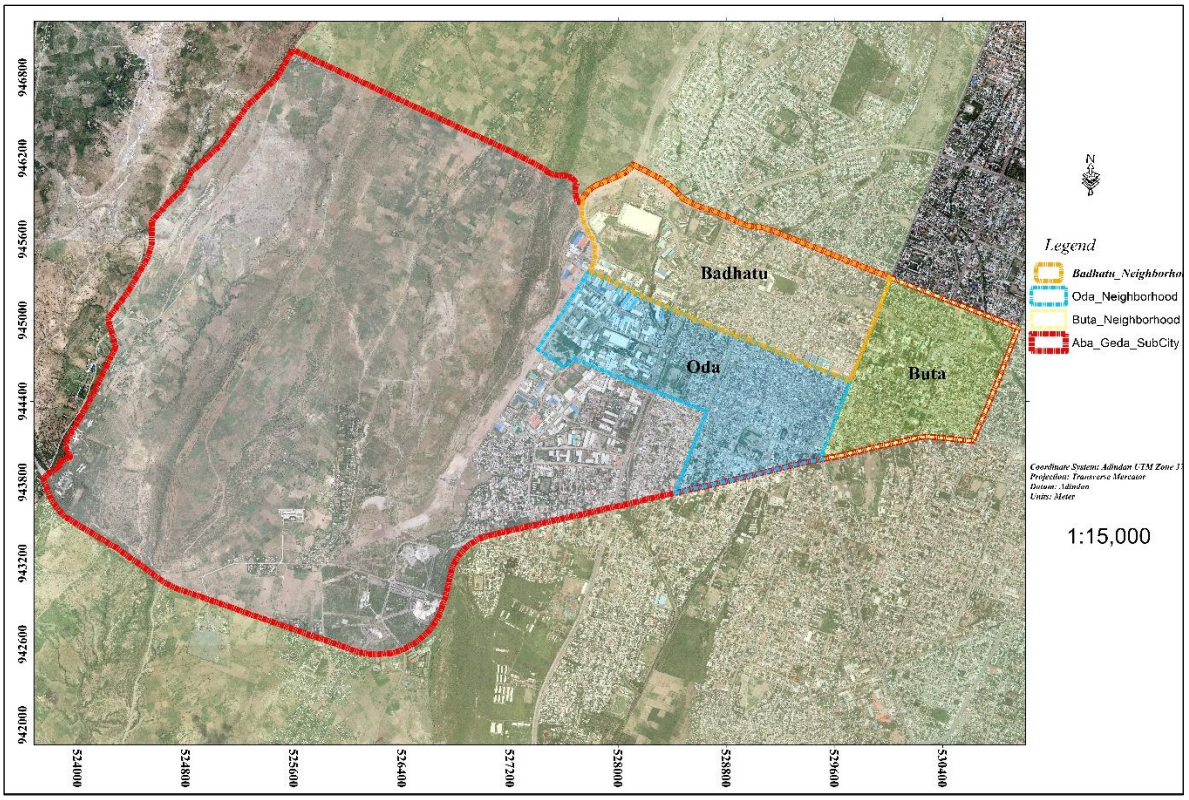

Figure 10: Image showing the three neighborhoods within Aba Geda Sub-City (Badhatu, Oda, and Buta)

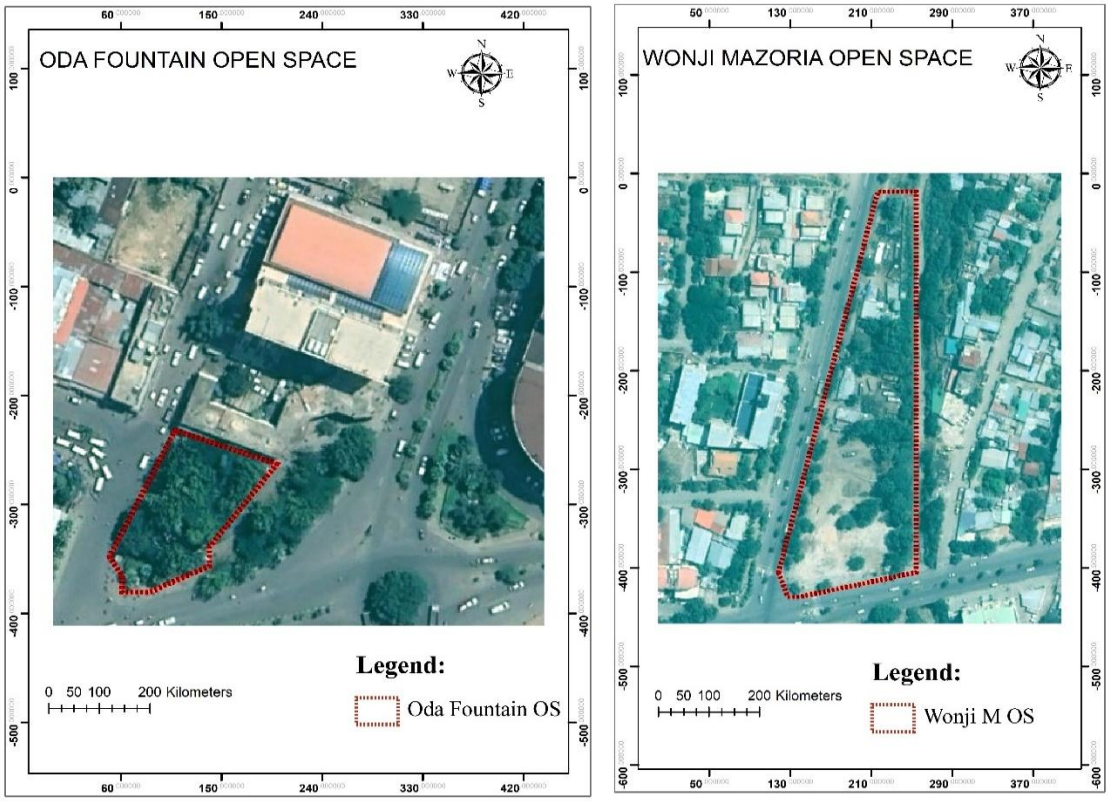

Figure 11: Image Showing Existing Open Spaces Situated within Aba Geda Sub-City

4.2.1. An Overview of Aba Geda Sub-City's Current and Proposed Land Use Maps

Understanding how urban planning choices impact the availability of public spaces and, in turn, the welfare of its inhabitants requires an examination of land usage in Aba Geda Sub-city. With an emphasis on the implications for urban open spaces.

4.2.1.1. Existing Land Use Map vs Open Spaces

The present land use map depicts the distribution of land designated for various purposes, such as residential, commercial, industrial, and open spaces. A close look at this map reveals that, while there are various designated open spaces, such as parks and recreational places, their distribution is unequal, and numerous neighborhoods lack proper access to these amenities. The remaining open spaces are frequently concentrated in specific neighborhoods, leaving other areas of the city neglected.

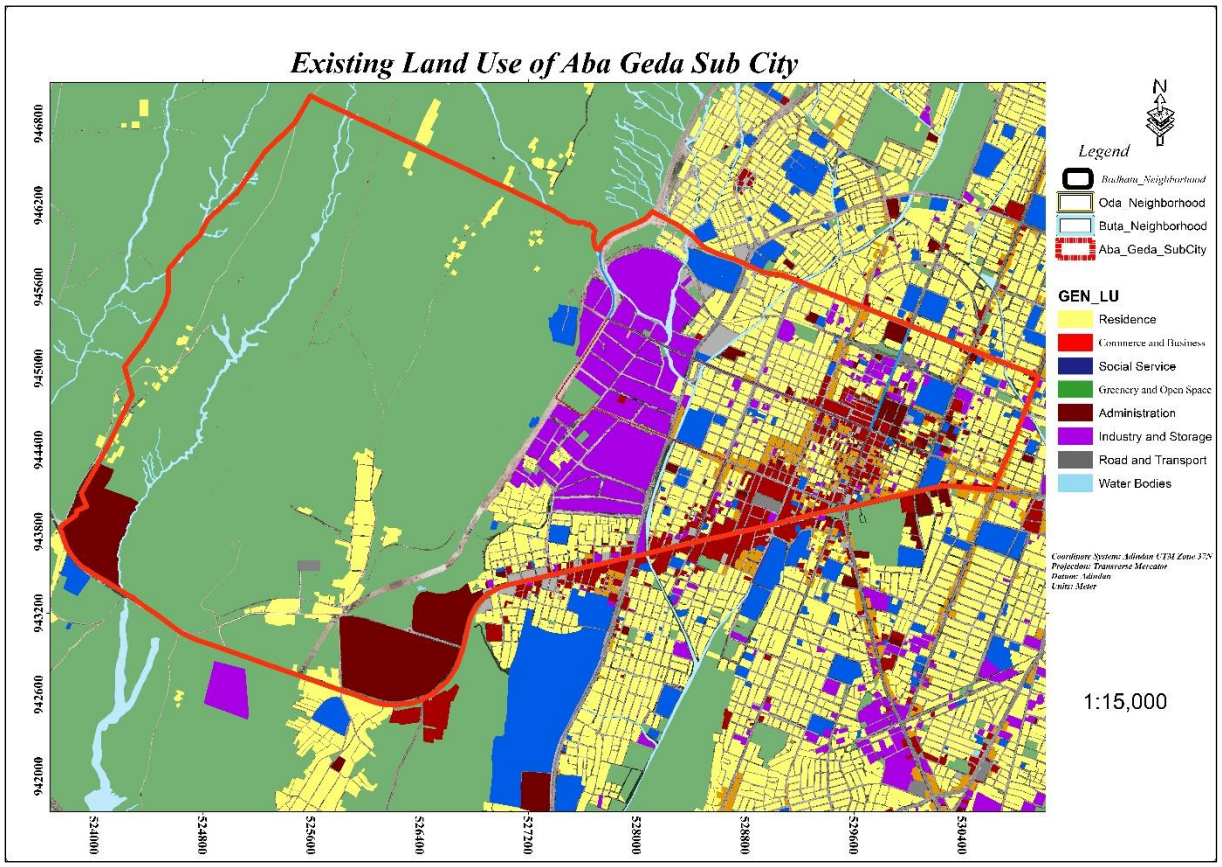

Figure 12: Existing Land Use Map of Aba Geda Sub City (Extracted from existing land use map of Adama City)

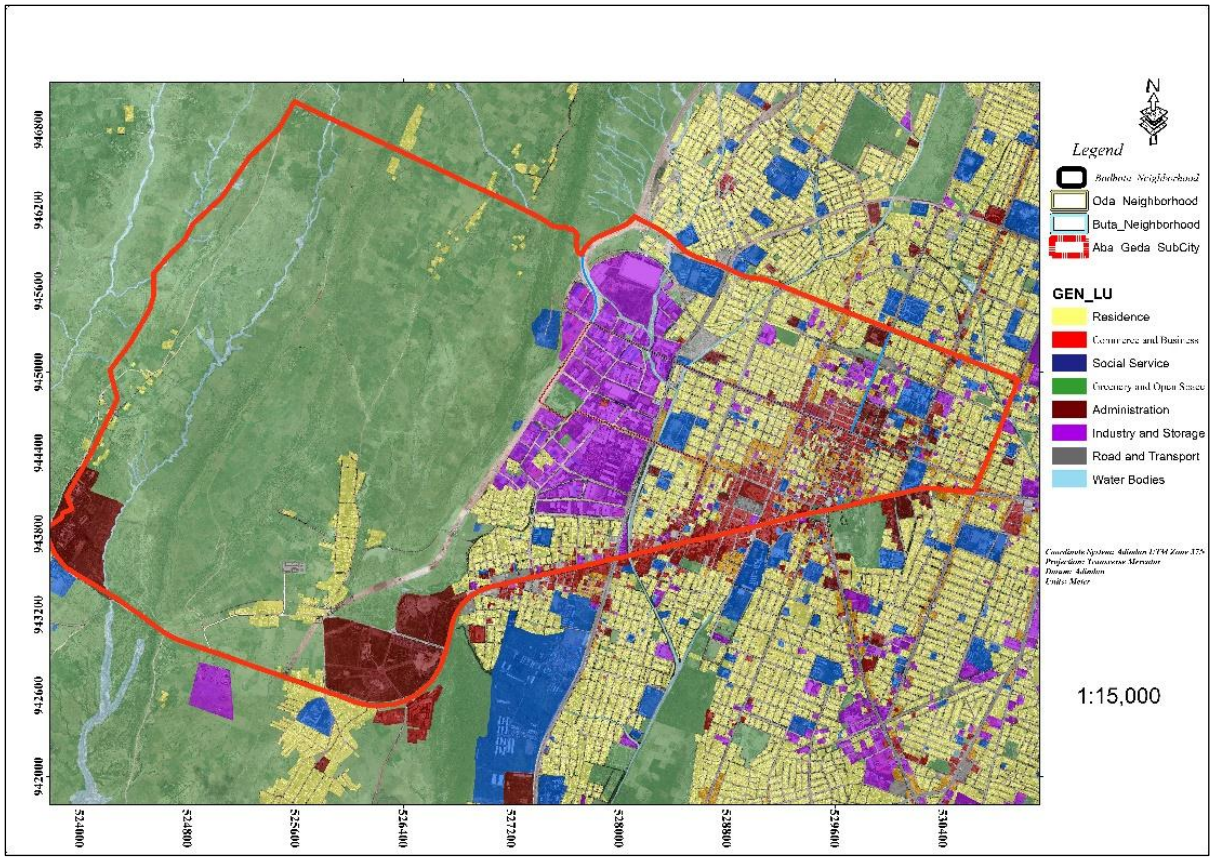

Figure 13: Existing Land use map overlapped with the Satellite Image

4.2.1.2. Proposed Land Use Map (2018) vs Open Spaces

The 2018 proposed land use map illustrates the city's future development plans, taking into account the area's expected growth and urbanization. However, an examination of this map reveals an alarming trend: the allocation for open spaces and public amenities remains disproportionately inadequate in comparison to the growing demand for such services.

When analyzing the proposed land use map of study area, it is clear that the majority of the newly allotted land use is reserved for residential, commercial and manufacture development, with only a few areas set for buffer zones as urban open spaces. This trend represents a continuance of the existing issues faced in the urban planning process, where economic development and housing demands outweigh the requirement for sustainable and accessible urban green spaces.

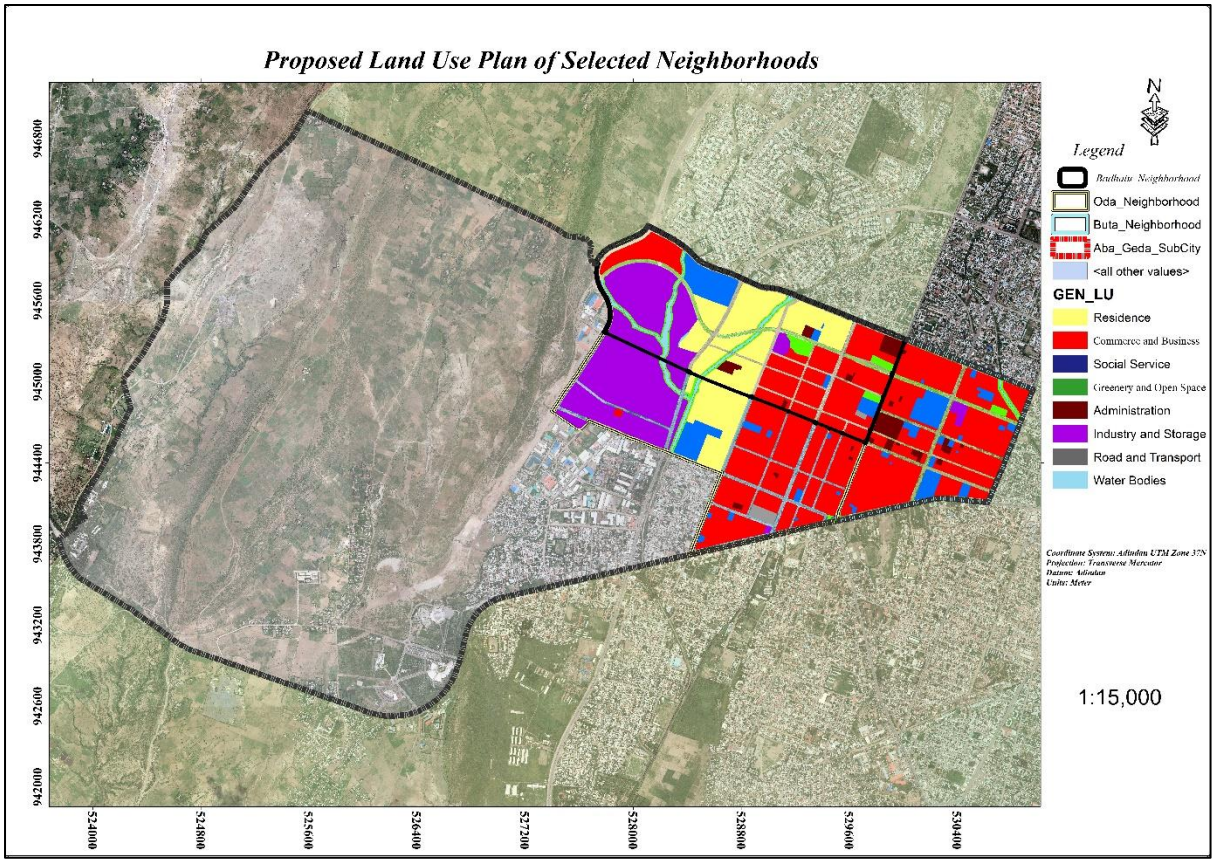

Figure 14: Proposed Land Use Map of Aba Geda Sub City (Extracted from the Structure Plan of Adama City 2018)

4.2.1.3. Implications of Land Use Maps in Relation to Open Spaces

A significant gap in urban planning concerning the availability of public spaces in Aba Geda Sub-city is revealed by comparing the projected and current land use maps. The proposed land use plan's lack of attention to open spaces suggests that pre-existing problems, such overcrowding in parks and recreational facilities, may get worse, making it harder for resident to access essential public areas that improve their quality of life.

Furthermore, the absence of adequate urban open areas on both maps raises questions regarding the region's long-term environmental sustainability. Lack of green areas as urbanization progresses can result in greater temperatures, more air pollution, and a decline in social cohesiveness, all of which can have an adverse effect on the community's general well-being.

In summary, the analysis of the current and planned land use maps highlights the urgent need for Aba Geda Sub-city to adopt a more balanced approach to urban planning. To promote a healthier, more sustainable urban environment that satisfies the requirements of its dwellers,

policymakers and planners must give open space integration top priority in future development plans.

4.3. Demographic Profile of Survey Respondents

The demographic analysis reveals a diverse sample of respondents, representing various age groups, educational backgrounds, and occupational categories. Assessing the demographic features of respondents in a study on urban open spaces provides insightful data on how different segments of the population perceive and use such spaces. The characteristics of age, gender, education level, occupation, and income level are all relevant to the study's aims.

4.3.1. Gender Distribution of The Respondents

Table 9: Table Showing Gender Distribution of the Respondents within the Study Areas

Characteristic	**Frequency**	**Percentage**
Sex		
Male	201	52.3%
Female	183	47.7%
Total	**384**	**100%**

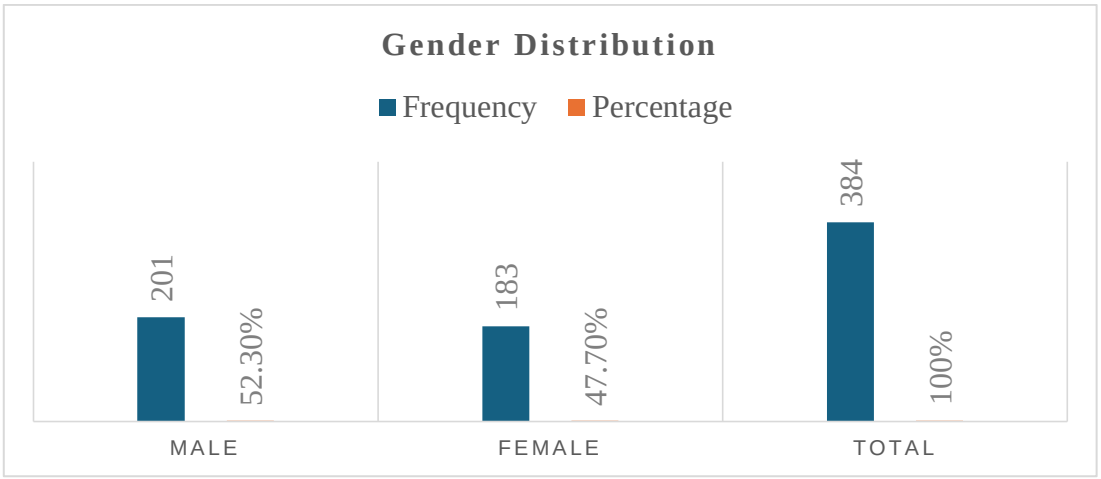

Figure 15: Gender Distribution of the Respondents within the Study Areas

4.3.2. Age Distribution of the Respondents

Table 10: Table Showing Age Distribution of the Respondents within the Study Areas

Characteristic	Frequency	Percentage
Age		
18-24	73	19.0%
25-34	127	33.1%
35-44	98	25.5%
45-54	52	13.5%
55+	34	8.9%
Total	**384**	**100%**

The gender distribution shows near-equal representation, with 52.3% male and 47.7% female respondents. The age distribution indicates a predominantly young to middle-aged population, with 58.6% of respondents between 25-44 years. This age structure reflects the broader demographic pattern of Adama City, where young adults constitute a significant portion of the urban population.

Examining the respondents' age distribution provides insight into how various age groups perceive and interact with urban open spaces. And gender analysis can reveal differences in views and usage patterns of open spaces. For example, women may have different safety concerns or social contact preferences than men. Understanding these distinctions is critical for designing inclusive urban areas that meet the demands of all genders.

4.3.3. Education Level of the Respondents

Table 11: Table Showing Education level of the respondents within the Study Area

Characteristic	Frequency	Percentage
Education Level		
No formal education	42	10.9%
Primary	87	22.7%
Secondary	156	40.6%
College/University	99	25.8%
Total	**384**	**100%**

Educational attainment varies significantly among respondents, with 40.6% having completed secondary education. The relatively high proportion of college/university graduates (25.8%) suggests a well-educated sample population, particularly in comparison to national averages. This educational profile has implications for understanding and utilizing urban open spaces. Evaluating respondents' education levels allows us to better understand

how different levels of education influence perceptions on benefit urban open space, management of urban open spaces and use of urban open spaces.

4.3.4. Occupation Distribution of the Respondents

Table 12: Table Showing Occupation Distribution of the Respondents within the Study Area

Characteristic	**Frequency**	**Percentage**
Occupation		
Government employee	89	23.2%
Private sector	112	29.2%
Self-employed	94	24.5%
Student	45	11.7%
Unemployed	44	11.4%
Total	**384**	**100%**

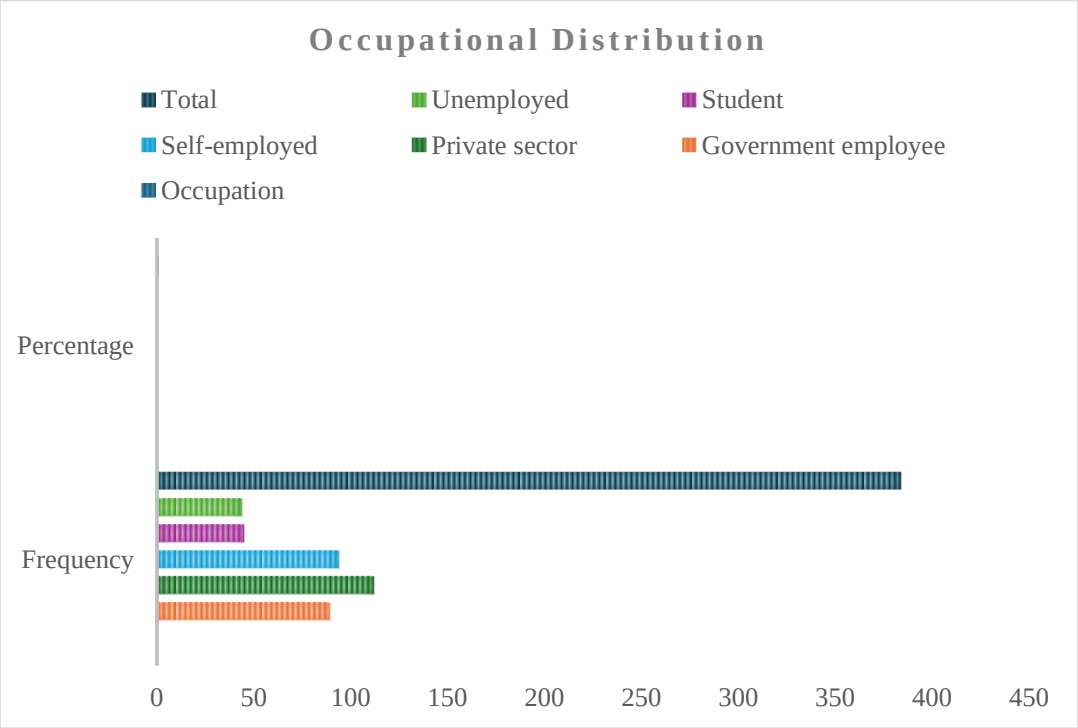

Figure 166: Occupation Distribution of the Respondents within the Study Area

Occupational distribution reveals a diverse economic base, with private sector employment (29.2%) being the most common, followed by self-employment (24.5%) and government service (23.2%). The presence of students (11.7%) and unemployed individuals (11.4%)

indicates the need for open spaces to serve various user groups with different needs and usage patterns.

The study seeks to determine the impact of urban open spaces on community well-being. Occupation can influence an individual's availability and demand for open spaces, such as working professionals who require areas for relaxation and recreation. Understanding respondents' occupations allows the study to identify how different occupations influence perceptions as well as usage of open spaces.

4.3.5. Income Distribution of The Respondents

Table 13: The Monthly Income Distribution of a Sample Population

Characteristic	**Frequency**	**Percentage**
Monthly Income (ETB)		
Less than 1,500	112	29.2
1,500 - 3,000	133	34.6
3,001 - 5,000	86	22.4
More than 5,000	53	13.8
Total	**384**	**100%**

The income levels are divided into four categories: less than 1,500 ETB, 1,500 to 3,000 ETB, 3,001 to 5,000 ETB, and more than 5,000 ETB. The table reveals that 29.2% of the sample is in the lowest income category (less than 1,500 ETB). The next highest category is 1,500 to 3,000 ETB, which represents 34.6% of the sample. The remaining categories, 3,001 to 5,000 ETB and more than 5,000 ETB, make up 22.4% and 13.8% of the sample, respectively.

Income is a major factor in determining access to and use of urban open spaces. Higher-income people may have more free time and means to go to distant parks or recreational facilities, whereas lower-income people may have less access to quality open spaces. This gap can highlight issues of equality in urban design because not all community members have equal access to urban green spaces. Understanding income levels might help identify the need for targeted investments in open space development in low-income neighborhoods, thereby fostering social fairness and inclusion.

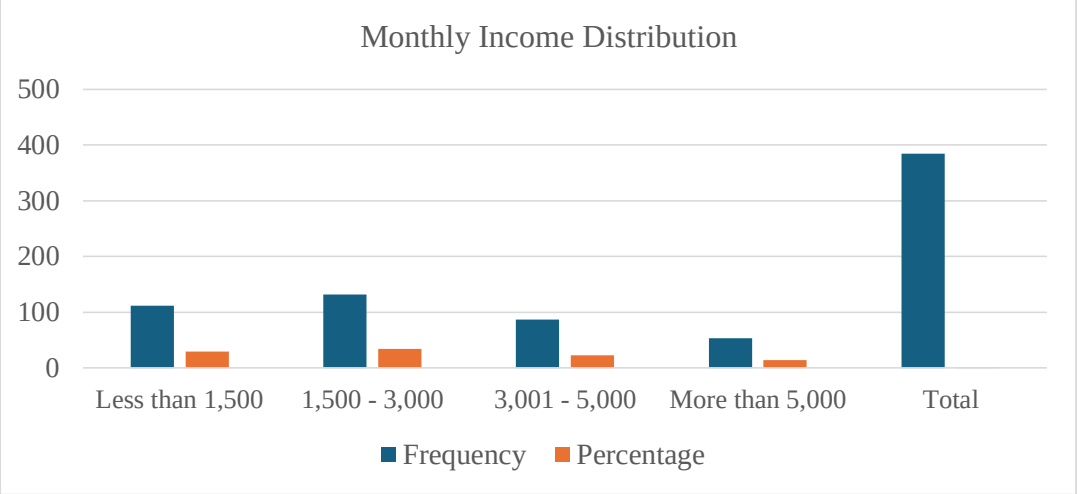

Figure 177: Monthly Income Distribution of a Sample Population

In conclusion, analyzing respondents' demographic features is critical for understanding how various segments of the public connect with urban open spaces. Each characteristic provides insights into usage patterns, preferences, and access barriers, which are directly related to the study's aims of analyzing the influence of urban open spaces on environmental quality and social well-being. Recognizing these distinctions enables urban planners and policymakers to develop more inclusive, accessible, and productive open space solutions that address the community's different requirements.

4.4. Characterization of Designated Existing Open Spaces

4.4.1. Oda Fountain Open Space

Located in the Oda Neighborhood, the 0.0856-hectare area is well-positioned, yet it faces numerous obstacles that limit its potential as a useful and appealing public area. Although its accessibility is improved by being close to important transportation hubs, the area is disturbed by the noisy taxi stands nearby, where noise levels are thought to be between 75- and 80-dB during rush hour. The area is uncomfortable for extended use, especially for passive or recreational activities, due to its constant exposure to high noise levels.

The lack of basic amenities and inadequate infrastructure exacerbate its limits. The facility provides no seating alternatives for guests, no shade to protect against sun exposure, and insufficient garbage disposal facilities, resulting in poor waste management. These deficiencies contribute to an overall lack of maintenance, as seen by the piling of litter throughout the property. Such conditions reduce the space's visual appeal and usability, reducing community engagement and creating an unwelcome mood.

Based on field observations, usage trends show that the area is underutilized, with daytime hours seeing the most activity. This low usage can be attributed mostly to noise pollution from the adjacent taxi stop, as well as a lack of appealing or functional characteristics that would stimulate repeat visitors or various activities. As a result, despite its central location, the space is mostly disregarded and does not serve as a lively community asset.

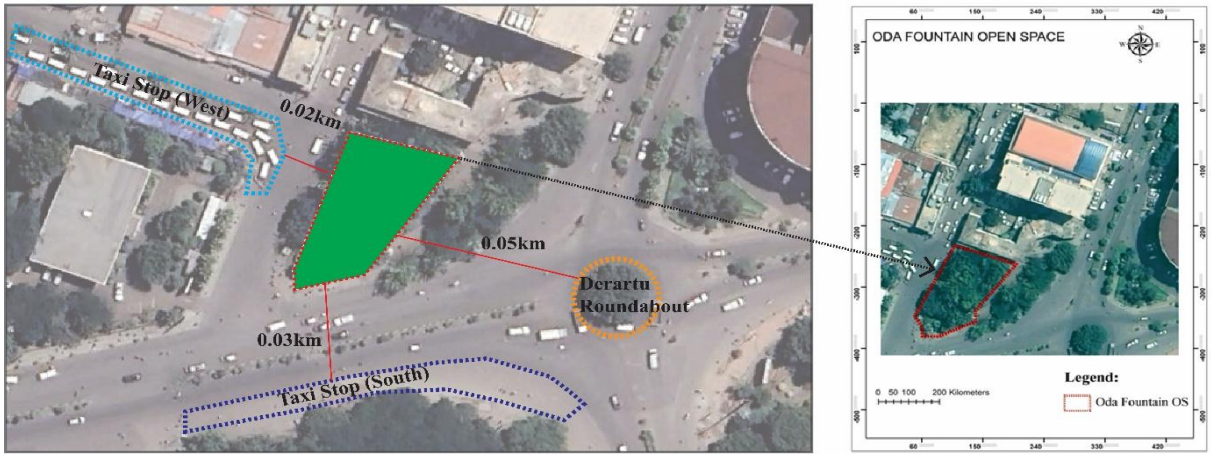

Figure 188: Image showing relative distance from noise pollution sources (Oda Fountain Open Space Located in Oda Neighborhood)

Figure 19: Image Showing Oda Fountain Open Space Located in Oda Neighborhood (Source: Site Observation)

Table 14: Characteristics of Oda Fountain Open Space

Feature	Description
Size (hectares)	0.0856
Location	Adjacent to Derartu Square
Accessibility	High (but impacted by noise)
Amenities	Very limited (no seating, shade, bins)
Noise Levels (dB)	75-80 (measured during peak hours)
Maintenance	Poor (litter accumulation)
Usage Frequency	Low (mostly daytime use)

4.4.2. Wonji Mazoria Open Space

The 0.88-hectare Wonji Mazoria Open Space, located around 1.5 kilometers west of Oda Fountain, presents an exceptional challenge, especially related to accessibility. The spatial distance between this open space and major target communities severely limits its use, especially by vulnerable populations such as the elderly, children, and those with mobility issues. The open space is located 1.02 kilometers from Oda, 1.9 kilometers from Badhatu, and 2.4 kilometers from Buta.

These distances surpass the widely acknowledged threshold for pedestrian access to recreational and social venues, diminishing functional inclusivity and convenience for residents of the area.

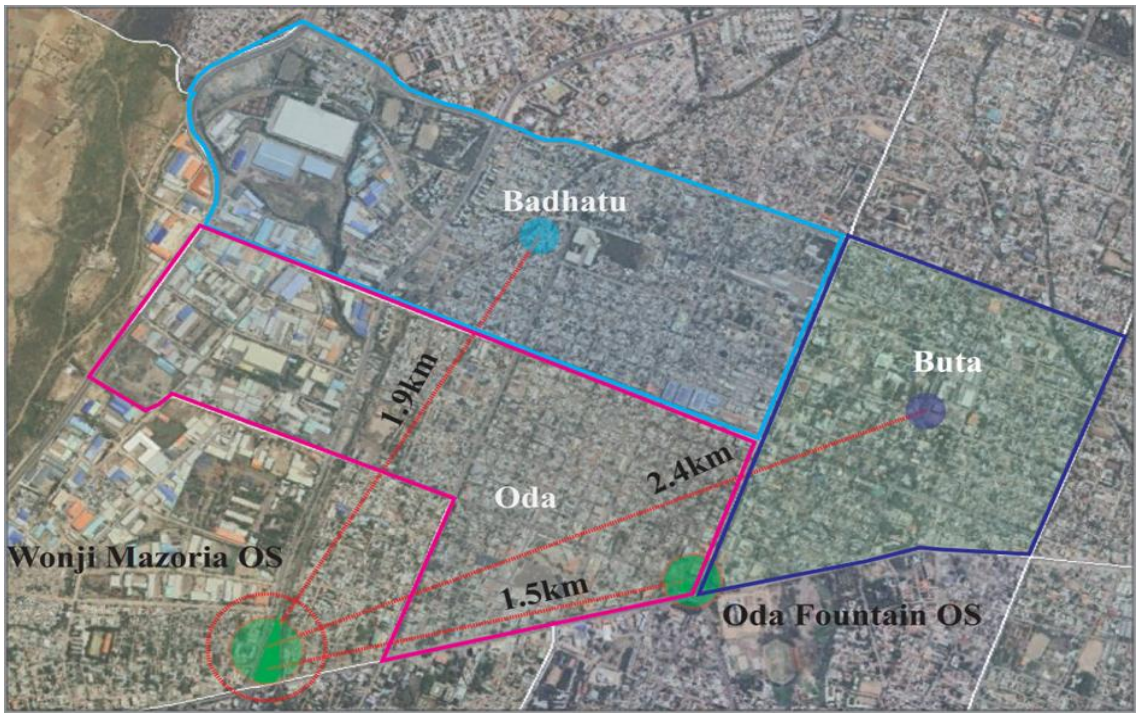

Figure 190: Spatial Distance between Wonji Mazoria and Oda Fountain Open Space Neighborhoods

Despite these obstacles, the Wonji Mazoria Open Space is comparatively better supplied with basic amenities, such as benches for seating, a limited number of shade-producing trees, and a partially paved area that provides some amount of comfort and utility to visitors. However, these benefits are outweighed by mediocre maintenance conditions, indicating the need for focused initiatives to improve infrastructure and upkeep. Uneven paving, insufficient lighting, and poor garbage management all reduce the space's overall utility and appeal.

Furthermore, its remote location relative to high-density residential areas contributes to its underutilization. While it has the potential to be a community asset, its relative distance, accessibility difficulties, and maintenance gaps all contribute to low usage rates. Addressing these difficulties through improved connectivity, facilities, and targeted programming has the potential to dramatically increase its value as a recreational hub, particularly for vulnerable populations in the community.

Figure 201: Wonji Mazoria Open Space located within the Aba Geda Sub-City (Image taken during Site Observation)

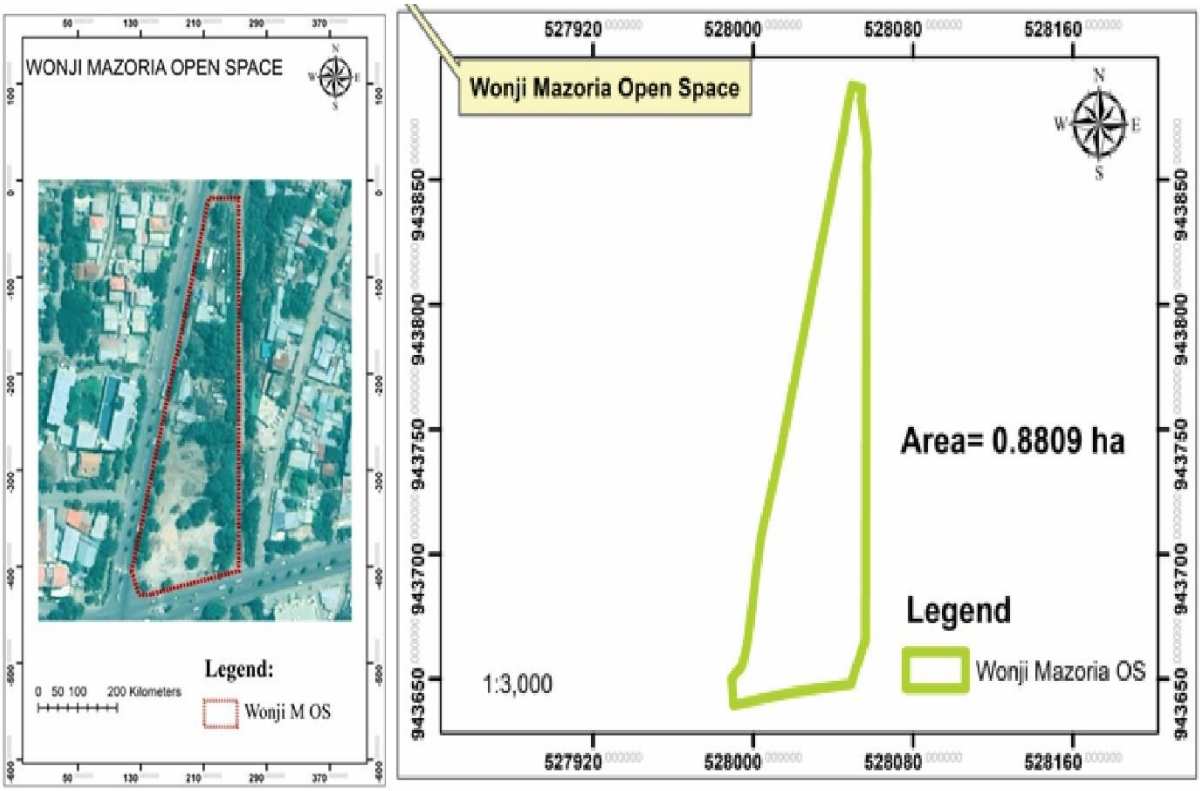

Figure 212: Wonji Mazoria Open Space located within the Aba Geda Sub-City

Table 15: Characteristics of Wonji Mazoria Open Space

Feature	**Description**
Size (hectares)	0.88
Location	1.5 km west of Oda Fountain
Accessibility	Low (distance from neighborhoods)
Amenities	Partially developed (need assessment)
Noise Levels (dB)	Moderate (60-70 dB estimated)
Maintenance	Fair (some areas well-kept)
Usage Frequency	Low (occasional use reported)

4.4.3. Comparative Analysis of Oda Fountain and Wonji Mazoria Open Spaces

The table below compares two open spaces in the study area: Oda Fountain Open Space and Wonji Mazoria Open Space. The table emphasizes various significant factors, such as size, location, accessibility, facilities, noise levels, maintenance, usage frequency, and overall assessment.

Table 16: Comparative Analysis of Oda Fountain and Wonji Mazoria Open Spaces

Feature	Oda Fountain Open Space (0.0856 ha)	Wonji Mazoria Open Space (0.88 ha)
Size (ha)	0.0856	0.88
Location	Oda Neighborhood, high noise environment	Peripheral, relatively low noise environment
Accessibility	High, but functionally low	Low
Amenities	Very limited (no seating, poor waste management)	Moderate (benches, partial shade, paved area)
Noise Levels (dB)	75-80 (estimated during peak hours)	50-60 (estimated)
Maintenance	Poor	Moderate
Usage Frequency	Low (primarily daytime)	Low (sporadic use)
Overall Assessment	Unsatisfactory	Moderately satisfactory (with limitations)

The findings reveal that a number of significant distinctions between Wonji Mazoria Open Space and Oda Fountain Open Space. Compared to Wonji Mazoria, which is 0.88 hectares in size, Oda Fountain is much smaller at 0.0856 hectares. Regarding location, Wonji Mazoria is in a secluded region with comparatively low noise levels, whereas Oda Fountain is in a noisy section of the Oda district.

On the other hand, accessibility paints a different picture. Oda Fountain's central placement makes it more accessible, but its functioning is constrained.

On the other hand, Wonji Mazoria provides greater amenities even if it is less accessible because of its remote location. While Wonji Mazoria offers moderate amenities including seats, partial shade, and a paved area, Oda Fountain lacks basic amenities like seating and efficient waste management.

Another notable distinction is the level of noise. While Wonji Mazoria offers a calmer atmosphere with noise levels of about 50–60 dB, Oda Fountain has higher noise levels during peak hours, estimated to be between 75 and 80 dB. Another problem is maintenance; Wonji Mazoria receives modest maintenance, whilst Oda Fountain receives inadequate care.

The usage frequency for both spaces is modest. Oda Fountain is generally used during the day, although Wonji Mazoria is occasionally used. Overall, Oda Fountain Open Space is rated unsatisfactory owing to its size, location, amenities, and maintenance difficulties. In contrast, Wonji Mazoria Open Space is rated moderately satisfactory despite accessibility and usage frequency issues.

This comparison analysis demonstrates that both open areas are severely limited in terms of size, amenities, and maintenance. However, Wonji Mazoria Open Space is typically thought to be in better condition due to reduced noise levels, moderate facilities, and moderate maintenance. The findings of this analysis can help to guide future urban planning and design work focused at increasing the quality and functionality of open spaces in the studied region.

4.5. Environment: Air Quality and Noise Pollution Assessment

The air quality and noise pollution assessment reveal significant neighborhood surrounding impacts associated with limited open spaces. The analysis includes temperature measurements, air quality monitoring, and noise level assessments. The limited provision and maintenance of existing open spaces contribute significantly to environmental challenges, particularly higher temperature effects and poor air quality. This section explores the environmental effects of the Aba Geda Sub-City's sparsely populated and badly managed open spaces in further detail, incorporating field survey qualitative observations and, where possible, quantitative data.

4.5.1. Microclimate and Higher Temperature Effect

Table 17: Environmental Quality Measurements (*Monthly Average Air Quality Data (Two-Month Record for October and November, 2024)*

Parameter	Month	Near Oda Fountain	Near Wonji Mazoria	WHO Standard
Temperature (°C)	October	32.0	30.7	-
	November	32.5	30.3	-
PM2.5 (µg/m³)[1]	October	60.1	46.5	10
	November	57.3	43.9	10
PM10 (µg/m³)[2]	October	85.0	72.0	20
	November	89.8	68.3	20
CO2 (ppm)[3]	October	455	405	-
	November	448	395	-

Survey data shows that the traffic congestion close to Oda Fountain has resulted in noticeably higher levels of PM2.5 [4]and PM10 in the surrounding neighborhoods. The surrounding heat

[1] PM2.5 is a measure of the concentration of particulate matter in the air, and the EPA and WHO have established standards for it.

[2] PM10 is a measure of particulate matter in the air, where PM stands for particulate matter and the 10 refers to particles with a diameter of 10 micrometers or less. PM10 levels are measured in micrograms per cubic meter (µg/m³)

[3] Parts per million (ppm) is a unit of measurement for the concentration of carbon dioxide (CO2) in the atmosphere

effect is indicated by the higher temperatures observed close to the densely populated areas, pointing to a clear link between environmental deterioration and a lack of green space. (See Appendix 2 and 3 for Details)

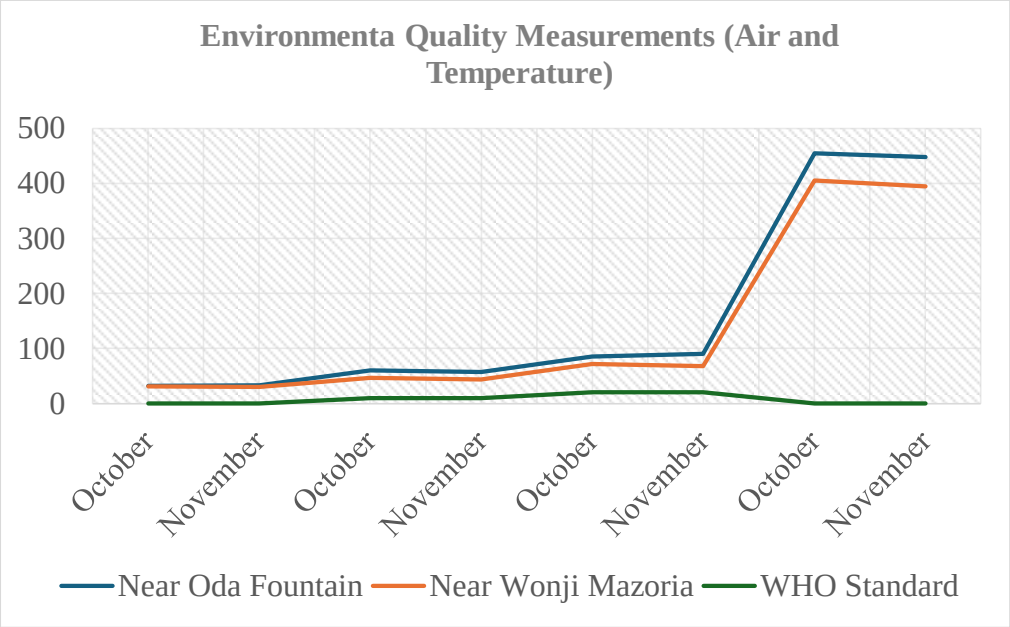

Figure 223: Air Quality and Temperature Assessment

Significant changes in microclimates across areas with and without substantial green cover were found through qualitative assessments. The high building density and sparse vegetation around Oda Fountain Open Space led to considerably warmer daytime temperatures, especially during the hottest parts of the day. Residents complained of being uncomfortable in the heat, which caused them to spend less time outside during the warmest hours of the day. On the other hand, although though Wonji Mazoria Open Space is far from the main neighborhoods, the area's significantly greater green space and older trees contributed to a discernible drop in felt temperature. The quantitative data (Table 17), which indicate a temperature differential of 1.8°C between the two sites, are in agreement with this qualitative evaluation. This variance emphasizes the mitigating impact of green spaces on the urban heat island consequence.

[4] Particulate matter 2.5 (PM2.5) refers to tiny particles in the air that are 2.5 microns or smaller. PM2.5 can penetrate into the lungs and bloodstream and cause irritation of the airways and aggravation of heart and lung diseases. According to the new World Health Organization (WHO) guidelines, annual average concentrations of PM2.5 should not exceed 5 µg/m3, while 24-hour average exposures should not exceed 15 µg/m3.

- *(Source: Air Quality, Energy and Health (AQE). (2021).*

5.2. Air Quality and Pollution Levels

Based on qualitative findings, Oda Fountain Open Space's close proximity to a busy taxi stop has a substantial impact on the area's air quality. The usability and environmental quality of the open space are adversely affected by dust, fumes, and unpleasant vehicle emissions, as reported by participants in focus group discussions. This implies that the environmental and social benefits that urban open spaces are supposed to offer may be diminished by outside variables like traffic pollution. Several key informants reported persistent respiratory problems, headaches, and eye irritation among those living near the taxi stand. This view is supported by quantitative data (Table 17), which reveal higher PM2.5 and PM10 levels near Oda Fountain than in Wonji Mazoria and the WHO standards. The increased levels of PM2.5 and PM10 in the Oda area indicate considerable air pollution, which is directly connected to traffic congestion and a lack of adequate green space to act as a natural filter.

4.5.3. Noise Pollution

The noise levels around Oda Fountain were persistently high throughout the day. Qualitative assessments revealed the sound of numerous automobiles, horns, and conversations, resulting in a consistently noisy atmosphere. FGD participants identified this noise as a major source of stress and disruption. The lack of sound-absorbing vegetation compounded the situation. The proximity of the taxi stands and busy traffic contributed to high levels of noise pollution, resulting in a noticeably less calm environment than Wonji Mazoria. Residents interviewed near Oda Fountain commonly claimed trouble concentrating, sleeping problems, and feelings of discomfort as a result of the continuous noise. (See Appendix 4 for more Details)

Table 18: Noise Pollution Measurements

Location	**Noise Level (dB)**
Oda Fountain Open Space	75
Wonji Mazoria Open Space	60
Built-up Area (near Oda Fountain)	80

The noise pollution measurements show that the built-up area around Oda Fountain Open Space has high levels of noise pollution, with a noise level of 80 decibels. This shows that the area's inadequate green cover contributes to noise pollution, and that noise levels should be reduced accordingly.

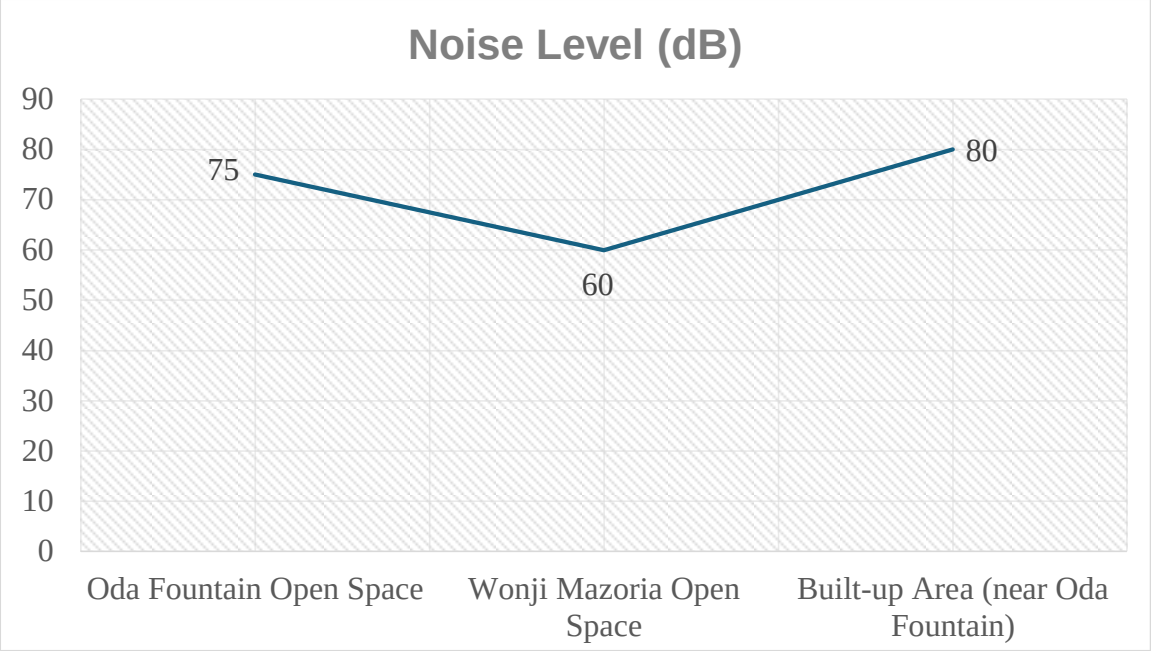

Figure 234: Summary of Noise Level Measurement

In summary, the analysis of environmental impacts demonstrates a substantial relationship between the amount and quality of open spaces and the overall environmental health of the Aba Geda Sub-city. The smaller, less maintained Oda Fountain Open Space has significantly higher levels of noise and air pollution, higher temperatures, and poor waste management, whereas the larger Wonji Mazoria Open Space, despite its distance from residential areas, has a better environmental profile. These findings highlight the importance of increasing investment in green infrastructure as well as better management of existing open spaces in order to reduce environmental concerns and improve the overall quality of life for Adama City residents.

4.6. Community Utilization and Perceptions

4.6.1. Usage Patterns

The analysis of usage patterns reveals that open spaces are used for various purposes, including social gatherings, recreation, and relaxation.

Table 19: Frequency of Open Space Use

Frequency	Respondents	Percentage
Daily	91	23.7%
2-3 times/week	157	40.8%
Once/week	78	20.3%
Monthly	41	10.7%
Rarely/Never	17	4.4%

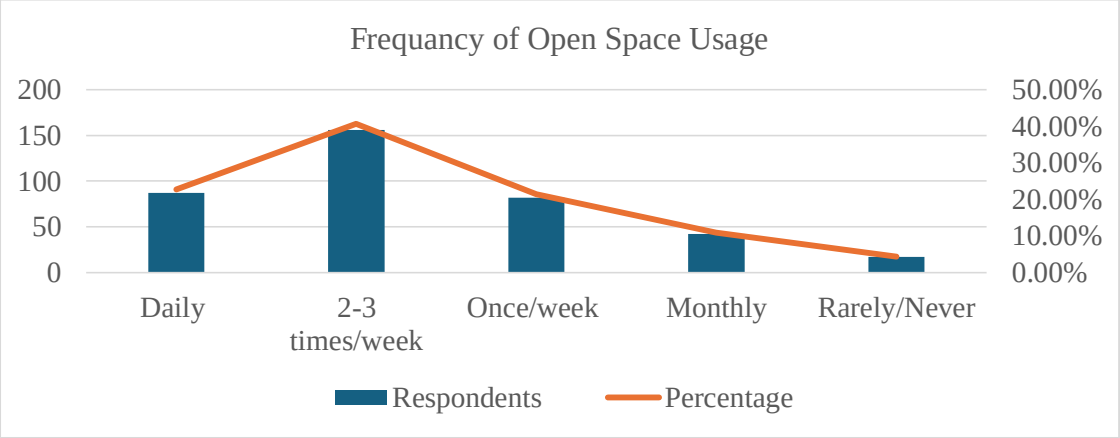

Figure 245: Frequency of Open Space Usage by the Respondents

The frequency of open space use varies significantly among respondents, with 40.8% using open spaces 2-3 times per week. The most common activities reported by respondents include social gatherings (25%), Children's play (21%), and Exercise and relaxation (18%).

Table 20: Social Benefits Reported by the Respondents

Benefit Category	**Percentage of Respondents**
Community gatherings	25%
Children's play	21%
Exercise and recreation	18%
Cultural events	14%
Social networking	13%
Environmental education	9%

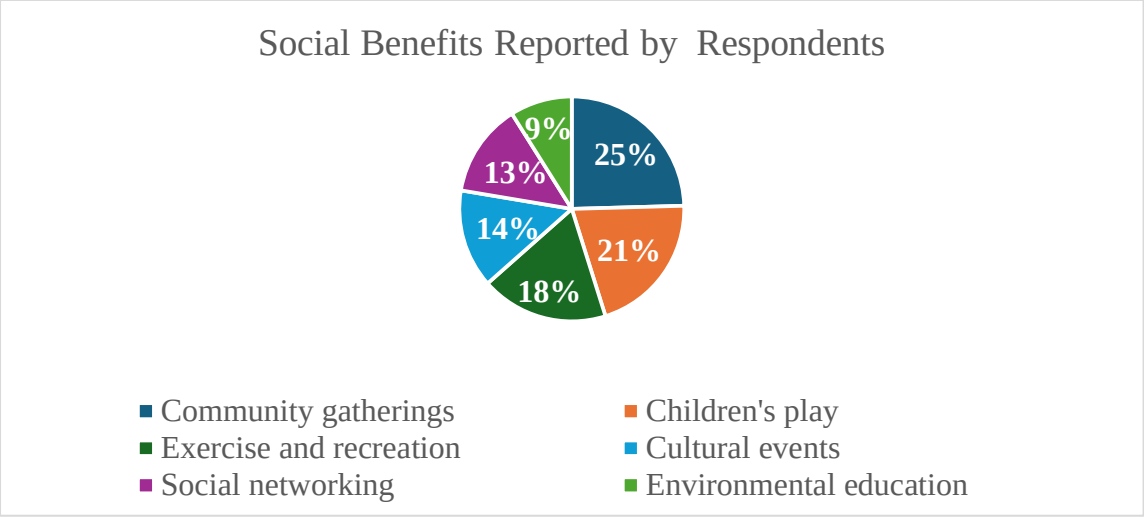

Figure 256: Primary Uses of Open Spaces

The figure illustrates the primary uses of open spaces, showing the proportion of respondents engaging in different activities.

4.7. Social Impacts and Community Perceptions

The social consequences of inadequate urban open spaces are far-reaching and varied, affecting community well-being, social cohesiveness, and residents' quality of life. This section delves into the findings from the qualitative and quantitative data on community perceptions of existing open spaces and their social implications.

Table 21: Community Perceptions of Open Spaces

Aspect	Very Poor	Poor	Fair	Good	Very Good	Total
Accessibility	40	120	160	50	14	384
Cleanliness	55	132	119	60	18	384
Safety	60	124	140	50	10	384
Amenities	132	66	130	40	16	384
Overall Satisfaction	150	77	112	25	20	384

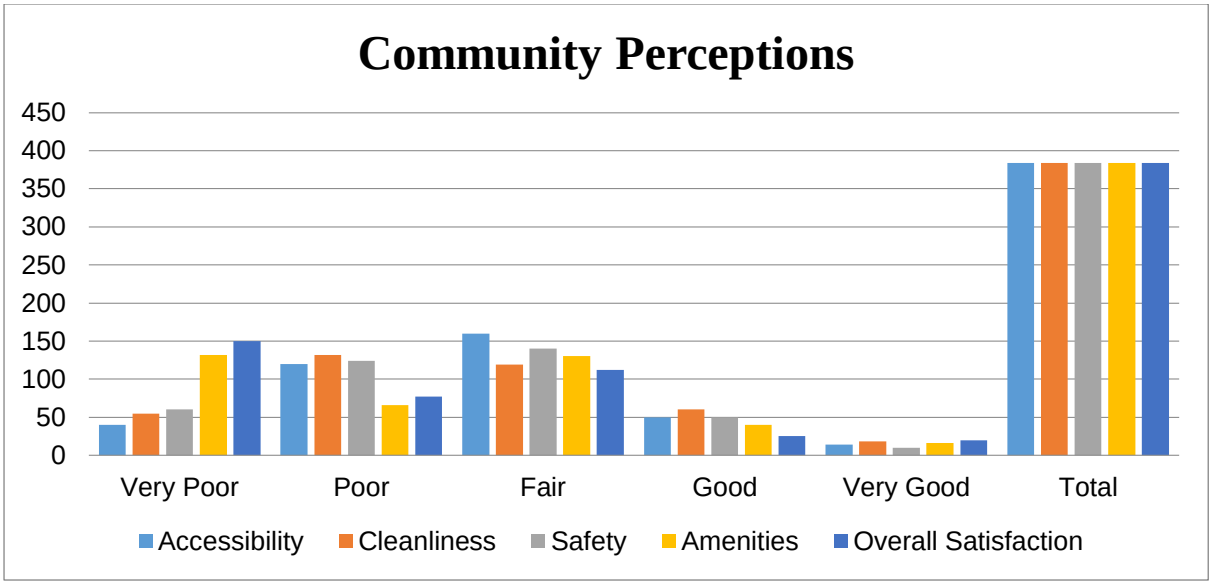

Figure 267: Community Perceptions of Open Spaces within the Study Area

According to the survey results, a sizable percentage of participants expressed discontent with a number of features of the current open spaces. For example, 80% of respondents expressed dissatisfaction with the general availability of open areas, underscoring the urgent need for upgrades in amenities, safety, cleanliness, and accessibility.

4.7.1. Social Cohesion and Community Interaction

Qualitative assessments showed that the lack of accessible and well-maintained open spaces strongly impacts social cohesion within these neighborhoods. Focus group discussions emphasized that residents often feel isolated and detached from their community because of the limited opportunities for social interaction. Participants articulated that, without adequate public spaces, there are less venues for get-togethers, recreational activities, and public events. This seclusion is predominantly noticeable among children and elderly residents, who benefit significantly from social interactions eased by public spaces.

The survey data backs up these qualitative findings. Over 65% of respondents said they don't have a strong sense of community since there aren't enough accessible open areas. Many neighbors expressed concern about the safety of their communities, citing the lack of conspicuous public locations where community members may assemble and watch one another's activities. This sentiment was especially strong among women, who indicated feelings of insecurity while going out alone.

4.7.2. Mental Health and Well-Being

The psychological effects of limiting access to open spaces emerged as a major subject in both qualitative interviews and survey answers. Many respondents reported feeling stressed, anxious, and frustrated as a result of the limits in their living environment. The lack of natural environments for relaxation and recreation is strongly related to higher levels of urban stressors.

Participants in focus groups stated that they frequently turn to indoor activities owing to the bad circumstances in existing public spaces, which lowers their quality of life. The lack of greenery and natural surroundings was commonly cited as harmful to their mental health. Access to green spaces has been linked to lower stress levels and better mental health outcomes (Maas et al., 2006), showing a strong need for enhanced urban design in Adama City.

4.7.3. Safety Perceptions

Safety concerns have an enormous impact on how residents perceive open spaces in their communities. Qualitative data from interviews suggested that many locals avoid accessing Oda Fountain Open Space due to concerns about crime and harassment. In a poll, 70% of respondents expressed concern about personal safety while accessing existing urban places,

chiefly in the evening. The absence of suitable lighting, visibility, and security features in these regions aggravates these worries.

Residents emphasized the significance of increased security and community policing in public locations, particularly for the safety of vulnerable groups like women and children. This perceived lack of safety not only limits utilization, but also creates social isolation and lowers community engagement.

4.8. Community Needs and Preferences for Future Development

Qualitative feedback from key informant interviews and focus group discussions provided deep insights into the community's needs and preferences regarding urban open space development.

Table 22: Community Needs and Preferences for Future Development Based on Qualitative Data Key Preferences

Theme	Discussion points	Frequency Mentioned (KIIs/FGDs)	Example Quotes
Location	More centrally located spaces, better distribution across neighborhoods	High (mentioned in 12/15 KIIs, 5/6 FGDs)	"We need a park closer to our homes." (FGD 2)
Size and Design	Larger spaces, incorporating diverse features (playgrounds, seating)	High (10/15 KIIs, 4/6 FGDs)	"A bigger park with space for children to play." (KII 7)
Amenities	Shade, lighting, pathways, waste bins, accessible features	High (13/15 KIIs, 5/6 FGDs)	"Better lighting and benches are needed." (KII 12), "Safe walking paths" (FGD 1)
Safety and Security	Improved lighting, security measures, community policing	Moderate (8/15 KIIs, 3/6 FGDs)	"We feel unsafe using the park at night." (FGD 4)
Maintenance	Regular cleaning, community involvement in maintenance	High (11/15 KIIs, 5/6 FGDs)	"Someone needs to regularly clean the park." (KII 3)

Based on findings from KIIs and focus group discussions, the table emphasizes five significant aspects associated to park preferences: location, size and design, facilities, safety and security, and upkeep. Participants frequently stated a need for parks that are more centrally situated, larger in size, and supplied with different amenities such as playgrounds and benches. Adequate facilities, such as shade, lighting, and accessible routes, were also

deemed necessary. Concerns about safety and security were expressed, particularly at night, and the importance of regular maintenance and community participation was highlighted.

Table 23: Community Recommendations for Future Open Space Development

Theme	Discussion points	Frequency Mentioned
Location	More centrally located spaces; better distribution across neighborhoods	37
Size and Design	Larger spaces; incorporating diverse features (playgrounds, green areas, fitness zones)	45
Amenities	Shade structures, well-maintained walking paths, seating, lighting	50
Safety and Security	Improved lighting, community policing to ensure safety	42
Maintenance	Regular cleaning, involvement of community in maintenance plans	48

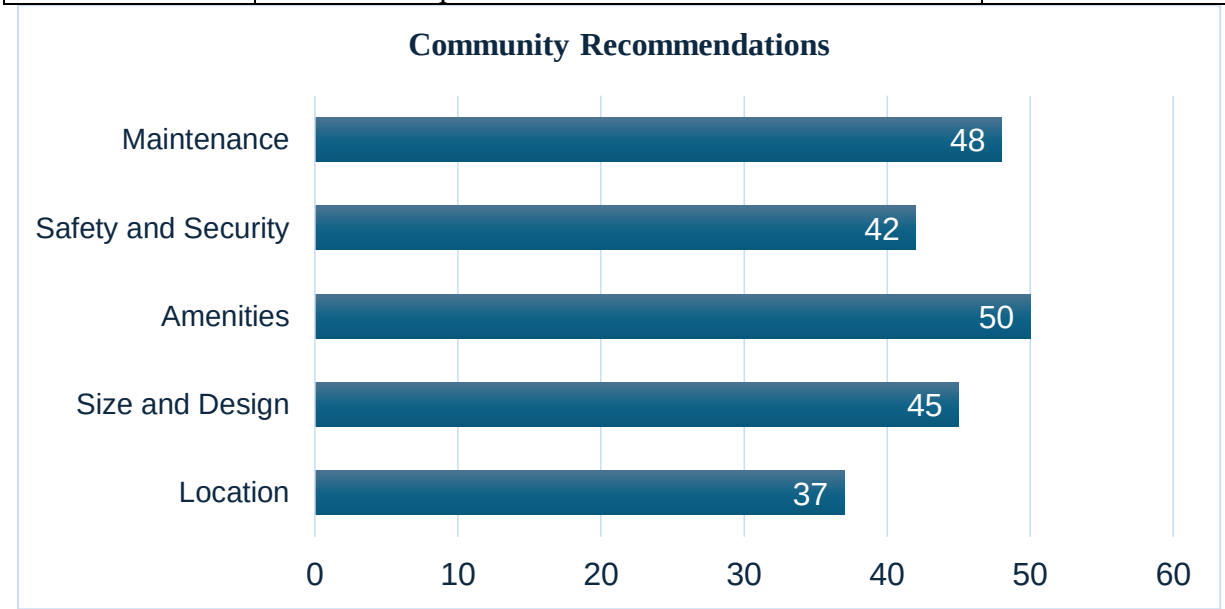

Figure 278: Community Recommendations for Future Open Space Development

The community expressed a strong demand for amenities, versatile spaces that meet a variety of requirements. The frequency of references for each category reveals the residents' priorities, with a strong emphasis on the need for better amenities and maintenance of urban open space.

4.8.1. Desired Features and Amenities

The analysis of qualitative data showed strong community demand for more all-embracing and well-equipped open spaces. Community members stated a strong preference for:

- **Play Areas for Children:** Many parents stressed the significance of providing specialized and safe play locations for children, such as playgrounds and sports facilities. This need was notably stressed during interviews with parents, who stated that safe recreational places would encourage outside play and physical activity among children.
- **Exercise and Fitness Facilities:** There was high demand for fitness zones, walking routes, and outdoor gyms. Residents stated that having access to exercise facilities will encourage healthier lifestyles and increase community togetherness through organized fitness activities.
- **Seating and Shade Structures:** Respondents underlined the importance of comfortable seating areas, picnic grounds, and shade structures to promote social gatherings and leisure activities. The lack of these amenities was commonly highlighted as a barrier to using the existing open spaces.

4.8.2. Accessibility and Connectivity

Community members indicated an aspiration for better access to open places, particularly for those with mobility issues. Many emphasized the need for paved pathways, ramps, and visible signage to allow access for all residents, especially the elderly and parents with strollers.

Additionally, participants advocated for better transportation options, highlighting that increased public transport ways could potentially improve access to current and future open spaces. This aligns with findings in urban planning literature that emphasize the importance of connectivity in endorsing the usage of public open spaces (Wolch et al., 2014).

4.8.3. Community Involvement in Planning

A frequent aspect of the conversations was the desire for community participation in open space planning and development. Residents requested that their views be heard in decision-making procedures to ensure that the spaces fulfill the community's specific requirements. Many proposed forming local committees or task groups committed to the maintenance and programming of open spaces.

This desire for community engagement consistent with contemporary urban planning paradigms that support for participatory approaches to urban development, recognizing that local residents' perceptions are crucial for creating effective public spaces.

In summary, the social impacts of insufficient urban open spaces in Adama City are substantial, resulting in decreased social cohesiveness, mental health issues, and safety concerns among neighborhood residents.

Community feedback indicates that a strong desire for better, easily accessible, and well-equipped open spaces that promote social interaction and encourage physical activity. The findings highlight the necessity of integrating community preferences into the planning and development of urban open spaces to create environments that improve the quality of life for all neighborhood residents. By actively including the community in these procedures, Aba Geda Sub-City can create vibrant public spaces that reflect the needs and ambitions of its diverse urban residents.

4.9. Challenges and Opportunities for Open Space Development Based on Qualitative Data

4.9.1. Challenges for Open Space Development

Limited Funding and Resources: One of the most significant problems to establishing and preserving open spaces in the city is a lack of adequate financial resources.

Urban planning and development resources are frequently pushed tight, with immediate infrastructural demands taking precedence over long-term green space development. According to key informant interviews, present appropriations for parks and open spaces are insufficient, resulting in poor maintenance and inadequate facilities.

Land Scarcity: Rapid urbanization in the city has resulted in substantial land demands. The increased demand for residential and commercial constructions frequently leaves little room to create new open spaces. Residents raised concerns during focus group talks about commercial developments being prioritized over green spaces, indicating the necessity for balanced urban planning.

Lack of Integrated Planning: Open space development is frequently fragmented, with no unified strategy that matches with the city's overall urban planning aims. Interviews with urban planners found that present policies do not adequately prioritize the incorporation of green areas in new developments, resulting in ad hoc measures that fail to meet community demands.

Community Engagement: The community is frequently underrepresented in open space planning and decision-making processes. This lack of interaction may result in developments

that do not reflect the community's preferences and needs. The qualitative data from focus groups found that citizens feel estranged from the planning process, resulting in a lack of ownership over community open spaces.

Maintenance and Management: The insufficient maintenance of existing open spaces poses a considerable challenge. Poor maintenance causes litter accumulation, overgrown plants, and inadequate facilities, which might discourage community use. According to community surveys, residents frequently avoid accessing open spaces because they are in disrepair.

4.9.2. Opportunities for Open Space Development

Community Involvement and Engagement: There is a significant opportunity for increased community involvement in open space design and upkeep.

Involving people in decision-making processes can help them feel more responsible and in control. Community organizations and local leaders can organize participatory planning workshops to encourage residents to express their needs and preferences for open spaces.

- Public-Private Partnerships: Forming collaborations with private firms, non-governmental organizations (NGOs), and community groups can bring additional financing and resources for open space creation and management. Collaborations can be formed to support community activities, keep parks clean, and provide amenities.
- Innovative Funding Solutions: Exploring alternate funding options, such as grants, crowdfunding, or local company sponsorships, might help enhance financial resources for open space projects. Using community development money for green space projects can increase financing availability.
- Integration of Green Spaces in Urban Planning: By prioritizing the incorporation of green areas in urban planning initiatives, local officials may ensure that future developments incorporate appropriate open space. Policies requiring a certain percentage of land for green spaces in commercial and residential constructions can improve overall urban livability.
- Education and Awareness: Raising knowledge about the benefits of urban open spaces can help to build community support for their preservation and growth. Educational campaigns can be held to educate communities on the ecological, social, and health benefits of green spaces, increasing advocacy for their inclusion in urban development plans.

- Sustainable Practices: Implementing sustainable landscape strategies, such as native plant landscaping and rainwater collection, can improve the environmental quality of open spaces while decreasing maintenance expenses. Incorporating eco-friendly architecture into new developments can win support from environmentally aware residents.

In summary, the section on Challenges and Opportunities for Open Space Development identifies the fundamental impediments to effective open space planning and maintenance in Adama, as well as practical ways for addressing these challenges. Stakeholders may work together to create vibrant, accessible, and sustainable open spaces that suit the requirements of the community by addressing the obstacles head on and capitalizing on the identified opportunities. Transforming the sub-city's urban landscape specifically and the city of Adama generally into a more livable and environmentally friendly location would require increased collaboration, community engagement, and innovative planning.

Table 24: Challenges and Opportunities for Open Space Development within the Study Area

Category	Challenges	Opportunities
Funding	Inadequate financial resources for development and maintenance of open spaces	Explore advanced funding solutions such as grants, crowdfunding, and public-private partnerships
Land Use	Shortage of available land due to rapid urbanization and competing demands	Advocate for policies requiring a minimum percentage of land for green spaces in new developments.
Planning	Lack of integrated planning that prioritizes open spaces alongside other infrastructure needs	Increase community involvement in participatory planning procedures to better connect open space development with the needs of communities.
Community Engagement	Limited community involvement in decision-making processes	Encourage community ownership by actively engaging communities in the planning and upkeep of open space.
Maintenance	Insufficient maintenance leading to neglected and underutilized open spaces	Create sustainable maintenance strategies with community groups and local organizations.
Education	Low awareness of the benefits of urban open spaces and their role in community well-being	Implement educational programs to increase knowledge of the ecological, social, and health benefits of open spaces.
Sustainable Practices	Old-style landscaping practices that may not be environmentally friendly	Incorporate sustainable methods, such as native planting and eco-friendly designs, into new developments.

The table above provides an organized summary of the hurdles and potential solutions for tackling issues in open space development based on qualitative data analysis.

4.10. Summary of Results, Findings and Discussion

4.10.1. Synthesis of Key Findings

The study provided some vital insights into the existing situation of Aba Geda Sub City's urban open areas. Qualitative assessments revealed widespread community unhappiness with accessibility, cleanliness, safety, and accessible amenities in existing open spaces.

Quantitative measures confirmed these opinions, revealing frightening levels of discontent with numerous kinds of open space features. For example, a large proportion of respondents ranked accessibility and safety as "Poor" or "Very Poor," emphasizing the urgent need for reform.

4.10.2. Interpretation of Results

The findings imply that inadequate availability and management of urban open spaces has a considerable negative impact on residents' quality of life. The limited accessibility to functional green areas limits not just leisure activities, but also the opportunity for social interactions in these locations. The reported environmental implications, such as increased air pollution and urban heat island effects, are related to the scarcity of green spaces. As a result, this research's findings highlight the crucial role that urban open spaces play in improving both environmental quality and social cohesiveness.

4.10.3. Comparison with Existing Literature

The findings are consistent with prior research highlighting the benefits of urban open areas for community well-being. Maas et al. (2006) and Wolch et al. (2014) found that access to green areas is associated with better mental health and social connections. Furthermore, the issues Adama faces, such as restricted budget and land shortages, are consistent with the experiences of other fast urbanizing cities, as detailed by Dewan et al. (2012). This comparative analysis underscores the assumption that Adama's difficulties are not isolated and mirror broader global trends in urban growth.

4.10.4. Impact of Open Spaces on Community Well-Being

The qualitative data gathered from community focus groups demonstrated that residents have a deep emotional attachment to their local open spaces. Many people indicated a wish for more inclusive and accessible parks and recreational places, highlighting the need for spaces that promote community engagement and strengthen social relationships. The findings imply that the quality and availability of open spaces have a direct impact on people' physical and

mental health, consistent with prior studies associating green space access to reduced stress levels and enhanced general well-being.

4.10.5. Challenges in Implementation

Despite the obvious benefits of open spaces, various problems prevent their efficient growth and maintenance in the sub city. Limited financial resources and conflicting urban development agendas impede investment in new green areas and the upkeep of existing ones. Furthermore, a lack of coordinated urban planning frequently results in fragmented and poorly connected green spaces, limiting their functionality and accessibility. To address these difficulties, local authorities, community organizations, and citizens must work together to advocate for and execute sustainable open space initiatives.

4.10.6. Community Perspectives

Focus group discussions revealed qualitative insights that emphasize the need of community involvement in urban open space design and management.

Residents voiced unhappiness with the lack of involvement in decision-making processes, which frequently results in developments that do not match their requirements or preferences. This gap highlights the need of encouraging community ownership and participatory planning processes to ensure that open space initiatives fit with local expectations and cultural values.

4.10.7. Policy Implications

The study's findings have important significance for policymakers and urban planners in Aba Geda Sub City and Adama City as a whole. There is an urgent need to prioritize the development and preservation of urban open spaces in planning agendas. Implementing rules requiring a certain amount of land to be allocated to green areas, investing in community-driven maintenance initiatives, and encouraging public-private partnerships to leverage extra resources are among the recommendations. Such approaches would improve the overall sustainability and functionality of urban open areas, eventually benefitting community well-being.

4.10.8. Conclusion of the Discussion

To summarize, the findings of this study show the crucial need for improved urban open spaces in Adama City. The difficulties identified, as well as the prospects for change, represent a strong call to action for local governments and community stakeholders.

By prioritizing the creation of accessible, safe, and well-maintained open spaces, Adama can build a healthier, more dynamic urban environment that increases citizens' well-being and strengthens connections within communities.

CHAPTER FIVE

MAJOR FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This study looked into the varying impacts of urban open spaces on the environment and social well-being in Adama, Ethiopia's Aba Geda Sub-city. The research used a mixed-methods approach, combining quantitative surveys and spatial analysis with qualitative data collected through focus group discussions and key informant interviews. This integrated approach enabled a thorough understanding of the existing state of open spaces, community attitudes, and the difficulties and opportunities that come with their development and maintenance. This chapter summarizes the important findings, makes overall implications, and suggests practical recommendations for policymakers, urban planners, and community stakeholders to improve the planning, management, and development of urban open spaces in the studied area and Adama City in general.

5.1.Major Findings:

The study demonstrated an intricate relationship of factors determining the efficacy of urban open spaces in Aba Geda Sub city. Certain major findings emerged:

- **Quantitative Shortages:** The quantitative data demonstrated a large gap in the availability of urban open spaces as compared to suggested requirements (Ethiopian National Urban Green Infrastructure Standard and WHO guidelines). This shortage was most severe in the sub-city's inner older, more densely inhabited sections. Furthermore, the quality of existing open spaces was discovered to be inadequate, with many lacking critical facilities and displaying poor maintenance.
- **Qualitative Concerns:** Qualitative study findings consistently revealed community discontent with many characteristics of open spaces, such as accessibility, cleanliness, safety, and amenity provision. These complaints were shared by various demographic groups, indicating widespread unhappiness with the current status of open space availability.
- **Environmental Impacts:** The absence of suitable green spaces contributed to various environmental difficulties, including increased air pollution, greater ambient temperatures (urban heat island effect), and a general degradation in the overall quality of the urban environment.

- **Social Impacts:** The inadequate availability and low quality of open spaces have a severe influence on social well-being, restricting chances for recreation, networking, and building a community. This was especially noticeable in the absence of safe and accessible spaces for children and individuals with disabilities.
- **Challenges to Development and Management:** The study highlighted various structural barriers to effective open space development and administration, including limited financial resources, inappropriate urban design, minimal community engagement, and a lack of sustainable maintenance measures.

5.2. Conclusions:

The following important conclusions are drawn after a thorough review of both quantitative and qualitative data:

- **Insufficient availability of high-quality open spaces:** The Aba Geda Sub-city experiences a major shortfall in the amount and quality of urban open spaces, failing to satisfy the needs of its rising population and falling short of internationally accepted norms.
- **There is a negative correlation between wellbeing and the quality of open spaces:** The quality and accessibility of open spaces are substantially correlated negatively with residents' social and environmental well-being, according to the research. A higher quality of life is directly correlated with improvements in the availability of open space.
- **Systemic challenges require holistic approaches:** The open space development challenges of Aba Geda Sub-city are complex and interrelated, necessitating a comprehensive strategy that tackles budgetary limitations, inadequate urban planning, and inadequacies in community involvement.
- **Public involvement is crucial:** Meaningful community involvement is essential for the development and management of open spaces at every stage, from planning and design to implementation and upkeep.

5.3. Recommendations:

The following recommendations are put forward, split out according to target stakeholder group, to deal with the problems identified and enhance the delivery of such urban open spaces in Aba Geda Sub-city and Adama City on the specific objectives:

Recommendation towards the current state of urban open spaces: -

- Integrated planning approach: Prioritize urban open spaces as part of urban infrastructure through an integrated urban planning strategy.
- Community-based design: Collaborate with communities to create open spaces that reflect their needs, preferences, and cultural values.
- Universal accessibility: Prioritize universal accessibility by building urban open spaces for all individuals, regardless of age, ability, or financial condition.

Recommendation towards the environmental benefits of urban open spaces

Urban open spaces play a crucial role in improving environmental quality and sustainability, the following recommendations should be considered:

- Limit industrial and vehicular pollution near open spaces to maintain clean air.
- Implement public awareness initiatives to educate inhabitants about the environmental and encourage active use.
- Increase the planting of native trees and vegetation to improve air quality and reduce urban heat island.
- Develop green corridors and connected open spaces to support wildlife movement and ecological balance.
- Implement green roofs and vertical gardens in urban spaces to improve insulation and reduce energy consumption.

Recommendation towards the social benefits of urban open spaces

Urban open spaces play a key role in fostering social interaction and overall community well-being. To maximize these social benefits, the following recommendations can be considered:

- Ensure universal access by designing open spaces that accommodate people of all ages, abilities, and socio-economic backgrounds.

- Improve public transportation connectivity to parks and open spaces, making them easily reachable for all urban residents.
- Incorporate multifunctional spaces that cater to diverse community needs, such as play areas, sports facilities, and quiet relaxation zones.
- Improve lighting, security patrols, and surveillance systems to ensure safety, especially at night.
- Provide shaded areas, seating, and restroom facilities to make open spaces more comfortable for longer visits.
- Incorporate mental wellness spaces, such as meditation gardens and quiet areas, to support stress reduction and relaxation.

Recommendation on the planning and management strategies of urban open spaces:

- Encourage mixed-use developments that integrate parks and urban green spaces into residential, commercial, and institutional areas.
- Develop a regular maintenance schedule to ensure cleanliness, safety, and usability.
- Enforce clear policies against encroachment, illegal activities, and misuse of public urban open spaces.
- Involve local communities in the planning, design, and decision-making processes of urban open spaces.
- Establish public-private partnerships (PPPs) to fund, develop, and maintain urban open spaces.

5.3.1. Future Research Directions

The study provides a foundation for future research into the long-term effects of increased urban open spaces on community health and environmental resilience. Future research might also look into the effectiveness of various community engagement strategies in open space planning, as well as comparison assessments between Adama and other cities facing comparable difficulties.

5.3.2. Limitations of the Study

Although this study offers insightful information, it is important to recognize its limits. The study mainly examined the perceptions of people living in the Aba Geda Sub-city, which

might not accurately reflect other demographic groups in Adama or other Ethiopian cities. Furthermore, self-reported measures were used to collect the data, which could induce biases. A more thorough methodology that includes quantitative environmental assessments and wider geographic sampling could be beneficial for future study.

In summary, the study's findings highlight the crucial necessity of urban open spaces for environmental sustainability and social well-being in fast urbanizing environments such as Adama. Implementing the proposals stated above will necessitate a coordinated effort by policymakers, urban planners, and the community. Adama can make its city more livable, resilient, and egalitarian for all people by putting open spaces upfront. More research might look into the long-term effects of existing policies and the effectiveness of various community engagement approaches in supporting sustainable open space management.

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APPENDICES

Appendix 1: Structured Questionnaire, Semi-Structured Interview and Open-Ended Questions

The **Structured Questionnaire for Household Surveys**, **Semi-Structured Interview Guide for Key Informants**, and **Open-Ended Questions for FGDs** are prepared to better align with the specific objectives and context of assessing the impact of urban open spaces on environmental sustainability and social well-being in Aba Geda Sub-city. These crafted instruments provide deeper insights into specific research areas, such as environmental impacts, social benefits, access barriers, and planning and management challenges.

Part I: Structured Questionnaire for Household Survey

Section 1: Demographic Information

1. What is your age (in completed years)?
2. What is your gender?
3. What is your marital status? (e.g., single, married, divorced, widowed)
4. What is your highest level of education? (e.g., no formal education, primary, secondary, diploma, degree)
5. What is your primary occupation? (e.g., government employee, private sector, self-employed, unemployed, student)
6. How many people live in your household (including children)?
7. What is your approximate household income per month? (e.g., < 2,000 ETB, 2,000–5,000 ETB, > 5,000 ETB)

Section 2: Awareness and Perceptions about Open Spaces

8. Are you aware of any designated open spaces in your neighborhood? (Yes/No)
9. If yes, can you name or describe the open spaces you are aware of?

10. In your opinion, what are the main purposes of open spaces in your neighborhood? (e.g., recreation, environmental conservation, social activities, others)

Section 3: Open Space Usage

11. Do you or your family members use open spaces in your neighborhood? (Yes/No)
12. If yes, how often do you visit these open spaces? (e.g., daily, weekly, monthly, occasionally)
13. What activities do you or your family engage in when using open spaces? (e.g., walking, children's play, exercising, socializing, resting)
14. Who in your household uses open spaces the most? (e.g., adults, children, elderly, all members)
15. What time of day do you usually visit open spaces? (e.g., morning, afternoon, evening)

Section 4: Barriers to Open Space Access

16. Are there any barriers or difficulties you face in accessing open spaces? (Yes/No)
17. If yes, what are the main barriers? (e.g., distance, lack of safety, poor maintenance, limited facilities, overcrowding, others)
18. Do you think open spaces in your neighborhood are inclusive and accessible to all groups, including women, children, and the elderly? (Yes/No)
19. What specific improvements would make open spaces more accessible for you and your community?

Section 5: Environmental Impacts

20. Do you think the presence of open spaces has improved the environmental conditions in your neighborhood? (Yes/No)
21. If yes, what improvements have you noticed? (e.g., reduced air pollution, cooler temperatures, less noise, better drainage, others)

22. In your opinion, are the open spaces in your neighborhood well-maintained to support environmental benefits? (Yes/No)

23. What environmental issues do you think are caused by the lack of open spaces in your neighborhood? (e.g., poor air quality, flooding, heat, others)

Section 6: Social Impacts

24. Do you think open spaces contribute to social benefits in your neighborhood? (Yes/No)

25. If yes, what benefits have you observed? (e.g., community bonding, recreational opportunities, cultural events, reduced crime)

26. Do you think open spaces contribute to the well-being and happiness of your household? (Yes/No)

27. What social issues do you think arise from the lack of open spaces in your neighborhood? (e.g., isolation, lack of recreation, increased conflicts, others)

Section 7: Suggestions for Improvement

28. In your opinion, what improvements are needed for the existing open spaces in your neighborhood? (e.g., adding facilities, better maintenance, increasing safety, expanding open space areas)

29. Do you think new open spaces should be developed in your neighborhood? (Yes/No)

30. If yes, where do you think new open spaces should be located, and what facilities or features should they include?

Part II: Semi-Structured Interview Guide for Key Informants

Introduction

This interview begins by introducing the purpose of the research, explaining the role of the key informant, and assuring confidentiality. And a request consent is asked for recording the interview.

Section 1: Background

1. Could you describe your role in urban planning, environmental management, or community development in Aba Geda Sub-city?
2. What has been your experience with urban open space development and management in Adama City?

Section 2: Current State of Open Spaces

3. How would you describe the current state of open spaces in Aba Geda Sub-city in terms of quantity, quality, and distribution?
4. Are there any specific policies or frameworks guiding the development and management of open spaces in this sub-city?

Section 3: Environmental Impacts

5. In your professional opinion, what environmental benefits do open spaces bring to the sub-city (e.g., air quality, temperature regulation, drainage)?
6. Are there environmental challenges resulting from the lack of open spaces, such as flooding, heat, or poor air quality? If so, how significant are these issues?
7. How well are environmental factors considered in the planning and management of open spaces?

Section 4: Social Impacts

8. From your perspective, how do open spaces contribute to social well-being in Aba Geda Sub-city?

9. Are existing open spaces inclusive and accessible to all groups, including women, children, and the elderly?
10. Are there any social challenges—such as conflicts, inequities, or underutilization—related to open spaces in this sub-city?

Section 5: Planning and Management

11. How effectively are open spaces integrated into Aba Geda Sub-city's urban planning and development strategies?
12. What are the major challenges in managing and maintaining open spaces in this sub-city? (e.g., funding, institutional capacity, community involvement)
13. Are there any specific gaps in existing policies or practices that hinder the effective development of open spaces?

Section 6: Future Directions

14. What do you think are the most urgent priorities for improving open spaces in Aba Geda Sub-city?
15. Are there any planned or ongoing projects to develop or expand open spaces in this area?
16. How can the community, private sector, or other stakeholders be more effectively involved in open space development and management?

Part III: Open-Ended Questions for FGDs

Introduction

It starts by welcoming participants and introducing the purpose of the discussion. The researcher explains that their perspectives are valuable, and assure them of confidentiality. Emphasize that there are no right or wrong answers, and encourage open and respectful participation.

Section 1: Community Needs and Preferences

1. What do you think are the main benefits of having open spaces in your neighborhood?
2. Are the existing open spaces in Aba Geda Sub-city meeting the needs of the community? Why or why not?
3. What types of open spaces and facilities would you like to see in your neighborhood?

Section 2: Environmental and Social Impacts

4. How do you think the presence of open spaces affects the environment in your neighborhood?
5. Have you noticed any environmental problems, such as flooding or air pollution, that could be addressed by improving open spaces?
6. What social benefits do you think open spaces provide, such as recreational opportunities, cultural activities, or community bonding?

Section 3: Barriers to Access

7. What challenges or barriers do you face in accessing open spaces in your neighborhood (e.g., safety, distance, poor facilities)?
8. Are certain groups, such as women, children, or the elderly, more affected by these barriers than others? If so, how?
9. How do you think these barriers could be addressed?

Section 4: Suggestions for Improvement

10. What improvements would you suggest for the existing open spaces in Aba Geda Sub-city?

Appendix 2: Steps for Calculating the Summary of Air Quality Data

The measurement computations and equations that follow are based on the following sources:
1. WHO (World Health Organization) "Air Quality Data Analysis Guidelines" (2021)
2. Environmental Protection Agency of the United States (2017). Volume II of the Ambient Air Quality Monitoring Program: Quality Assurance Handbook for Air Pollution Measurement Systems. Washington, D.C.

Daily Average Calculation: Determine the daily average of the two measurements (morning and evening) for every location and parameter. is determined by applying the subsequent formula:

Equation 2: Daily Average Calculation:

$$Daily\ Average = \frac{Morning\ Measurement + Evening\ Measurement}{2}$$

Monthly Average Calculation: By adding up all of the daily averages and dividing by the total number of days in the month, determine the monthly average for each parameter at each site at the end of each month. is computed using the formula that follows:

Equation 3: Monthly Average Calculation:

$$Monthly\ Average = \frac{\sum Daily\ Averages}{Number\ of\ Days\ in\ a\ Month}$$

Two-Month Summary: Average the monthly averages for October and December to determine the overall average for each parameter for the two months. is determined by applying the subsequent formula:

Equation 4: Two Month Summary Calculation:

$$Two - Month\ Average = \frac{October\ Average + November\ Average}{2}$$

Comparing with WHO criteria: To ascertain compliance, compare the two-month averages for PM2.5, PM10, and other metrics with WHO criteria.

- **Example for Calculation Procedure:**

Suppose for PM2.5 near Oda Fountain in October:

- Daily averages for 31 days: $50.0, 55.0, 48.0, \ldots$
- Monthly Average:

$$\text{October Average} = \frac{\sum(\text{Daily Averages})}{31}$$

If the **October Average** is $55.0\,\mu g/m^3$ and the **December Average** is $50.0\,\mu g/m^3$, then the **Two-Month Average** is:

$$\text{Two-Month Average} = \frac{55.0 + 50.0}{2} = 52.5\,\mu g/m^3$$

Appendix 3: Raw data for temperature and air quality readings made between October and November of 2024 Using AirScope: Pollen & Air Quality mobile app.

Raw data for temperature and air quality readings made between October and November of 2024. This data was created using the AirScope: Pollen & Air Quality mobile app and is consistent with summary table 17 in the Environmental Assessment portion of Chapter 4.

Table 25: Raw Data for Temperature and Air Quality (October and November Readings)

Date	Location	Time	Temperature (Â°C)	PM2.5 (Âµg/mÂ³)	PM10 (Âµg/mÂ³)	CO2 (ppm)
10/1/2024	Near Oda Fountain	Morning	31	64.7	86.7	440.8
10/1/2024	Near Oda Fountain	Evening	30.5	58.7	91.4	455.6
10/1/2024	Near Wonji Mazoria	Morning	30.4	46.4	70.3	392.9
10/1/2024	Near Wonji Mazoria	Evening	29.7	41.9	70.5	393.7
10/2/2024	Near Oda Fountain	Morning	31.2	57.5	93.4	448.5
10/2/2024	Near Oda Fountain	Evening	32.4	60.8	86.5	446.6
10/2/2024	Near Wonji Mazoria	Morning	30.9	43.2	74.6	405.5
10/2/2024	Near Wonji Mazoria	Evening	29.6	42.8	68.1	407.3
10/3/2024	Near Oda Fountain	Morning	31.7	56.2	85.4	457.2
10/3/2024	Near Oda Fountain	Evening	30.3	64.7	87.8	440.1
10/3/2024	Near Wonji Mazoria	Morning	30	45.6	74.9	399.3
10/3/2024	Near Wonji Mazoria	Evening	29.8	48.6	70.4	396.9
10/4/2024	Near Oda Fountain	Morning	30.9	59.6	88.1	440.6
10/4/2024	Near Oda Fountain	Evening	30.3	55	87.8	446.9
10/4/2024	Near Wonji Mazoria	Morning	30.3	49.6	74.2	405.9
10/4/2024	Near Wonji Mazoria	Evening	29.7	41.2	74.1	398.2
10/5/2024	Near Oda Fountain	Morning	32.6	58.2	85.3	456.4
10/5/2024	Near Oda Fountain	Evening	31.3	63.2	89.2	457.9
10/5/2024	Near Wonji Mazoria	Morning	30.7	49.3	73.7	397.4
10/5/2024	Near Wonji Mazoria	Evening	30.8	47	72.3	403.9

10/6/2024	Near Oda Fountain	Morning	30.3	63	94.1	450.7
10/6/2024	Near Oda Fountain	Evening	32.6	62.1	90.9	452.9
10/6/2024	Near Wonji Mazoria	Morning	29.5	47.4	68.2	392.4
10/6/2024	Near Wonji Mazoria	Evening	30.7	41.8	72.3	400.5
10/7/2024	Near Oda Fountain	Morning	30.3	62.8	94.3	443.9
10/7/2024	Near Oda Fountain	Evening	32.9	64.9	92.6	455.7
10/7/2024	Near Wonji Mazoria	Morning	29.9	44.5	71.1	398.5
10/7/2024	Near Wonji Mazoria	Evening	30.4	40.5	70.7	406.5
10/8/2024	Near Oda Fountain	Morning	32.7	55.5	94.2	446.5
10/8/2024	Near Oda Fountain	Evening	32.4	57.6	85.4	452.2
10/8/2024	Near Wonji Mazoria	Morning	29.8	47.2	74.9	393.2
10/8/2024	Near Wonji Mazoria	Evening	29.6	45.6	71.6	397.5
10/9/2024	Near Oda Fountain	Morning	32.6	61.2	85.3	448.8
10/9/2024	Near Oda Fountain	Evening	32	59.3	93.1	453.3
10/9/2024	Near Wonji Mazoria	Morning	30.1	46.7	71.2	402.6
10/9/2024	Near Wonji Mazoria	Evening	30.6	47.1	74.3	406.1
10/10/2024	Near Oda Fountain	Morning	31.4	61.8	89.7	454.5
10/10/2024	Near Oda Fountain	Evening	30	56.2	93.7	459.8
10/10/2024	Near Wonji Mazoria	Morning	30.8	45.4	74.6	393.2
10/10/2024	Near Wonji Mazoria	Evening	30.8	47	73.5	402.7
10/11/2024	Near Oda Fountain	Morning	32.2	62.3	86.6	446.3
10/11/2024	Near Oda Fountain	Evening	32.7	58	93.3	452.7
10/11/2024	Near Wonji Mazoria	Morning	30.7	47.6	72.4	393.4
10/11/2024	Near Wonji Mazoria	Evening	31	48	71.2	396.4
10/12/2024	Near Oda Fountain	Morning	32.8	63.9	91.3	445.1
10/12/2024	Near Oda Fountain	Evening	31.5	57.2	88.3	443.7
10/12/2024	Near Wonji Mazoria	Morning	30	42.6	72	407

10/12/2024	Near Wonji Mazoria	Evening	29.6	45.2	72.6	397.8
10/13/2024	Near Oda Fountain	Morning	30.3	61.4	92	450.7
10/13/2024	Near Oda Fountain	Evening	30.4	62.7	90	449.5
10/13/2024	Near Wonji Mazoria	Morning	29.9	47.8	70.4	409.5
10/13/2024	Near Wonji Mazoria	Evening	30.5	50	69.7	401.2
10/14/2024	Near Oda Fountain	Morning	30.6	62.1	93	455.5
10/14/2024	Near Oda Fountain	Evening	31.2	57.4	94.4	453.3
10/14/2024	Near Wonji Mazoria	Morning	30.2	45.7	73	390.4
10/14/2024	Near Wonji Mazoria	Evening	29.8	41.9	69.5	406.1
10/15/2024	Near Oda Fountain	Morning	30.9	56.3	88.6	441.1
10/15/2024	Near Oda Fountain	Evening	30.7	62.3	90.7	446.2
10/15/2024	Near Wonji Mazoria	Morning	30.2	40.7	72.5	392.4
10/15/2024	Near Wonji Mazoria	Evening	29.9	42.5	73.1	403.5
10/16/2024	Near Oda Fountain	Morning	32.8	62	93.9	446.9
10/16/2024	Near Oda Fountain	Evening	32.3	61.3	89.1	452.5
10/16/2024	Near Wonji Mazoria	Morning	30.1	42.1	71.7	403.7
10/16/2024	Near Wonji Mazoria	Evening	31	45.4	74.3	407.1
10/17/2024	Near Oda Fountain	Morning	30.2	60.5	88	453.4
10/17/2024	Near Oda Fountain	Evening	31	62.8	86.2	448.4
10/17/2024	Near Wonji Mazoria	Morning	30.3	44.6	71.7	408.6
10/17/2024	Near Wonji Mazoria	Evening	30.6	48.7	73.2	402.1
10/18/2024	Near Oda Fountain	Morning	32.5	56.5	94.4	457.9
10/18/2024	Near Oda Fountain	Evening	30.2	59.4	94.6	442.7
10/18/2024	Near Wonji Mazoria	Morning	30.4	40.7	70	390.9
10/18/2024	Near Wonji Mazoria	Evening	29.9	43.7	72.8	401.7
10/19/2024	Near Oda Fountain	Morning	32.6	56.9	90.8	442.6
10/19/2024	Near Oda Fountain	Evening	32.5	58.4	91.9	455.8

10/19/2024	Near Wonji Mazoria	Morning	30.9	44.7	72.1	407
10/19/2024	Near Wonji Mazoria	Evening	29.6	46.4	68.6	401.6
10/20/2024	Near Oda Fountain	Morning	32.5	55.3	90.3	444.4
10/20/2024	Near Oda Fountain	Evening	30.2	57.6	89.8	440.4
10/20/2024	Near Wonji Mazoria	Morning	29.6	41.4	70.3	400.3
10/20/2024	Near Wonji Mazoria	Evening	30.1	45.8	74.1	394.6
10/21/2024	Near Oda Fountain	Morning	31.8	59	87.4	456.1
10/21/2024	Near Oda Fountain	Evening	32.2	64.1	93.8	451.5
10/21/2024	Near Wonji Mazoria	Morning	29.7	43.3	72.5	403.1
10/21/2024	Near Wonji Mazoria	Evening	30.7	48.3	69.2	391.8
10/22/2024	Near Oda Fountain	Morning	30.8	56.2	93.7	450.6
10/22/2024	Near Oda Fountain	Evening	30.2	56.6	91.2	454.6
10/22/2024	Near Wonji Mazoria	Morning	30.2	41.5	68.5	390.3
10/22/2024	Near Wonji Mazoria	Evening	29.5	42.9	69.3	393.5
10/23/2024	Near Oda Fountain	Morning	31.6	59.7	85.6	446.3
10/23/2024	Near Oda Fountain	Evening	31.2	63.1	92.8	458.6
10/23/2024	Near Wonji Mazoria	Morning	30.4	42.7	72.5	404.3
10/23/2024	Near Wonji Mazoria	Evening	29.7	42.7	74.3	396.7
10/24/2024	Near Oda Fountain	Morning	30.8	59.9	90.3	458.1
10/24/2024	Near Oda Fountain	Evening	30.1	55.4	87.7	444.6
10/24/2024	Near Wonji Mazoria	Morning	29.6	41.4	73.1	391.3
10/24/2024	Near Wonji Mazoria	Evening	30.4	46.4	72.6	407.1
10/25/2024	Near Oda Fountain	Morning	32	61.8	93.5	448.5
10/25/2024	Near Oda Fountain	Evening	32	62.6	90.4	458.1
10/25/2024	Near Wonji Mazoria	Morning	30.6	41.9	74.4	405.2
10/25/2024	Near Wonji Mazoria	Evening	29.9	43.9	74.7	405.2
10/26/2024	Near Oda Fountain	Morning	31.1	58.9	89.1	446.4

10/26/2024	Near Oda Fountain	Evening	30.7	59.8	94.2	441.5
10/26/2024	Near Wonji Mazoria	Morning	30.9	48.5	68.9	396
10/26/2024	Near Wonji Mazoria	Evening	29.5	43.6	72.8	395.5
10/27/2024	Near Oda Fountain	Morning	31.9	58.1	87.4	449
10/27/2024	Near Oda Fountain	Evening	31	58.5	93.4	455
10/27/2024	Near Wonji Mazoria	Morning	30.7	48.6	69.5	404.9
10/27/2024	Near Wonji Mazoria	Evening	30.5	44.7	74.2	405.6
10/28/2024	Near Oda Fountain	Morning	30.3	63.4	93.9	449.5
10/28/2024	Near Oda Fountain	Evening	31.1	61.2	94.4	446.9
10/28/2024	Near Wonji Mazoria	Morning	29.9	48.1	73.1	404.4
10/28/2024	Near Wonji Mazoria	Evening	30	44.1	69	402.1
10/29/2024	Near Oda Fountain	Morning	32.9	59.5	85.2	458.7
10/29/2024	Near Oda Fountain	Evening	31.6	61.9	87.6	443.3
10/29/2024	Near Wonji Mazoria	Morning	30.1	41	72.2	405.6
10/29/2024	Near Wonji Mazoria	Evening	30.1	42	70.4	408
10/30/2024	Near Oda Fountain	Morning	32.2	64.5	90.8	449.3
10/30/2024	Near Oda Fountain	Evening	31.8	64.3	90.4	451.1
10/30/2024	Near Wonji Mazoria	Morning	30	46.2	70.8	390.4
10/30/2024	Near Wonji Mazoria	Evening	30.8	44.5	68.5	409
10/31/2024	Near Oda Fountain	Morning	32.3	62.4	93.6	442.9
10/31/2024	Near Oda Fountain	Evening	32.5	62.8	88.9	456.4
10/31/2024	Near Wonji Mazoria	Morning	30	44.1	70.2	399.2
10/31/2024	Near Wonji Mazoria	Evening	29.7	41.8	70.1	408.5
11/1/2024	Near Oda Fountain	Morning	32.5	60.2	88.6	447.7
11/1/2024	Near Oda Fountain	Evening	32.5	59.4	94.5	440.6
11/1/2024	Near Wonji Mazoria	Morning	29.8	46.3	74.7	396.6
11/1/2024	Near Wonji Mazoria	Evening	30.5	47	72.2	400.8

11/2/2024	Near Oda Fountain	Morning	30.1	57.3	85.1	451.4
11/2/2024	Near Oda Fountain	Evening	31.9	57.8	85.7	444.2
11/2/2024	Near Wonji Mazoria	Morning	30.3	45.2	73.1	402.4
11/2/2024	Near Wonji Mazoria	Evening	30.1	40.4	70.7	390.2
11/3/2024	Near Oda Fountain	Morning	31.3	58.3	91.6	455.7
11/3/2024	Near Oda Fountain	Evening	31.6	59.2	92.7	447.8
11/3/2024	Near Wonji Mazoria	Morning	29.5	43.9	72.9	407.2
11/3/2024	Near Wonji Mazoria	Evening	29.9	41	74.8	399.7
11/4/2024	Near Oda Fountain	Morning	30.5	62	90.8	448.8
11/4/2024	Near Oda Fountain	Evening	31.9	55.9	91.5	451.7
11/4/2024	Near Wonji Mazoria	Morning	30.1	47	68.1	395.8
11/4/2024	Near Wonji Mazoria	Evening	29.8	42.4	73.5	396.7
11/5/2024	Near Oda Fountain	Morning	32.1	59.2	89.6	442.5
11/5/2024	Near Oda Fountain	Evening	30.8	59.8	90.1	454.2
11/5/2024	Near Wonji Mazoria	Morning	30	42.4	69.9	400.5
11/5/2024	Near Wonji Mazoria	Evening	30.8	48.8	73.9	408.5
11/6/2024	Near Oda Fountain	Morning	33	60	85.8	442.2
11/6/2024	Near Oda Fountain	Evening	31.8	63.2	94	457.1
11/6/2024	Near Wonji Mazoria	Morning	30	45.8	72.8	391.5
11/6/2024	Near Wonji Mazoria	Evening	29.7	48.7	73.2	400.5
11/7/2024	Near Oda Fountain	Morning	33	61.4	90.6	447.4
11/7/2024	Near Oda Fountain	Evening	32.8	63.3	90.2	447.3
11/7/2024	Near Wonji Mazoria	Morning	29.6	49.1	68.3	395.9
11/7/2024	Near Wonji Mazoria	Evening	29.9	40.8	69.1	406.6
11/8/2024	Near Oda Fountain	Morning	31.7	61.2	90.5	454.5
11/8/2024	Near Oda Fountain	Evening	32.3	59.6	89.1	451.3
11/8/2024	Near Wonji Mazoria	Morning	29.9	48.4	70.8	406.4

11/8/2024	Near Wonji Mazoria	Evening	29.5	44.8	70.6	398
11/9/2024	Near Oda Fountain	Morning	32.6	59.9	85.5	446.3
11/9/2024	Near Oda Fountain	Evening	30.2	56.3	85.8	452.1
11/9/2024	Near Wonji Mazoria	Morning	30.6	41.4	73.8	403.4
11/9/2024	Near Wonji Mazoria	Evening	30.7	43.1	71.5	395.6
11/10/2024	Near Oda Fountain	Morning	30.7	58.1	86.4	455.7
11/10/2024	Near Oda Fountain	Evening	30.2	64.7	86.3	445.2
11/10/2024	Near Wonji Mazoria	Morning	30.2	48.2	70.7	394.3
11/10/2024	Near Wonji Mazoria	Evening	30.9	48	74.8	402.8
11/11/2024	Near Oda Fountain	Morning	31.2	56.9	86.5	441.2
11/11/2024	Near Oda Fountain	Evening	32.1	59	86.6	444.7
11/11/2024	Near Wonji Mazoria	Morning	30	45	71.5	404.4
11/11/2024	Near Wonji Mazoria	Evening	29.8	48.1	68.4	399.9
11/12/2024	Near Oda Fountain	Morning	32.9	63.6	92.2	449.8
11/12/2024	Near Oda Fountain	Evening	32.5	62	88.1	442.8
11/12/2024	Near Wonji Mazoria	Morning	30.6	43	69.6	397.9
11/12/2024	Near Wonji Mazoria	Evening	30.4	49.3	68.6	402
11/13/2024	Near Oda Fountain	Morning	31	63.6	90	453.8
11/13/2024	Near Oda Fountain	Evening	30.5	58.2	93.4	449.1
11/13/2024	Near Wonji Mazoria	Morning	29.9	40.4	74.4	409.7
11/13/2024	Near Wonji Mazoria	Evening	30.5	43.8	69	391.5
11/14/2024	Near Oda Fountain	Morning	32.8	57.7	89.9	458
11/14/2024	Near Oda Fountain	Evening	30.9	56.6	90.4	458.6
11/14/2024	Near Wonji Mazoria	Morning	30.7	45.2	73.5	396.3
11/14/2024	Near Wonji Mazoria	Evening	29.6	47.6	69.8	401.9
11/15/2024	Near Oda Fountain	Morning	31.8	61.4	86.9	454.1
11/15/2024	Near Oda Fountain	Evening	30.3	61.6	86.9	450.9

11/15/2024	Near Wonji Mazoria	Morning	30.4	49.8	73.5	393.6
11/15/2024	Near Wonji Mazoria	Evening	30.5	44.5	70	392.6
11/16/2024	Near Oda Fountain	Morning	31.9	57.5	87.2	447.4
11/16/2024	Near Oda Fountain	Evening	32.8	63.8	87	451.2
11/16/2024	Near Wonji Mazoria	Morning	30.9	45.6	73.6	395.5
11/16/2024	Near Wonji Mazoria	Evening	29.6	43.1	74.5	395.4
11/17/2024	Near Oda Fountain	Morning	32.3	58.6	89.3	441.8
11/17/2024	Near Oda Fountain	Evening	30.2	59.9	88.3	446.1
11/17/2024	Near Wonji Mazoria	Morning	29.5	47.9	74.8	400.8
11/17/2024	Near Wonji Mazoria	Evening	30.6	48	69.7	399.8
11/18/2024	Near Oda Fountain	Morning	31.1	61.7	90.7	440.1
11/18/2024	Near Oda Fountain	Evening	31.2	58.6	89.1	448.5
11/18/2024	Near Wonji Mazoria	Morning	29.6	41.4	75	409.2
11/18/2024	Near Wonji Mazoria	Evening	30.6	41.9	70.6	401.3
11/19/2024	Near Oda Fountain	Morning	32.5	61.1	88.5	457
11/19/2024	Near Oda Fountain	Evening	31.6	59.5	93.5	456.9
11/19/2024	Near Wonji Mazoria	Morning	30.9	41.3	68.3	409.3
11/19/2024	Near Wonji Mazoria	Evening	29.7	42.9	68.3	402.6
11/20/2024	Near Oda Fountain	Morning	32.1	61.3	86.8	449.9
11/20/2024	Near Oda Fountain	Evening	31.2	63.7	86.9	450.4
11/20/2024	Near Wonji Mazoria	Morning	29.6	43.4	68.3	394.3
11/20/2024	Near Wonji Mazoria	Evening	29.9	40.6	72.2	395.9
11/21/2024	Near Oda Fountain	Morning	30.3	58.9	94.8	453
11/21/2024	Near Oda Fountain	Evening	32.3	59.7	92.9	449.9
11/21/2024	Near Wonji Mazoria	Morning	30.7	46.2	68.7	406.1
11/21/2024	Near Wonji Mazoria	Evening	29.8	42.3	73.1	408.3
11/22/2024	Near Oda Fountain	Morning	32.8	58.6	90.1	446.6

11/22/2024	Near Oda Fountain	Evening	31.6	58	88.2	453.1
11/22/2024	Near Wonji Mazoria	Morning	30.5	49.7	72.6	405.9
11/22/2024	Near Wonji Mazoria	Evening	30.4	44.5	69.1	393.4
11/23/2024	Near Oda Fountain	Morning	31	57.6	85	443.4
11/23/2024	Near Oda Fountain	Evening	31.3	57.9	88.2	449.6
11/23/2024	Near Wonji Mazoria	Morning	31	43.6	70.1	391.5
11/23/2024	Near Wonji Mazoria	Evening	29.6	40.5	69.2	401.2
11/24/2024	Near Oda Fountain	Morning	30.4	60.6	93.2	442.4
11/24/2024	Near Oda Fountain	Evening	30.4	60.9	91.7	458.3
11/24/2024	Near Wonji Mazoria	Morning	29.5	46.4	71.4	398.5
11/24/2024	Near Wonji Mazoria	Evening	30.2	45.9	68.1	399.1
11/25/2024	Near Oda Fountain	Morning	32.6	56.7	85.6	454.9
11/25/2024	Near Oda Fountain	Evening	31	59.8	89.1	449.9
11/25/2024	Near Wonji Mazoria	Morning	29.9	48	74.6	406.8
11/25/2024	Near Wonji Mazoria	Evening	29.7	41.1	68.9	398.3
11/26/2024	Near Oda Fountain	Morning	31.1	59.7	94.2	459.9
11/26/2024	Near Oda Fountain	Evening	30.7	55.2	89.8	447.9
11/26/2024	Near Wonji Mazoria	Morning	30.7	41	68.3	408.5
11/26/2024	Near Wonji Mazoria	Evening	30.1	45.5	74.9	397.1
11/27/2024	Near Oda Fountain	Morning	33	55.9	91.6	452.5
11/27/2024	Near Oda Fountain	Evening	32.4	58.7	92.9	447.5
11/27/2024	Near Wonji Mazoria	Morning	30.2	47.4	68.1	400.6
11/27/2024	Near Wonji Mazoria	Evening	30.1	40.2	72	408.4
11/28/2024	Near Oda Fountain	Morning	31.4	60.4	87.7	445.9
11/28/2024	Near Oda Fountain	Evening	32.1	61.8	92.3	441.7
11/28/2024	Near Wonji Mazoria	Morning	30.4	45.3	73.7	393.3
11/28/2024	Near Wonji Mazoria	Evening	30.2	42.1	72.9	400.9

11/29/2024	Near Oda Fountain	Morning	30.9	62.6	86.6	446.5
11/29/2024	Near Oda Fountain	Evening	32.9	61.7	86.9	447.4
11/29/2024	Near Wonji Mazoria	Morning	30.9	46.7	70	408.6
11/29/2024	Near Wonji Mazoria	Evening	30.5	44.5	69.2	407.2
11/30/2024	Near Oda Fountain	Morning	32.2	62.6	87.8	456.3
11/30/2024	Near Oda Fountain	Evening	30.9	55.9	85.8	446.6
11/30/2024	Near Wonji Mazoria	Morning	29.5	44.5	68.2	399.6
11/30/2024	Near Wonji Mazoria	Evening	30.2	47.2	72.5	404.6

Appendix 4: Raw data for Noise readings made in October of 2024 Using Decibel X: dB Sound Level Meter app

Methods to Compile Data:

- Calculating the Daily Average: Determine the average daily noise level for each location:

Equation 5: Daily Average Calculation:

$$Daily\ Average\ (dB) = \frac{Morning + Afternoon + Evening}{3}$$

- Weekly Average Calculation: Determine each location's weekly average at the conclusion of the week.

Equation 6: Weekly Average Calculation:

$$Weekly\ Average\ (dB) = \frac{\sum Daily\ Averages}{7}$$

- Comparison to the WHO Standard: Weekly average noise levels should be compared to suggested benchmarks, such as the WHO Environmental Noise Guidelines, which state that residential areas should have a noise level of 55 dB during the day.

Table 26: Raw Data for Noise Reading for One Week

Date	Location	Time	Noise Level (dB)
10/1/2024	Oda Fountain Open Space	Morning	79.2
10/1/2024	Oda Fountain Open Space	Afternoon	71.1
10/1/2024	Oda Fountain Open Space	Evening	76.6
10/1/2024	Wonji Mazoria Open Space	Morning	57.4
10/1/2024	Wonji Mazoria Open Space	Afternoon	57.6
10/1/2024	Wonji Mazoria Open Space	Evening	59.4
10/1/2024	Built-up Area (near Oda Fountain)	Morning	82.4
10/1/2024	Built-up Area (near Oda Fountain)	Afternoon	76.9
10/1/2024	Built-up Area (near Oda Fountain)	Evening	81.4
10/2/2024	Oda Fountain Open Space	Morning	77.4
10/2/2024	Oda Fountain Open Space	Afternoon	78.3
10/2/2024	Oda Fountain Open Space	Evening	73.2
10/2/2024	Wonji Mazoria Open Space	Morning	56.2
10/2/2024	Wonji Mazoria Open Space	Afternoon	60.6
10/2/2024	Wonji Mazoria Open Space	Evening	59.6
10/2/2024	Built-up Area (near Oda Fountain)	Morning	80.9
10/2/2024	Built-up Area (near Oda Fountain)	Afternoon	81.9
10/2/2024	Built-up Area (near Oda Fountain)	Evening	78
10/3/2024	Oda Fountain Open Space	Morning	75.2

10/3/2024	Oda Fountain Open Space	Afternoon	80
10/3/2024	Oda Fountain Open Space	Evening	78.5
10/3/2024	Wonji Mazoria Open Space	Morning	60.5
10/3/2024	Wonji Mazoria Open Space	Afternoon	60.8
10/3/2024	Wonji Mazoria Open Space	Evening	62.7
10/3/2024	Built-up Area (near Oda Fountain)	Morning	79.1
10/3/2024	Built-up Area (near Oda Fountain)	Afternoon	82.2
10/3/2024	Built-up Area (near Oda Fountain)	Evening	80.4
10/4/2024	Oda Fountain Open Space	Morning	76.2
10/4/2024	Oda Fountain Open Space	Afternoon	74.8
10/4/2024	Oda Fountain Open Space	Evening	79.1
10/4/2024	Wonji Mazoria Open Space	Morning	60.4
10/4/2024	Wonji Mazoria Open Space	Afternoon	63.1
10/4/2024	Wonji Mazoria Open Space	Evening	58.3
10/4/2024	Built-up Area (near Oda Fountain)	Morning	78.3
10/4/2024	Built-up Area (near Oda Fountain)	Afternoon	76.2
10/4/2024	Built-up Area (near Oda Fountain)	Evening	85
10/5/2024	Oda Fountain Open Space	Morning	71.7
10/5/2024	Oda Fountain Open Space	Afternoon	79.2
10/5/2024	Oda Fountain Open Space	Evening	77.5
10/5/2024	Wonji Mazoria Open Space	Morning	57.7
10/5/2024	Wonji Mazoria Open Space	Afternoon	58.3
10/5/2024	Wonji Mazoria Open Space	Evening	57.4
10/5/2024	Built-up Area (near Oda Fountain)	Morning	76.3
10/5/2024	Built-up Area (near Oda Fountain)	Afternoon	77.3
10/5/2024	Built-up Area (near Oda Fountain)	Evening	76.2
10/6/2024	Oda Fountain Open Space	Morning	78.1
10/6/2024	Oda Fountain Open Space	Afternoon	70.8
10/6/2024	Oda Fountain Open Space	Evening	79.9
10/6/2024	Wonji Mazoria Open Space	Morning	62.9
10/6/2024	Wonji Mazoria Open Space	Afternoon	64.8
10/6/2024	Wonji Mazoria Open Space	Evening	56.7
10/6/2024	Built-up Area (near Oda Fountain)	Morning	80.8
10/6/2024	Built-up Area (near Oda Fountain)	Afternoon	79.4
10/6/2024	Built-up Area (near Oda Fountain)	Evening	79.4
10/7/2024	Oda Fountain Open Space	Morning	70.3
10/7/2024	Oda Fountain Open Space	Afternoon	75.2
10/7/2024	Oda Fountain Open Space	Evening	74.5
10/7/2024	Wonji Mazoria Open Space	Morning	59.2
10/7/2024	Wonji Mazoria Open Space	Afternoon	56.9
10/7/2024	Wonji Mazoria Open Space	Evening	63.8
10/7/2024	Built-up Area (near Oda Fountain)	Morning	81.9
10/7/2024	Built-up Area (near Oda Fountain)	Afternoon	84.8
10/7/2024	Built-up Area (near Oda Fountain)	Evening	80.1