ASSESSING THE ACCESSIBILITY OF EXISTING AND NEWLY DEVELOPED URBAN GREEN SPACE: THE CASE OF ADDIS ABABA CITY

Hanna Tedla Teklu

A Thesis Submitted to

The Department of Architecture

School of Civil Engineering and Architecture

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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Approve of Board of Examiners

I, the advisor of the thesis entitled "**Assessing the accessibility of existing and newly developed urban green space: The case of Addis Ababa city"** and developed by Hanna Tedla, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

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Major Advisor Signature Date

We, the undersigned, members of the Board of Examiners of the thesis by Hanna Tedla have read and evaluated the thesis entitled "**Assessing the accessibility of existing and newly developed urban green space: The case of Addis Ababa city"** 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

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Finally, 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).

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Department Head Signature Date

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School Dean Signature Date

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Declaration

I hereby declare that this Master Thesis entitled "**Assessing the accessibility of existing and newly developed urban green space: The case of Addis Ababa city"** 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 student	Signature	Date

Recommendation

I, the advisor/ supervisor of this thesis, hereby certify that I have read the revised version of the thesis entitled **"Assessing the accessibility of existing and newly developed urban green space: The case of Addis Ababa city"** prepared under my guidance by **Hanna Tedla** submitted in partial fulfillment of the requirements for the degree of Mater's 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/ Supervisor Signature Date

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LIST OF ABBREVATION

AU	African Union
EEA	European Environment Agency
EN	English Nature
FAO	Food and Agriculture Organization
GI	Green Infrastructure
Ha	Hectare
MUDH	Ministry of Urban Development and Housing
UGS	Urban Green Space
WHO	World Health Organization

ABSTRACT

Cities of developing countries, such as Addis Ababa, are facing a significant problem concerning green spaces. Urban green space has become fundamental feature of urban development initiatives since its importance in providing numerous green space services for human well-being is highly indicated. Despite their numerous advantages, they are under severe threat, particularly in Sub-Saharan Africa's fast growing cities. Therefore, this research aims to assess the accessibility of urban green space in Addis Ababa city. Specifically, it comparatively investigates the availability, physical accessibility and service area gap of exiting and newly added recreational public urban green spaces in the city. The initial thematic mapping, data synthesis and key findings were generated using ArcGIS software. The method that was used to evaluate urban green space availability was acreage and per capita indicator. Proximity indicator was used to evaluate physical accessibility and to identify the proportional population without access to green space. And the service area gap was formulated by calculating the difference between the provided green infrastructure and the standard for the provision. The study finds out the newly added recreational urban green space has higher acreage compared to the previous one which also makes the per capita larger than the previous. The physical accessibility of the newly added green spaces was much lower than the previous urban green space in terms of proximity indicator which makes it less accessible for residents living in 400m and 800m distance from the facility. The service area gap of the city was minimized because of the providence of the newly added ones despite it still lack to meet the standards. The result implies the physical accessibility of the newly provided urban green space is less while the previous one is better despite of the contribution for the per capita is great. The study will help the decision makers to see in which part of the city they should focus regarding green space. The research can be used as a guideline for researchers to further study the solution of increasing green space accessibility in terms of different other aspects. And it will also guide the municipalities to consider accessibility while providing new green space facilities for the city.

Key words: Availability of urban green space, Per-capita green space, Physical accessibility, Proximity indicator, Recreational area.

CHAPTER ONE

INTRODUCTION

Urban green spaces are open places in cities that are predominantly covered by vegetation and water body which includes both public and private spaces (Shuk, 2016). Addis Ababa is the capital city of Ethiopia and one of the fastest-growing cities in Africa with high population and in need of urban green spaces. Due to this fact, the motive for this research is the desire to contribute an understanding for the question of green space accessibility in a city while providing new facilities. This chapter describes the background information around the topic area that has been done before, states; the problem, objective, research question, scope, limitation, organization and significance of the study.

1.1 Background

The world is becoming more urbanized, and the number of people living in cities is rapidly increasing. According to the United Nations Department of Economic and Social Affairs (UNESA), more than 60% of the world's population will be living in cities by 2030 (UNESA 2014). Cities currently account for just 2.7% of the Earth's surface area (UNESA 2014), but they consume 75% of total energy, and emit 80% of greenhouse gas emissions, which have a cumulative negative impact on natural resources (Gret-Regamey et al. 2013).

Urban green infrastructures are becoming a common strategy in various parts of the world to overcome the challenges faced by this kind of fast urbanization and its impact. So that currently, the significance of urban green space in the cities has raised attention in many fields.

The advantages of urban green space have been widely reported in many literatures. Urban green spaces has benefits of ecological (Mohamed and Zhirayr 2013), social (Kaczynski and Henderson 2008), economic (Anguluri and Narayanan 2017), and planning benefits (Attwell 2000; Baycan-Levent and Nijkamp 2009). The links between green space and health have been summarized in many publications (Hartig et al., 2014; WHO Regional Office for Europe, 2016). Many researches have revealed the social, psychological and health benefits of urban green space. Psychological relief and stress reduction, strengthened social stability and psychological connection to the home environment, immune system benefits, and increased physical activity

are all potential causal mechanisms contributing to public health benefits of urban green spaces. Ecosystem services such as reduced noise, air pollution, and excessive heat may also be provided by green space (Braubach, et al., 2017).

Green space in cities, particularly publicly accessible green space, has a substantial impact on the quality of life of city people and the environment (Baycan-Levent & Nijkamp, 2009). To ensure that urban green areas give a larger range of advantages to the urban system, certain criteria must be present, such as quantity or sufficiency, availability, and accessibility. According to the World Health Organization's recommendation (WHO, 2012), each inhabitant should have at least 9 m2 of green space within a 15-minute walk.

Sustainable and high-quality urban ecosystems are built on the foundation of urban green spaces. High amount of evidence shows that high-quality green spaces have significant economic, physical, and mental health benefits, as well as environmental benefits. (Paul Finch OBE, 2010). Green open spaces serve a variety of purposes and have many benefits in making cities and communities more sustainable. Good quality green open space promotes biodiversity, nature conservation, habitat and heritage, as well as improving the quality of life of the local community, and has been broadly classified into environmental/ecological, social, economic, and health benefits (Maimaitiyiming & Ghulam, 2014). Green infrastructure has a critical role to play in climate change adaptation and mitigation.

Since urban green space can create a healthy environment for all members of the urban community it is critical to ensure that public green areas are freely accessible to all population groups and that they are spread fairly around the city (WHO, 2017) Improving access to green spaces in cities is stated in the UN Sustainable Development Goal 11.7 as (“By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities”) (WHO, 2017).

Despite the many benefits that urban green spaces provide to communities, statistics show that they are declining in a number of cities around the world. The loss of urban green spaces is worse in developing countries than in developed countries. According to Adjei (2014), components of urban green spaces are decreasing at an alarming rate in many cities across Sub-Saharan African countries. Green spaces accounted up a modest percentage of the land mass in

several African cities, according to statistics and most of urban communities do not have access to these sites. According to studies, urban parks should be distributed in such a way that they are accessible to all urban communities within a reasonable walking distance (Jensen and Koch 2004; Nielsen and Hansen 2007). However, in African cities, the majority of urban residents do not have easy access to recreational parks within walking distance of their homes. Despite the fact that developing countries are home to the majority of the world's urban population, they are with little access of urban green spaces.

Ethiopia's capital, Addis Ababa, has been witnessing significant urbanization. The expansion of the city is significant societal shifts. Addis Ababa is one of Africa's most populous cities, although it is still badly constructed and administrated (Kumlachew, 2007). Over the last few decades, Addis Ababa's growing population has resulted in widespread detrimental exploitation of many natural resources. As the city has grown, public green spaces that should have been kept unoccupied have been converted (Tassew & Nair, 1970). Given the fact that the city proposed various components of urban green space during the previous two structural plan revision times, the city's current situation shows that there is no sufficient urban green space for city residents (Abeje 2007). According to Sileshi Azagew's (2020) investigation, parts of the city's urban green space are vanishing at an alarming rate, and their distribution is uneven throughout the city.

Addis Ababa, like many other cities, is under strain from resource scarcity, climate change, pollution, environmental deterioration, and health risks. A lack of response to these concerns will have immediate consequences (Mosissa et al, 2020). The capital city of Ethiopia is one of the cities with poor management and providence of green spaces. The green coverage is drastically decreasing as construction of buildings was undertaken in the expense of open and green areas (Abebaw, 2016). According to the Addis Ababa City Government Plan Commission, the city is rapidly losing its green cover (Mosissa et al, 2020)

The purpose of this research is to analyze the accessibility of recreational public urban green space in the city. Therefore, the overall objective of this study is to show the difference of accessibility between the existing and newly added urban green spaces. It compares the degree of accessibility of them in terms of different aspects. This is conducted by using different indicators of accessibility such as percentage, per capita and proximity.

This research is significance because of the contribution that it will make to the perception and awareness of the stake holders and communities that are concerned with the issue. The project is about analyzing the amount of recreational public green space found in the city and how much it is distributed. The area is important in a way that its contribution can be helpful to the adjustment of the policies and strategies that they have been following. It will insight the stake holders, to understand that taking action is crucial. This study will serves as a benchmark for policy and planning to ensure accessible and adequate urban green space in rapidly urbanizing city Addis Ababa.

1.2 Statement of the problem

Rapid urbanization and exponential population growth have created complexities in city management, of which green space management is one of them. In Ethiopia, as in many other African countries, urban green space components are gradually being converted to other urban land uses, and urban centers are experiencing issues such as green infrastructure component allocation that is not based on standards. The population of Addis Ababa is rapidly increasing. With this rapid population growth, the density of constructed spaces is increasing, housing is expanding, infrastructure is being developed, and industrial regions in the city's outskirts are being restructured.

It is also stated that Addis Ababa's urban forest and other green elements are distracting (Fetene and Worku 2013). Due to the city's high and rising density, as well as a lack of sufficient greening activities, the green coverage within the built-up area is also severely deteriorated. The amount of green space is decreasing rapidly as buildings are being constructed at the expense of open and green spaces. The scarcity as well as the inaccessibility is affecting different member of the society. For instance elders cannot access urban green space in walking distance. There are not enough places in the city for children, youth, and adults to play and relax in a safe atmosphere. The severity of the problem is such that the majority of the city's children are forced to play on the streets, putting them at a high risk of being victims of traffic crashes, poor street culture, and health issues and injuries. Adults cannot access recreational parks in which the situation is thought to be a contributing factor in widespread substance addiction and related societal issues.

The city has not enough recreational urban green space regarding the standard established both by internationally as well as nationally. Very few numbers of parks are provided for the city residents which make most of the population living without the access of recreational parks.

The findings from different literature reviews showed that both the availability and accessibility of different kind of urban green spaces are very low. It indicates that urban green space has very huge amount of service area gap for the city (Sileshi et al, 2020). But all this studies do not include the newly added recreational public urban green spaces. Therefore, this study focuses on comparing the existing recreational urban green space with the newly established ones in terms of accessibility. This research attempts to fill the gap that how the currently added parks affect the city in terms of accessibility and it shows how those added parks are affecting the entire city according to the placed standard by both nationally and internationally.

1.3 Research objective

1.3.1 General objective

The general objective of the study is to assess the comparative levels of accessibility of the existing and newly developed urban green space in Addis Ababa.

1.3.2 Specific objectives

The specific objectives of the study are to:

1. assess the comparative availability of existing and newly developed recreational public urban green space in Addis Ababa city;
2. evaluate the comparative physical accessibility of existing and newly developed recreational public urban green space in Addis Ababa; and
3. Explore service area gap of existing and newly developed recreational public urban green space in Addis Ababa city.

1.4 Research question

1. What is the comparative availability of existing and newly developed recreational public urban green space in Addis Ababa city?

2. What the comparative physical accessibility of existing and newly developed recreational public urban green space in Addis Ababa?

3. What is the service area gap of existing and newly developed recreational public urban green space in Addis Ababa city?

1.5 Scope of the research

Spatially, the study is conducted specifically in Addis Ababa city which is one of the largest cities in Ethiopia. It focuses on the existing and newly added urban green spaces. The UGS that are considered as newly added recreational public urban green spaces are UGS built and provided after 2020. Thematically, the study is conducted on the accessibility of the urban green space specifically with the purpose of recreational which can be accessed publically. It didn't cover other elements of urban green space.

1.6 Significance of the study

This study will have a very diverse significance for the city and its inhabitants. This research by applying the right research strategies and instruments explained the issues concerning green spaces accessibility in the city. The result of the study can be used by the other Federal Cities instead of duplicating efforts and resources. Planners and designers can use this research as a guideline to consider many accessibility aspects before providing new facilities. The municipal administration can utilize it to change policies and strategies related to urban green space. Furthermore, the study's findings contribute to scientific studies on green spaces by serving as a reference material. The study bridges those research gaps in green space accessibility in Addis Ababa.

1.7. Limitation of the study

The limitation of this study was that the study does not cover issues such as condition of the UGS, characteristics, quality, use and activity, infrastructures, management, status and public participation due to the time schedule given for the research and the financial resource provided was not efficient to cover these issues. However, it is strongly advised that these subjects to be taken into account in future research to strengthen the findings.

1.8 Organization of the Research

The research is organized into five chapters. Each chapter examines the content and data of the study. The main chapter in the research is further described as follows.

Chapter One: The introduction to the study illustrates the thesis by stating the general idea of the study, research problems, objectives, questions, significance, scope, description of the study area, and limitations during the research.

Chapter Two: The Literature Review chapter focuses on the description of theoretical and empirical issues relevant to the study's conceptualization. The goal of this chapter is to describe the key research topics, such as urban green space, availability, accessibility, service area gap and proximity. It is composed of a variety of works of literature that provide a theoretical foundation for understanding the subject matter under study from multiple angles.

Chapter Three: Material and methods is a chapter that discusses approach of the research. This chapter explains the materials and methods used for the study and the data collection process and analysis in detail. It consist the study area description, data sources, data collection, and data analysis methods, in particular.

Chapter Four: Result and Discussion is a chapter that reports the qualitative and quantitative data findings. It explains about data analysis, results and discussion of the study. The organized data is presented and interpreted in this chapter.

Chapter Five: Conclusion and recommendation is the last chapter of this research. This chapter drew conclusions based on the findings and discussions of different analysis. The chapter concludes with the results and discussions as well as recommendations for further studies are also given.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section of the research looks into the various literature on the subject in order to cover key facts and discoveries that have previously been uncovered by earlier researchers and several investigations in and around urban green space. This chapter is to give a general theoretical framework about urban green space and its types; related to this, it also presents facts of previous findings, ambiguity, and arguments about the concept that has been researched. In Addition, it explains more empirical concepts about benefits and effects of urban green spaces in the aspects of social, economic, health as well as psychological. It also covers about the general concepts of availability, proximity and service area gap of urban green space. It is divided in to theoretical and empirical literature review.

2.2 Theoretical review

2.2.1 Definition and concepts of urban green space

There is large literature on definitions of urban green spaces (UGS).According to Jim and Chen (2003), urban green spaces are outdoor areas with some vegetation that are primarily found in semi-natural settings. This includes urban elements like green walls, green parks, and green roofs that support biodiversity and connect urban, peri-urban, and rural areas, allowing ecosystems to function and supply services (Verd et al., 2020). All vegetated spaces, including trees, shrubs, and grasses, are defined as urban green spaces by Fam et al. (2008). Green spaces are natural places that provide a network of open spaces, air sheds, watersheds, wetlands, wildlife habitats, parks, and other amenities that support and enhance the quality of life. (Planning & Resources, 2017).

Urban green spaces are all of the vegetated areas found in cities. It is space in urban covered by vegetation of any kind which could be smaller green space features such as street trees and roadside vegetation, green spaces not available for public access or recreational use such as green roofs and facades, or green space on private grounds and larger green spaces that provide various social and recreational functions such as parks, playgrounds or greenways.

Urban green space is vegetation and water in cities. A single element (a street tree) or a set of elements (a park with lawns, trees, and ponds) can make up an urban green area, and its nature can be natural (a wetland), semi-natural (a canalized river), or manufactured (a park with lawns, trees, and ponds) (a green wall).While much of the apparent urban green space is public or belongs to the urban commons, there is also a significant amount of privately owned urban green space, such as house gardens. For pleasant, healthy, and resilient cities, a diverse, accessible, beautiful, and spatially balanced urban green area offer is essential (UN-Habitat in, 2011)

According to Alamrew (2002), an urban green space can be classified as formal or informal. Churches, mosques, embassies, cemeteries, parking lots, playgrounds, street gardens squares, private gardens, and vegetation in schools sports fields, protected public parks and hospitals are examples of formal green spaces (Mainardi, 2019). Agricultural lands, grazing lands, steeper degraded areas, forest areas, river valleys, reserved expansion areas, and shrub lands include informal green spaces.

Figure 1: Road Side Greenery

Source: U.S. Department of Agriculture, Forest Service. 2018

2.2.2 Types of urban green space

There are different kind and forms of urban green spaces. Open spaces, community parks, gardens and landscaped areas are some of the example of types of green space in the city (Vargas et al., 2018). Formal green space, informal green space, natural green space, public participation, children's space, active sports space, and recreation activities are all examples of urban green spaces. There are many different forms, structures, and shapes of urban green spaces (Vargas et al., 2018). Public parks, reserves, sports fields, streams, river banks, and other riparian areas, greenways, walkways, and trails, communal shared gardens, street trees and bushes, nature conservation areas, and less conventional spaces such as green walls, green alleyways, and cemeteries are all examples of urban green spaces, according to Roy et al. (2012).

One of the types of urban green space is which is used publically for recreational purposes are parks. According the definition of Sadeghian & Vardanyan (2015) Park is an area of natural, semi-natural, or planted space set aside for human enjoyment and recreation or the conservation of wildlife or natural habitats in their research of urban park history, classification, and functions.

Figure 2: Recreational public urban green space

Source: Danielle, 2019

2.3 Empirical review

2.3.1 The benefits of urban green space

A. Social benefits

Rather than only being places for pleasure and relaxation, urban parks have come to be seen as a vital aspect of urban and community development. It has been proposed that urban parks improve social cohesion by providing a location for social interactions (Van Herzele and Wiedemann, 2003).

The amount to which a geographical location achieves ‘community' in the sense of shared ideals, collaboration, and interaction is referred to as social cohesiveness (Beckley, 1995). Urban parks, for example, have the potential to be important because they provide opportunity for high levels of interaction between people of various social and ethnic backgrounds (Lofland, 1998). People must be able to meet and form relationships in order for local communities and social bonds to flourish (Völker et al., 2007). Interacting with others also encourages people to participate in society and fosters sentiments of acceptability (Putnam, 2000).

Over the last few decades, globalization has resulted in an increase in migration. As a result, some of the older, formerly more homogeneous nations are becoming increasingly multicultural (Krgrd, 2010). This has sparked debate about integration and social cohesiveness on the political level.

The majority of interpersonal interactions will take place in areas such as local recreation centers, schools, churches, and parks (Völker et al., 2007). When contrast to barren places, the presence of trees (and shade) and grass in communal spaces may lure residents to outdoor places, increasing possibilities for people to connect (Coley et al., 1997). Although various authors have emphasized the importance of urban parks in fostering social cohesiveness, empirical proof for many of these statements has been lacking. As a result, this section of the systematic review evaluates articles that give empirical evidence for the benefits of urban parks in terms of social cohesiveness.

Because of the simple access compared to other parts of a city, the majority of research believed that urban parks offer more potential for social inclusion than anywhere else. People are drawn to

urban parks because they offer recreational opportunities. When people participate in an activity that brings them together, such as organizing an event, cycling, or football, social cohesion improves.

However, the social connection that promotes social cohesion among people is primarily fleeting and consists of informal contacts. The majorities of people in the park either have a brief conversation with strangers or simply greet them, or they do not speak at all. The majority of visitors to the park do so with someone they know, such as friends or family members.

The majority of the researches were based on observations of how people interact in urban parks, or on interviews aimed at determining the purpose of social interaction and the meaning of behavior toward other park visitors. Only one study (Fan et al., 2011) employed variables to measure social cohesion, such as loneliness, dislike, and unfriendliness, and then developed models to explain the association between physical activity, social support, and stress. However, none of the articles analyzed demonstrated that urban parks can improve social cohesion based on compelling evidence.

Overall, it appears that the impact of urban parks on social cohesion has received little attention in the scientific literature since the year 2000. In conclusion, there is some evidence that parks improve social cohesion, although the evidence is weak due to the small number of research found and the poor quality of those researches.

B. Health and Psychological benefits

Green spaces improve public health by lowering health inequalities (Mitchell and Popham, 2008), boosting the effect of physical exercise (Mitchell, 2012), improving perceptions of life quality and self-reported overall health (Maas et al., 2006) and reducing stress and mental disorders (Ward Thompson et al., 2012). Indirect health impacts are imparted by offering various types of recreation (Weber and Anderson, 2010), boosting pleasure with one's living environment and social connections (Maas et al., 2009), and arenas and opportunities for physical activity (Coombes et al., 2010).

The majority of the papers included in this review utilized an observational cross-sectional study design, which means they used data from surveys or registers. Several researchers focus at

multiple health indicators. From the reviews, evidence of beneficial impacts for the direct health advantages for which we found included reduced obesity (Nielsen and Hansen, 2007), better mental health (Guite et al., 2006), quality of life (Hussain et al., 2010), stroke mortality (Hu et al., 2008), reduced stress (Hansmann et al., 2010; Korpela et al., 2010), reduced headache (Hansmann et al., 2007), psychological wellbeing (Hung and Cromption, 2006; Abkar et al., 2010), self-perceived health (Lafortezza et al., 2009), concentration capacity (Hussain et al., 2010), reduced Attention Disorder Hyperactivity Disorder (ADHD) – symptoms (Taylor and Kuo, 2009), reduced health complaints (Maas et al., 2009) and overall mortality (Takano et al., 2002a). There was also evidence for the following indirect health effects such as reduced noise (Gidlöf-Gunnarsson and Öhrström, 2007), reduced levels of the air pollutants NO_2 and $PO_{2.5}$ (Su et al., 2011), increased recreation, community attachment, and social support (Chen and Jim, 2008).

Comparative contexts for controlled investigations were used in only a few studies. Recreation centers, exercise facilities, and sports facilities were among the areas studied (Kaczynski and Henderson, 2007), with parks being found to be more effective in stimulating or increasing physical activity. Moreover, compared to parks, exercise and activity outdoor places, waterside locations, and urban woods had a stronger influence on stress levels and restorative experiences (Krenichyn, 2006). However, the former is a review research, whereas the later study was qualitative in nature, therefore offering more support for the proposed difference.

Distance, facilities and amenities, overall quality, park size and total tree canopy, species richness, time spent, and frequency of trips to the park were all factors that predicted health-related park use and activities. Several studies have also suggested that it is especially important for ethnic minorities, immigrants, and teenagers (Babey et al., 2008).

Overall, this analysis concludes that there is substantial evidence for parks indirectly enhancing health, particularly through increased physical activity. Another finding of the study is that access to parks can likely reduce obesity, which is a major global issue. This appears to be especially important for youngsters. The trend for the remaining claimed health benefits is good, and it could serve as a foundation for early recommendations, but additional research is required before evidence-based recommendations can be implemented.

C. Economic benefit

This section reviews a collection of articles about the economic function of urban green spaces. It mainly shows the economic benefit through tourism and increasing housing prices.

I. Through housing prices

Over time, various methods for assessing the economic value of nature have been investigated. Studying the impact of green spaces on property prices, particularly in an urban setting, is one way of indirectly appraising the economic value of these spaces.

The analysis by Brander and Koetse (2011) concluded that open spaces in general, as well as specifically parks generally raise the value of nearby properties, be it houses or apartments. The large majority of the other articles and studied confirm these picture, although the precise impact on property value ranges widely among cities and countries. As a result, when transferring results, vigilance is required. The same research compared urban parks to other types of green spaces, concluding that urban parks are more valuable than forests and agricultural lands, for example.

As the study of Hashino and Kuriyama (2010), held in one of Tokyo's wards, it was discovered that parks affect both property owners and renters. When a neighboring park was within 450 meters, they discovered a positive pricing effect (i.e. higher rents) in their analysis of 2370 residences. Increases were larger in medium-sized parks in particular. Although park size is important, studies show that even modest green areas can have a favorable impact. Kumagai and Yamada (2012) discovered that smaller green patches had a positive impact on land prices, though land prices increased proportionally with larger green patch coverage ratios.

In conclusion, according to this quality evaluation, there is moderate to strong evidence that urban parks have a beneficial impact on the value of neighboring property (houses, flats, and land), while it is crucial to keep in mind the limits of hedonic pricing methodologies, which are used in the vast majority of studies. Other sorts of green spaces have less of an impact on property values than parks. The good influence is related to recreational opportunities as well as views of the parks. Positive impacts increase with proximity to the park and decrease rapidly as distance from the park increases. However, there are times when parks have a negative impact, such as when crime, noise, or light pollution is present. Furthermore, because of the wide range

of local conditions, it is difficult to generalize specific price increases, such as those related to distance.

II. Through tourism

Urban parks serve more than just as a leisure space for locals. These green places will also be used by visitors from outside the city. In certain situations, particularly well-known parks, such as Central Park in New York, are major tourist destinations in and of themselves.

Green spaces, such as an urban forest, can play an essential role in drawing tourists to urban areas, according to the authors, by boosting the appeal of cities and serving as a complement to other urban attractions (Majumdar et al., 2011). According to Wu et al. (2010), there has been growing interest in urban ecotourism, which is described by the Urban Ecotourism Conference in 2004 as nature travel and conservation in a city context. Many Asian island regions, notably Singapore and Hong Kong, have actively pushed urban ecotourism and blended it with urban tourism, owing to their geographical constraints.

In conclusion, there are some indicators that urban green spaces such as parks provide tourism benefits, although the evidence is weak due to the small number of research found and the poor quality of those studies. The visitor sample in Hong Kong, for example, was quite small and non-representative. Majumdar et al. (2011) Savannah, Georgia, was the only researchers to look into the economic effects of parks on tourism. Although this study's evidence outperforms that of the others, the difficulty is that the findings aren't restricted to urban parks, but rather to the city's entire "urban forest". This form of contingent valuation study is likewise heavily influenced by the local (economic) context.

2.3.2 Provision of urban green space

Because of the importance of urban green space for human well-being and the long-term development of urban environments, standards for urban green space provision have been developed in both developed and developing cities. The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) recommend that each urban person have access to at least 9 m of urban green space (Kuchelmeister, 1998). Developed countries, on the other hand, have boosted their minimal standard to 20 m2 of urban green space per city person (Wang,

2009). Similar quantitative standard for the provision of urban GI components have been created in developing nations.

In Ethiopia, the Addis Ababa municipal master plan also proposes recreational park requirements based on park size. Accordingly, a city park should be 10 ha or more, a sub-city park should be 1-10 ha, a woreda park should be 0.3 to 1 ha, and a neighborhood park should be 0.1 to 0.3 ha. Furthermore, Ethiopia's National Urban Green Infrastructure standard recommended 15 million public green open spaces within the city limits, with every citizen living within 500 meters of a public green open space with a size of at least 0.3 hectare (MUDH, 2015). Despite the fact that the standard has been proposed, they have never been applied in the city. (Girma, 2019)

Despite the fact that the quantitative criteria serve as a guide for the provision of urban Green infrastructure components, they have been criticized for failing to produce excellent urban Green space components (Pauleit et al., 2003) and providing bland urban green infrastructure components that people do not use (Wilkinson, 1985). According to studies, the rules simply prescribe a gross amount of urban Green infrastructure components and are silent on how those components are distributed within developed settings, resulting in 'park poor' urban areas and environmental justice issues (Sister et al., 2009). As a result, relying solely on quantitative requirements to provide sufficient urban green space components is problematic, and a qualitative standard is required.

2.3.3 Accessibility of urban green space

Fair access to green areas analyses are frequently focused on identifying green area deficiency districts, hence identifying target districts for greening and the creation of new green areas (Dai, 2011; Kimpton, 2017). Green space accessibility has been investigated in many contexts and with various accessibility methods (Rossi, Byrne, & Pickering, 2015) including Euclidean distance or network distances or travel times from people’s homes (Chang & Liao, 2011; Laatikainen et al., 2017).

Accessibility measures based on time are seen to be more accurate in defining human behavior than those based on distance (Salonen & Toivonen, 2013). Traveling to a green area depends on personal tastes and the type of green area, but in general, the closer a green area is to people, the more likely it is to be visited (the so-called "distance-decay" effect)(Rossi et al., 2015). The

correlations between distance and the likelihood of visits (i.e. distance-decay patterns) are typically different amongst modes of transportation (Iacono et al., 2010). The amount of time people are willing to spend getting to their destination is determined by the type of activities they want to do in the green space. As a result, it's critical to segregate the accessibility of different types of green areas and account for transport modes associated with different forms of recreation behavior when studying green area accessibility at the city level (Laatikainen et al., 2017).

A. Availability of green space

The per-capita availability and access to UGS are basic indicators of urban inhabitants' quality of life (UNFPA, 2007). The urban greens are becoming increasingly vulnerable as a result of increased urban sprawl, infrastructural development, land transformation, and conflicting land use (Anguluri & Narayanan, 2017). As a result of the research, it is possible to comprehend the supply side of UGS and, as a result, accommodate the demand for greens in the changing city structure observed in urban centers. The discovered gaps can be used to help design a development strategy that prioritizes public UGS provisions alongside other infrastructure priorities.

B. Physical accessibility of green space

Access to UGS is becoming one of the most important topics in sustainable urban development, particularly on areas like environmental justice and public health. This is mostly due to the increased awareness of the health and well-being benefits of UGS nowadays (Ward Thompson, 2011). Accessibility is defined differently by different people according on their unique requirements and objectives, although it is generally agreed that making UGS more accessible may benefit children, persons from poorer socioeconomic groups, and people with other mental/psychological illnesses. Physical accessibility is a measure of how easy it is to get to significant destinations in terms of distance

C. Service area gap of urban green space

In many literatures, usually, the service area gap is defined as the comparison of the existing provision of the UGS against the standards set in different scales, which is nationally as well as

internationally (Saito et al, 2019). Data derived from the availability and proximity data is compared with the national and international provision standards.

2.3.4 Urban green space in developing countries

Developing countries have a large task ahead of them in terms of the development and management of urban green space. In developing countries, the destruction of urban green space has been excessive (Wright & Nebel, 2002; Douglas, 2016). For example, studies in Nairobi, Kisumu, Freetown, Accra, Lagos, and Kumasi (Fuwape & Onyekwelu, 2011; Makworo & Mireri, 2011; Mensah, 2014) indicated severe depletion of urban green space, resulting in very low coverage of green areas in the landmass of several African cities. As a result, there are various deficiencies in both demand and supply for urban green space (Tuzin et al., 2002), and they are not appropriately exploited by city people (Chishaleshale, 2012).

The provision of high-quality urban green space in cities is rarely recognized in Sub-Saharan Africa (Djibril et al., 2012; Olaleye et al., 2013). Furthermore, the critical function of urban GI elements in African cities is still underappreciated in policymaking (Roberts et al., 2012). There is also a dearth of a suitable GI approach that fits well into the city's planning and governance framework (Herslund et al., 2017)

Similar issues have been reported in Ethiopia, which is one of the fastest-growing cities in Sub-Saharan Africa (Lamson-Hall et al., 2018). Cities now account for 16 percent of the population, up from 7.1 percent in 1994 (Lamson-Hall et al., 2018) and are expected to account for 60 percent by 2040 at the current annual growth rate of 3.5 percent (United Nations, 2014; Lamson-Hall et al., 2018). The repercussions of increased urbanization on the development of urban GI components are frightening. In Ethiopia, the majority of urban areas are unable to satisfy the WHO's proposed minimal criterion for urban GI component per capita, which is 9m2 (Ministry of Urban Development and Housing, 2015).

Some studies have been done about the status of urban green spaces in Addis Ababa. For example the research of Gebremeskel (2019), assessing the status of green spaces and green space participatory management in the city of Addis Ababa, revealed that there had already been a loss of 1621 hectares of green space. In comparison to the green space coverage in 1986, this accounts for 30% of the total. The remaining green spaces account for only 7% of the city's total

area (54 000 ha). The loss of green space from 1986 to 2014 was calculated using remote sensing image analysis and interpretation to detect land cover change.

A study done by Tassew and S. Nair (2013) regarding public green spaces in kolfe keraniyo sub city revealed that the study area's green spaces are largely used for unanticipated reasons, and some have been converted to other uses. It was discovered that they were utilized as a store and meeting place, as a consumer's association shopping center, as a car parking lot, and as waste disposal places, and that some of them had been converted, while others were used as a source of social friction. This could be due to physical and operational activities and qualities. Some of the green spaces were fenced off, with no activity taking place within. Other green spaces were used for wholly unforeseen functions, such as automobile parking, building materials storage, meeting locations, consumer associations' super markets, and in a few cases, as toilets.

The research called current status and management practice of urban green spaces in Addis Ababa by Gebre et. al, (2017), conclude that despite some notable gains in greening efforts, the city's green spaces are being threatened by rising urban density and irresponsible tree cutting. Lack of proper planning, implementation, monitoring, and evaluation of greening activities, a misunderstanding among decision-makers about the purpose of green areas and their relationship to other development spaces, a tragedy of the commons situation in which a resource that belongs to everyone is nobody's responsibility, illegal settlement, use of urban green spaces for illegal waste dumping and open toilets, and invasion of urban green areas by residential and/or commercial development.

The result of the study of Eyasu and Paolo (2021) showed that urban green space is disproportionately concentrated in residential land use regions, indicating that the distribution of urban green space is influenced by the variability of urban land use functions. As a result, a set of planning actions must be adopted in order to improve the composition and design of urban green space. The findings also found that, in comparison to outer sub-cities, Addis Ababa's inner sub-cities had a very low proportion of UGS that did not fulfill local or international standard.

Addis Ababa's public recreational parks are limited in number, small in size, and cover broad service areas was the finding of Seifu and Till (2021) study. Furthermore, they also discovered that they are dispersed around the city. Six out of ten sub-cities in Addis Ababa, where more than

70% of the city's residents live, have few parks. The three types of parks have a wide range of accessibility. City and Woreda Parks, as well as the city's outskirts, had notably poor accessibility.

The research of Sileshi and Hailu (2020), Accessibility of urban green infrastructure in Addis Abba City, attempted to indicate the difference of green infrastructure from 2003 to 2016. It also shows the challenges and constraints of urban green infrastructure.

2.4 Summary of literature

Overall, it may be concluded that there is evidence for a range of benefits of urban green spaces, i.e. that we have uncovered scientific evidence that parks contribute to human and social wellbeing. This can be either directly (for example by making us more physically active) or indirectly (by their great biodiversity boosting possibilities for outdoor experience and enjoyment). Parks have been shown to have favorable effects on property prices, biodiversity, physical activity and obesity reduction, and local cooling. As a result, these advantages serve as the most compelling, scientifically validated reasons in favor of urban green spaces. The evidence base is moderate for various health-related advantages, such as contributions to stress reduction and enhanced self-reported health and mental health; and indirect health impacts through reduced noise and cooling, as well as longer longevity. Therefore both quantitative and qualitative requirements should be fulfilled since both do affect the community's wellbeing. It is also found that Addis Ababa has decreasing amount of urban green space in some researches. The conceptual frame work of this study is the comparative accessibility, in terms of amount, per capita and proximity, of the existing and newly added recreational public urban green space.

2.5. Lessons Drawn from the Review and Research Gaps

Generally, the importance of urban green spaces and its accessibility for different group of peoples in many aspects are tremendous. Both availability and physical accessibility is important aspects considering the providence of the service. Even if it has this much advantage the issue is not given attention as much as it needs especially in the developing country cities'.

All of the above studies tried to cover the concerning status of different elements of urban green space in the city. The strength of thus studies was in general, they tried to address the challenges

of the urban green space in different aspects. But first, most of the study did not focus on one element of the urban green space only which is recreational public urban green space or in the case of Addis Ababa parks. They generalized every elements of urban green space as one. And second the degree of accessibility of the newly added recreational public urban green space was not covered. Therefore this study tried to focus on the comparative accessibility of existing and newly added recreational public urban green spaces.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Description of the study area

3.1.1 Location

The study area is Addis Ababa city, the capital city of Ethiopia, which is located in the center of the country and one of the largest urban centers in the Sub-Saharan Africa. The city is located between latitudes 8˚49'N - 9˚5'N and longitudes 38˚38'E - 38˚54'E which is situated in the foothills of the Entoto Mountains, spread across many wooded hillsides and gullies, cut through with fast flowing streams. It is surrounded by the regional state of Oromia. It is the largest city in the country and plays a central political, economic and symbolic role in Ethiopia. Constitutionally, Addis Ababa is a self-administered city, accountable to the federal government (Ezana, 2021).

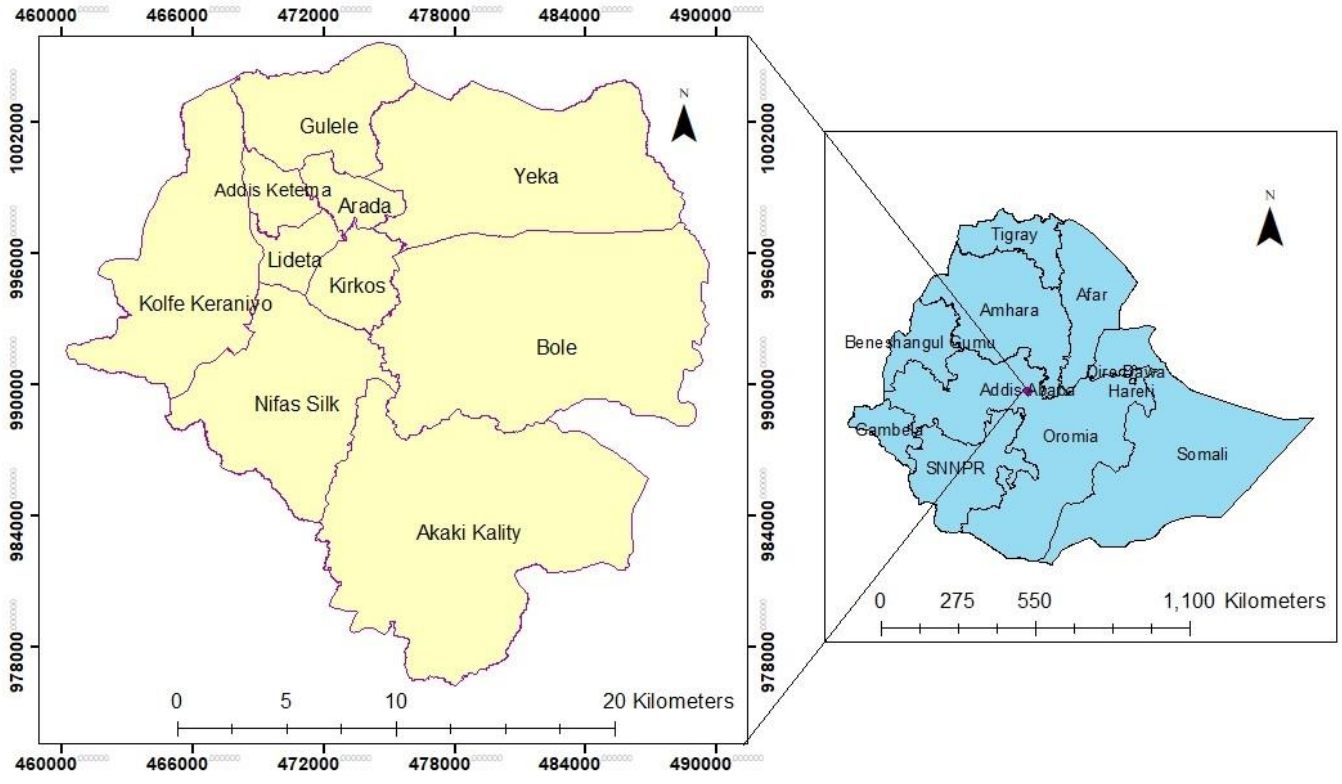

Figure 3: Location Map of the Study Area

3.1.2 Climate

The climate in Addis Ababa is subtropical highland, and monthly variations in precipitation are significant. The climate is warm and temperate while the summers are much rainier than the winters. The average annual temperature in Addis Abeba is 15.6 °C | 60.0 °F and precipitation is about 1874 mm | 73.8 inch per year.

The month with the highest relative humidity is August (87.04 %). The month with the lowest relative humidity is February (44.35 %). The month with the highest number of rainy days is July (29.00 days). The month with the lowest number of rainy days is December (1.67 days). The driest month is December with 7 mm | 0.3 inch of precipitation. The greatest amount of precipitation occurs in August, with an average of 419 mm | 16.5 inch. With an average of 17.2 °C | 63.0 °F, April is the warmest month. The lowest average temperatures in the year occur in December, when it is around 14.4 °C | 58.0 °F. The variation in temperatures throughout the year is 2.8 °C | 5.1 °F. The month with the most daily hours of sunshine is February with an average of 9.62 hours of sunshine. In total there are 298.29 hours of sunshine throughout February. The month with the fewest daily hours of sunshine in Addis Abeba is January with an average of 9.3 hours of sunshine a day. In total there are 288.44 hours of sunshine in January. Around 3114.25 hours of sunshine are counted in Addis Abeba throughout the year (table 1). On average there are 102.5 hours of sunshine per month. (Addis Ababa weather and climate, 2021)

Table 1: Average temperature and rainfall of Addis Ababa

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Avg. Tem (°C)	15.1	16.4	17.2	17.2	17	15.7	14.8	14.7	14.8	14.6	14.7	14.4
Min. Tem (°C)	8.3	9.5	10.9	11.4	11.3	10.8	11	11	10.2	8.3	8.1	7.8
Max. Tem(°C)	22.3	23.6	23.7	23.4	22.9	21.3	20	19.8	20.1	20.9	21.6	21.5
Precipitation / Rainfall (mm)	18	28	72	147	178	271	386	419	286	51	11	7
Humidity (%)	52	44	49	58	62	76	86	87	82	61	52	52
Rain days (d)	3	4	8	11	10	17	22	22	18	5	2	1
Avg.sun hours (hours)	9.3	9.8	9.6	9.5	9.3	7.8	6.1	5.9	7.1	9.3	9.6	9.3

Source (Addis Ababa weather and climate, 2021)

3.1.3 Population

Similar to other cities in developing countries, the population of Addis Ababa is increasing from time to time. The city's current population is based on estimations because Ethiopia last conducted a census in 2007. However, according to estimation of United Nations Population Projections (2021) its total population is 5,006,000 with an annual growth rate of 4.42 percent. According to this figure, Addis Ababa's population represents 3.6% of the country's total population and 18% of Ethiopia's urban population (fig. 4).

In terms of population, Addis Ababa is Ethiopia's most primitive metropolis. Its population is ten times greater than that of Adama, the town with the second-highest population. The estimate also indicates that there are somewhat more female residents than male residents. According to the estimate, 24% of the population is under the age of 15, indicating a young population. Since a few years ago, the city's proportion of young people has decreased, indicating low fertility that is below replacement level. Thus, the large migration to the city in search of employment and better education is the reason for the high population growth rate seen in recent years. Contrarily, the population of working age is fairly large in which 72% of the population is between the ages of 15 and 65 (Abnet et al., 2017).

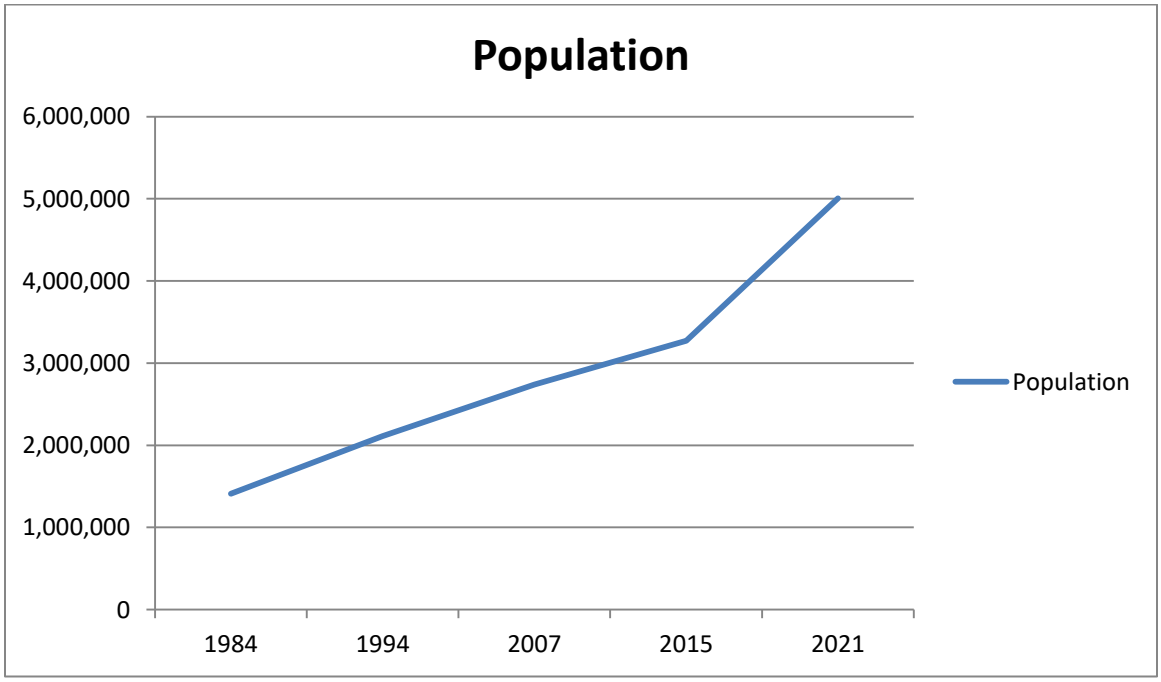

Figure 4: Population of Addis Ababa from 1984 to 2021 (CSA, 2021 projected)

3.2 Data collection and Data source

For mapping and analysis, many types of spatial and non-spatial datasets were gathered from various sources and processed using a variety of GIS tools and remote sensing techniques. This study used data from both primary and secondary sources, including both spatial and non-spatial data from actual fieldwork and secondary data. The table below lists the data required, the types of data utilized in the study, the formats, and where the data came from or the source of the data (Table 2).

Table 2: Data type and Data source of the study

No	Data Required	Data source	Data type	Data Format
1	Administrative boundaries of Addis Ababa	Addis Ababa city Administration	Shape file	Polygon
2	Boundaries of sub cities	Addis Ababa city Administration	Shape file	Polygon
3	Satellite image	Google Earth Pro 2021	Raster (.tiff)	
4	Road Network	Extracted from existing structural plan	Shape file	Polyline
5	Residential area of Addis Ababa	Extracted from UMT map	Shape file	Polygon
6	Layer of recreational public UGS	Extracted from Google Earth Pro and export it in to ArcGIS shape file	Shape file	Polygon
7	Access points of parks	Manually digitized by Field survey and extracted from Google earth pro and export it in to ArcGIS shape file	Shape file	Point
8	Population	CSA	Excel	-
9	Structural plan of the city	Addis Ababa city Administration	Shape file	Polygon

3.3 Software used

The software and materials utilized in this study were chosen based on their capacity to solve current problems while meeting the set objectives. Various software and materials were employed in order to fulfill the study's goal. As a result, Google Earth Pro was used to digitize road and park access points, as well as to check the exact location of green spaces. The ArcGIS 10.8 software package was also used to do network analysis, extraction, rasterization, intersection, reclassification, and factor map development**.** In table 3, each software and material is described in depth in terms of the research's goal and version.

Table 3: Software used

No	Materials	Version	Purpose
1	ArcGIS	10.8	➢ For data storing, managing and analyzing. ➢ For Network analysis ➢ Thematic map preparation
2	Microsoft Excel	2016	➢ Integrating attribute data and database file creation for event layer generation process
3	Handy GPS		➢ For point data collection of urban green areas
4	Google earth pro		➢ For checking and extracting the green area and to digitize it
5	Microsoft word	2016	➢ Compositing final thesis

3.4 Data Analysis Method

As La Rosa (2014) points out, accessibility is a broad phrase that is frequently "misused" and confounded with concepts like "mobility." Academics and urban researchers have long recognized accessibility as a multidimensional concept influenced by both spatio-physical and socio-personal aspects. In this study spatial accessibility based on quantitative standards was measured. In order to analyze the accessibility of urban green spaces in the city, several procedures were taken.

In order to show the difference in accessibility, the analysis was made for both existing and newly added recreational public UGS and the data was compared to each other. The recreational public UGS that was labeled as “existing” were considered UGS that was built and provided for users before 2020. And the recreational public UGS that was labeled as “newly added” were considered UGS that was built and are provided for users after 2020. In this analysis three parks that are found in two sub cities were considered as newly added recreational public UGS. Therefore, comparison was made for every analysis for both existing and newly added recreational public UGS.

The first analysis, which is availability of recreational public UGS, was done with two different indicators which were total amount and per capita. The total amount of the UGS was described in terms of both acreage and percentage. It shows how much percentage of total area is covered with recreational public UGS. It also analyzed the part of the city with low UGS and part of the city with better UGS. The per capita indicator shows how much UGS is available for every individual that is found in the city as well as in the sub city.

The physical accessibility in terms of proximity was the second indicator that was used to analyze its accessibility. The proximity indicator was used to analyze the area of service that the urban green spaces give. It also shows the amount of populations that are getting the access of the UGS within walking distance.

The third assessment that helps to understand the accessibility of the green space was service area gap. This method helped to give an understanding of how much is the city’s green space far behind the standards in terms of both national and international. It also shows the areas with very high deficiency and areas which need urgent measures to be taken.

3.4.1 Availability

The Normalized Difference Vegetation Index (NDVI) using satellite imaging data is a widely used tool for determining green space availability (Egorov et al., 2016). The NDVI method uses a satellite image to characterize vegetation, however it doesn't account for the various sorts of greens seen in the city (Anguluri & Narayanan, 2017). As a result, it's not appropriate for a study in which different types of greens are categorized based on their ownership and accessibility characteristics. Therefore the following analysis was made

A. Amount of recreational public urban green space

To assess the availability of urban green space, a variety of indicators are used. One often used indicator is the amount of urban green space in terms of acres or percentage (Kabisch & Haase 2013; Yao et al. 2014). Based on the indicated indication, GIS has provided a handy technique for analyzing the states of the components of urban green space. Thus the total acreage of the recreational public urban green space is added and divided to the total area of the city and multiplied with 100.This bring out the percentage of UGS that is found in the city. Then percentage for each sub cities was also computed.

B. Per capita green indicator

Another analysis to quantify its availability is Per capita of UGS. Thus aggregate of urban park acreage available for the sub city was estimated using ArcGIS 10.8 "calculate geometry" tool to calculate park per capita. Then, based on the population of each sub city and the city, a per capita park index was calculated. The per capita green index was calculated using Equation 1 (Anguluri and Narayanan 2017).

$$APi = \sum_{i=0}^{n} \frac{GAi}{SPi} \quad \text{……Equation 1}$$

Where; GAi-refer to the park area and SPi-is a population which enjoys services within the boundaries of the sub-city i, APi- per-capita park index indicated the amount of parks available in a city for every inhabitant of the sub-city.

3.4.2 Physical Accessibility

Only urban green spaces with vegetation that are used for recreational purposes and serve various requirements of the urban community was considered in this analysis therefore only urban parks was considered in the analysis. Even though urban forest, agricultural land, river and riverbank green are significant element of urban green space, they are not taken into account since they do not qualify for the recreational purpose of urban green space in Addis Ababa, and their current statuses are very unsuitable for recreational usage.

A Geo-spatial database, such as Arch GIS, is required for the spatial accessibility analysis of urban parks. Administrative boundary shape file, layer of recreational public urban green space, and access points of UGS were among the data types utilized to create the database. The city's road network shape files, as well as population density data, was employed in the research.

In this study, urban green space accessibility (spatial accessibility) is objectively quantified using quantitative standards which is called proximity indicator (Lahoti et al. 2019; Barbosa et al. 2007). The methodology for assessing data in the indicator is described in full below.

Proximity indicator

To measure the proximity of recreational public UGS to the residential areas Network distance was used in ArcGIS. This method is an indicator that was modeled in GIS to measure the fraction of the population with and without access to urban green areas (Nicholls 2001). Planners have been able to develop some fundamental concepts about citizens' willingness and capacity to walk to the neighborhood park as a minimal level (Nicholls 2001).

To determine the fraction of residential regions within the service area polygons, many methods were used. First, using the network analyst's tool, polylines of roads were integrated in ArcGIS 10.8 and saved as aggregated road routes. The aggregated transport routes were then used as an input layer in the network dataset. Park entrances (access points) were used as facility inputs, and radiuses of 800m and 400m (Azagew and Worku, 2020) from the Parks entrances (access points) were used as impedance.

Different literatures used different distance standard for calculating service area for UGS (Nicholls 2001). Therefore this study selected and used comfortable amount of walking distance for different age groups for a daily use which is considered as 400m and 800m distance.

UGS' service area polygons were also clipped at the sub-city level. The disparities between the residential areas inside the service area polygon and the total residential area of the sub-city were used to calculate the proportion of residential areas within UGS service area polygons at the sub-city level. The number of residents living outside the park service area polygons was calculated by multiplying the percentages of residential areas outside the service area polygons by the sub-total city's population.

3.4.3 Service area gap

In this analysis the data produced from the availability and proximity data is compared to the standard set by Ethiopia UGIS (Azagew and Worku, 2020) and WHO (2016). The standard set by WHO (2016) was $9m^2$ UGS for every individual living in the area and the standard sset by Ethiopia UGIS was $15m^2$ UGS for each individual.To calculate the service area gap UPs in the city Eq. 2 was used (Anguluri and Narayanan 2017).

$$GAg = (Np - Api) \times P \quad \text{.....Equation 2}$$

where; GAg-shows a shortage area of the park, P- Population number of the region, NP-denotes the international or national standard and APi-per-capita park index indicated the amount of parks available in a city and sub city for every inhabitant of the sub-city.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1. Result

4.1.1 Comparative availability of existing and newly developed recreational public urban green space

The availability of efficient green space in the city is the main concern of the modern world now days. So knowing the quantity of recreational public UGS available for the city's resident and the percentage that it covers from the total area will give some image about its availability. The availability indicator of UGS here is identified as acreage and percentage of the UGS found in the city as well as the per capita of UGS.

I. <u>Amount</u>

The total amount of recreational public UGS found in the city as well as each sub city is described as acreage and percentage that it covers. This is calculated by adding each green spaces and dividing them by total area of the city as well as sub city times 100.

A. Amount of existing recreational public urban green space

The total amount of existing recreational UGS in the city is 168.7 hectare which is 0.32% of the total area of the city. The sub city with high recreational public UGS is Bole, Arada and Kirkos with total area of 36.4ha, 30.6ha and 27.8ha respectively. The sub city with the lowest green space is Akaki Kality, Lideta and Kolfe keraniyo with the total area of 5.8ha, 6.5ha and 7.4ha respectively (Table 4).

Table 4: Amount of recreational public UGS in terms of acreage and percentage

Sub-city	Total Area(m^2)	Area of parks (m^2)	% of parks
Adis Ketema	8,638,853	-	-
Akaki Kality	123,455,172	58,845	0.05
Arada	9,499,376	37,320	3.2
Bole	118,472,112	4372	0.3
Gulele	31,193,194	182,297	0.6
Kirkos	14,645,876	278,315	1.9
Kolfe keraniyo	63,492,540	74,297	0.12
Lideta	9,177,843	65,252	0.7
Nefas Silk	62,078,558	264,438	0.4
Yeka	86,130,129	93,942	0.1
Total	526,783,653	1,687,791	0.32

Source: (Azagew and Worku, 2020)

B. Amount of newly added recreational public urban green space

The amount of newly added UGS is the total area of UGS that has been added currently in terms of acreage and percentage. So sub cites with newly added recreational UGS are only Gulele and Arada (fig 4). Other sub city has no new providence of green space. The sub city with high acreage of newly added recreational public UGS is Gulele with total area UGS of 560ha. The second sub city with newly added recreational public UGS is with the total area of green space of 65ha. UGS of Arada makes 6.8% of the sub city's total area and in the case of Gulule it also comprises 18% of the sub city's total area. This was calculated by dividing total area of UGS of the sub city divided by total area of their respective sub city multiplied by 100.

Therefore total amount of newly added recreational parks UGS in the city is 625 hectare. This comprises 1.2% of the total area of the city as calculated by dividing the summation of newly added UGS by the total area of the city multiplied by hundred. It also makes 15.4% of the total area of the two sub cities, Arada and Gulele as calculated by dividing the summation of newly added UGS by the total area of the two sub cities and multiplying it with hundred (table 4).

The total current UGS of Arada and Gulele sub city is 95.6 and 578.2 hectare respectively. This will make it 10.1 % and 18.5% of the total area of their respective sub cities respectively, which is found by dividing total current UGS by area of their respective sub city multiplied by hundred. Currently the two sub cities have 673.8 hectare UGS including both previous and newly added UGS in the two sub cities. This will make 16.6% of the two sub cities total area. This is calculated by dividing total area of current UGS in the two sub cites divided by total area of the two sub cities multiplied by hundred (table 5).

Totally the city has 793.7 hectare of UGS currently including all the previous and newly added UGS in all sub cities (table 5). This is 1.5 % total area of the city as calculated by dividing total current UGS by total area of the city times hundred.

Table 5 Amount of recreational public UGS in terms of acreage and percentage

Sub City	Total area (m^2)	Previous UGS(m^2)	Newly Developed UGS(m^2)	% Newly Developed UGS	Current Total UGS(m^2)	% of current total UGS
Arada	9,499,376	306,405	650,000	6.8	956,405	10.1
Gulele	31,193,194	182,297	5,600,000	18.0	5,782,297	18.5
Selected SC Total	40,692,570	488,702	6,250,000	15.4	6,738,702	16.6
City total	526,783,653	1,687,791	6,250,000	1.2	7,937,791	1.5

C. Comparison of the existing and newly added recreational public urban green space

In terms of acreage the newly added recreational UGS has a very big difference in total area. The new one contributes up to 625ha while the existing one was only 168.7ha. But in terms of distribution the newly added UGS are mostly accumulated in the central and northern part of the city which is limited only to two sub cities while the existing one is scattered all over the city except for one sub city, which is Adis Ketema (fig. 5).

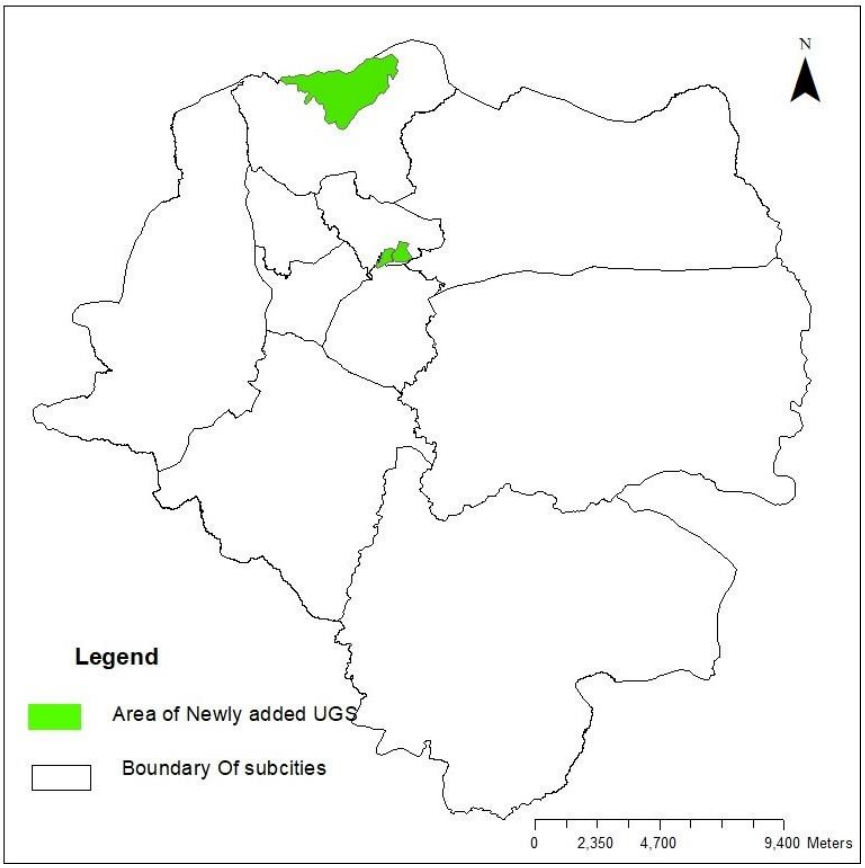

Figure 5: Area of newly added recreational UGS

II. Per Capita

The World Health Organization (WHO) recommends a minimum of $9m^2$ UGS for each person (UN-Habitat, 2013); however, green space availability per capita varies globally. In Ethiopia the standard for urban green space for each person is $15m^2$. Per capita of UGS is the amount of UGS available for every individual. This is calculated by dividing the area of UGS by the total population of the city. It is also identified for each sub cities.

A. Per capita of existing recreational public urban green space

The result of the per capita of UGS for the city is $0.37m^2$ for each person. The sub city with high per capita is Arada, Kirkos and Gulele with $0.86m^2$, $0.75m^2$ and $0.41m^2$ respectively for each person. Kolfe keraniyo, Yeka and Lideta have the smallest per capita which is $0.10m^2$, $0.16m^2$and $0.19m^2$ respectively for each person (Table 6). Sub city wise park per capita map of the city is shown in the below (fig. 6).

Table 6: Per capita of urban parks

Sub-city	Total population	Per capita (m^2)
Adis Ketema	428,051	-
Akaki Kality	303,842	0.2
Arada	354,515	0.86
Bole	517,933	0.7
Gulele	448,588	0.41
Kirkos	370,830	0.75
Kolfe keraniyo	718,908	0.10
Lideta	338,109	0.19
Nefas Silk	530,150	0.5
Yeka	581,074	0.16
Total	4,592,000	0.37

Source: (Azagew and Worku, 2020)

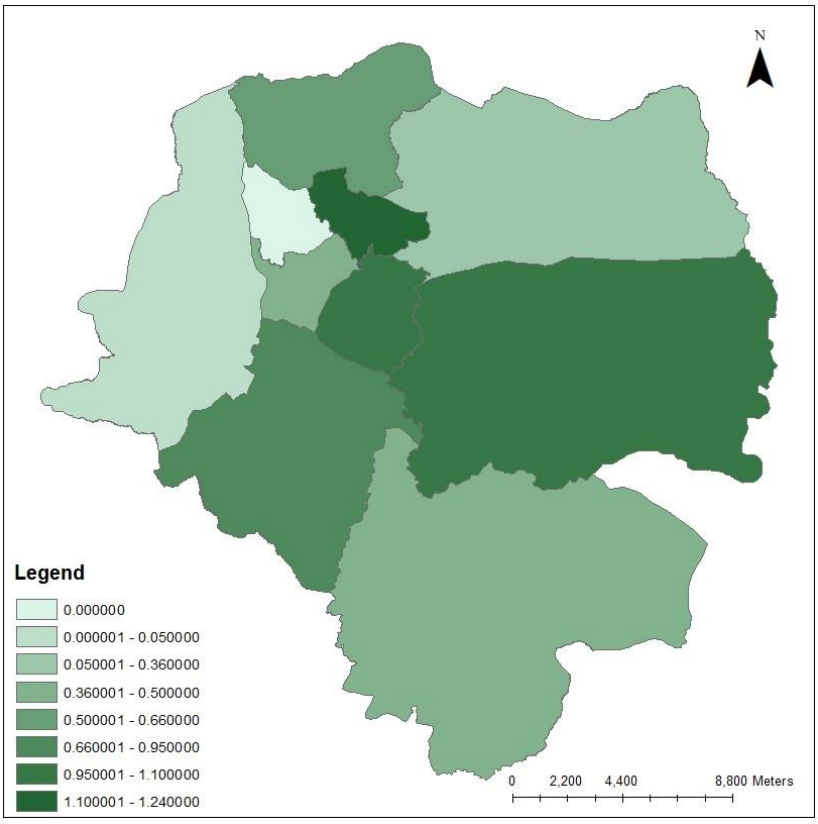

Figure 6: Sub city wise park per capita map

B. Per capita of newly added recreational public urban green space

Per capita of urban green space is the amount of area of green space provided for every individual residing in the specific area. This could be computed as the city level as well as the sub city level. Thus it is calculated by dividing the summation of the area of all urban green spaces found in the specific area by its total population size of that specific area. The population of 2021 was used to show the per capita of the city.

The sub city of Gulele has huge amount of recreational public UGS for every individual living in the sub city which is up to 11.8m^2 and the sub city of Arada has 1.7m^2 areas for each individual inhibiting in the sub city (table 7). This is calculated by dividing the sub cities UGS area by their respective sub cities' population size. Then the summation of the two sub cities newly added UGS contributes 7.3m^2 for both sub cities as calculated by dividing the summation of the two sub cities newly added UGS by population of the two sub cities. Thus the summation of the two sub cities newly added UGS divided by the total population of the city gives 1.2m^2 UGS which is the per capita of the city.

The total current per capita of Arada makes 2.5m^2 and Gulele makes 12.2m^2 for their own sub cities. This is calculated by adding both previous and newly added UGS in each sub cities and dividing it with its own population size. In other hand the per capita of the summation of current UGS of the two sub cities makes 7.9m^2 for both sub cities and 1.6$m^2$for the whole city. This is calculated by dividing the summation of current UGS of both sub cities by the summation of the two sub cities' population and the population of the whole city.

Table 7: Per capita of newly added recreational public UGS

Sub-city	Total Population	Previous UGS(m^2)	Newly Developed UGS(m^2)	Per capita of Newly developed UGS	Current Total UGS(m^2)	Per capita of current total UGS
Arada	377,365	306,405	650,000	1.7	956,405	2.5
Gulele	475,657	182,297	5,600,000	11.8	5,782,297	12.2
Selected SC Total	853,022	488,702	6,250,000	7.3	6,738,702	7.9
Total	5,093,083	1,687,791	6,250,000	1.2	7,937,791	1.6

C. Comparison of the existing and newly added recreational public urban green space

Regarding of per capita the newly added recreational public UGS boosts the city's per capita a little bit. It contributes up to $1.2m^2$ areas only by itself. For the sub city of Gulele, it has even greater amount than the standard set by WHO which is $9m^2$. But when we come to the existing recreational public UGS it has very low per capita for the city as well as for each sub cities which is less than one.

4.1.2 Comparative physical accessibility of existing and newly developed recreational public urban green space in Addis Ababa

Accessibility is a wide term that is frequently "misused" and mixed up with concepts like mobility. (La Rosa, 2014). The ability to approach something is referred to as access (El-Geneidy & Levinson, 2006). It's also known as the ease with which a site or service can be accessed (Gregory 1986). The proximity indicator measures the total area of the city that the UGS gives service for and the number of persons within a certain distance of each GS and weights them according to their distance from the gravitational model. The distance traveled from a recreational space to the nearest residential areas was modeled in GIS using Network analysis in this study to investigate accessibility of urban green space. This method is widely used to measure accessibility in which how much area does the UGS give service for and proportion of population having access to the service.

In order to perform proximity indicator analysis, several data was extracted, inputted and analyzed. First, the projected population of Addis Ababa was used and population density was calculated for each sub city and population density map was made (fig 8). Second, using filed survey, GPS point data of access points of recreational public UGS was gathered and manually digitized and these data was used as an input in point data form in to ArcGIS (fig 7). Polygon shape file of boundary map of Addis Ababa and each sub city was also used as an input in to ArchGIS. Then, using ArcGIS the network data set was created using polyline of road map of Addis Ababa which created aggregates route of roads (fig 8).

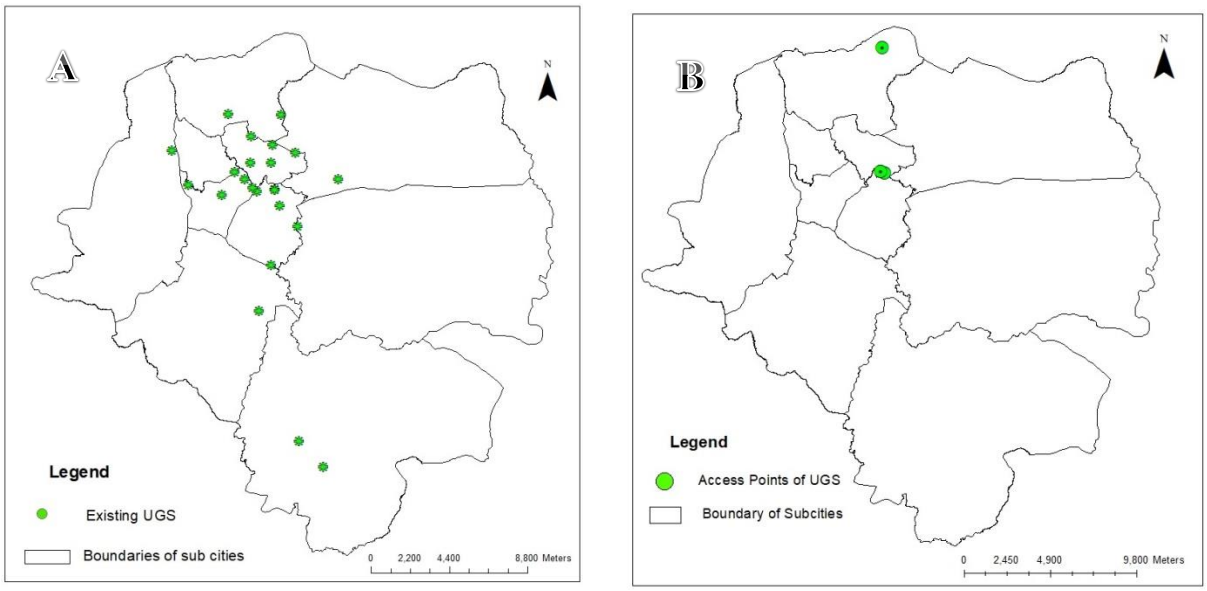

Figure 7: Access Points of A) Existing and B) newly developed recreational UGS

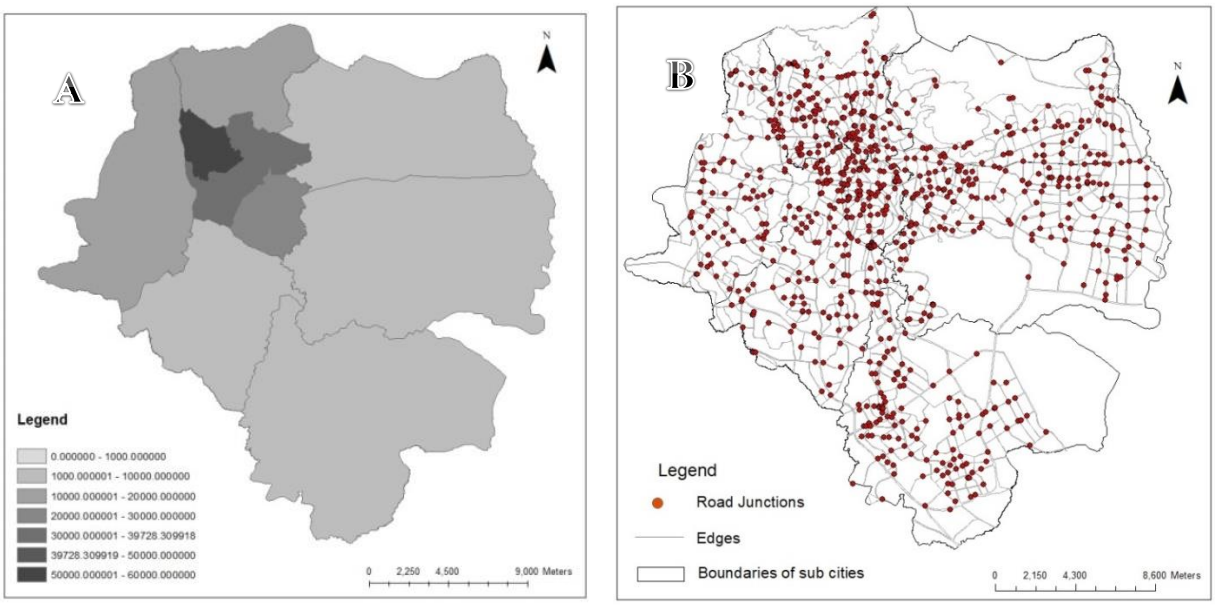

Figure 8: Map of A) Population Density and B) Aggregated road route

A. Proximity Indicator of existing recreational public urban green space

The distance parameter for the proximity indicator is derived from international standard in which 400 and 800 meter is used which is considered as effective walking distance from the facility (Nicholls, 2001).

I. Service area

The results showed that the total service area of existing recreational public UGS with 400m covered 3,234,458m^2 and with 800m covers 18,830,983m^2. This means 0.6% and 3% of the total area in 400 m and 800 m respectively (Table 8 & 9).

When we come to sub cities, the service area within 400 m Lideta, Kirkos and Yeka had the largest service area with 851,670m^2, 685,111m^2 and 456,339m^2 respectively. The subcities with the lowest service area within 400m were Bole, Adis Ketema and Nefas Silk with 39,986m^2, 54,293m^2 and 181,614m^2.In addition, the percentage of service area for the sub cities ranges from 9.3% which is Lideta to 0.2% which is Akaki Kality.

Table 8: Service area within 400 meter

Sub-city	Total Area(m^2)	Service area(m^2)	Service area %
Adis Ketema	8,638,853	54,293	0.7
Akaki Kality	123,455,172	204,569	0.2
Arada	9,499,376	291,999	3.0
Bole	118,472,112	39,986	0.03
Gulele	31,193,194	242,988	0.8
Kirkos	14,645,876	685,111	4.7
Kolfe keraniyo	63,492,540	222,503	0.4
Lideta	9,177,843	851,670	9.3
Nefas Silk	62,078,558	181,614	0.3
Yeka	86,130,129	456,339	0.5
Total	526,783,653	3,234,458	0.6

Source: (Azagew and Worku, 2020)

The largest service area with 800m was 3,110,300m^2, 3,025,964m^2 and 1,605,533$m^2$for Lideta, kirkos and Arada respectively. Subcities with lowest service areas like Bole, Adis Ketema and Akaki Kality had 220,054m^2, 725,624m^2 and 886,737m^2 respectively. Moreover, the percentage ranges from 33.8% for Lideta to 0.2% for Bole (table 9).

Table 9: Service within 800m

Sub-city	Total Area(m^2)	Service area (m^2)	Service area %
Adis Ketema	8,638,853	725,624	9.8
Akaki Kality	123,455,172	886,737	0.8
Arada	9,499,376	1,605,533	16.2
Bole	118,472,112	220,054	0.2
Gulele	31,193,194	1,387,861	4.6
Kirkos	14,645,876	3,025,964	20.6
Kolfe keraniyo	63,492,540	891,915	1.5
Lideta	9,177,843	3,110,300	33.8
Nefas Silk	62,078,558	1,353,737	1.9
Yeka	86,130,129	2,691,543	3.1
Total	526,783,653	18830983	3.0

Source: (Azagew and Worku, 2020)

II. Population served

Served population means the number of population that with in a distance of 400m and 800m from the UGS. This means the number of peoples who get the service of the UGS with in fair amount of walking distance.400m and 800m was chosen because of the above reason. It was computed

The total population served was calculated by multiplying the service areas of recreational public UGS of the city by population density of the area. The result showed that 158,065 populations were served with in the 400m service area and 520,957 populations were served with in 800m. This means only 3.1% of the total population is served within 400 m service area and 11.3% of the population is served with in 800m service area.

Additionally, Within 400 m service area the sub cities with high served population were Lideta, Kirkos and Yeka with a population of 68,965, 17,064 and 10,820 respectively. Bole, Akaki Kality and Adis Ketema were sub cities with lowest population served with 1004, 1098 and 1802 respectively. The percentage of the population with 400m service area served ranges from 20.4% for Lideta to 0.2% for Bole (table 10).

Table 10: Population served within 400m

Sub-city	Total population	Population served	Population served %
Adis Ketema	428,051	1802	0.4
Akaki Kality	303,842	1098	0.4
Arada	354,515	10,781	3.0
Bole	517,933	1004	0.2
Gulele	448,588	6007	1.3
Kirkos	370,830	17,064	4.6
Kolfe keraniyo	718,908	6819	0.9
Lideta	338,109	68,965	20.4
Nefas Silk	530,150	2023	0.4
Yeka	581,074	10,820	1.9
Total	4,592,000	158065	3.1

Source: (Azagew and Worku, 2020)

Within 800 m service area the sub cities with high served population were Lideta, Kirkos and Yeka with a population of 224,717, 71,538 and 60,234 respectively. Bole, Akaki Kality and Nifas silk were sub cities with lowest population served with 5513, 4643 and 13,627 respectively. The percentage of the population served ranges from 66.5% for Lideta to 1.1 for Bole (table 11).

Table 11: Population served with in 800m

Sub-city	Total population	Population served	Population served %
Adis Ketema	428,051	22,734	5.3
Akaki Kality	303,842	4643	1.5
Arada	354,515	56,536	15.9
Bole	517,933	5513	1.1
Gulele	448,588	36,291	8.1
Kirkos	370,830	71,538	19.3
Kolfe keraniyo	718,908	25,126	3.5
Lideta	338,109	224,717	66.5
Nefas Silk	530,150	13,627	2.6
Yeka	581,074	60,234	10.4
Total	4,592,000	520,957	11.3

Source: (Azagew and Worku, 2020)

B. Proximity Indicator of newly added recreational public urban green space

I. Service area

Service area of urban green space is the total area that the given UGS covers to provide accessible service within walking distance in this case, 400m and 800m. This means it is the amount of area that the UGS give service for the peoples who resides in the area with in 400m and 800m from their residence to the facility by walking using their near streets. It was computed using Network distance in ArchGIS as explained in details in the methodology part.

The distance 400m and 800m was chosen because according to many researches and since this study has focused on daily services of UPs within walking distance, the two distances were applied, while the former is a comfortable distance for walking from the residence to the facility and the latter is a little bit long, but still acceptable for most adult people (Azagew and Worku, 2020).

The results showed that the service area of the newly developed UGS with in 400m is totally 109,398m^2 with the sub city of Arada 73,999m^2 and Gulele 35,399m^2 (table 12). This covers only 0.02% area of the total city and 0.27% area of the summation of the two sub cities, Arada

and gulele. This is calculated by dividing the summation of service area of both sub cities by the city's total area and the summation of the area of the two sub cities respectively.

Therefore currently the total service area of UGS in 400m including both previous and newly added are 365,998m^2 for the sub city of Arada and 278,387m^2 for the sub city of Gulele. This covers 3.9% and 0.9% of the total area of the sub city of Arada and Gulele respectively as calculated by dividing the current total service area of UGS of the sub city by the total area of the sub city. So the two sub cities' service area of UGS currently contributes 644,385m^2 totally which make 1.6% of the total area of the summation of the two sub cities. This is calculated by dividing the summation of the both previous and newly added service area of Arada and Gulele by the summation of the total area of the two sub cites.

Thus currently the total service area of UGS in 400m including both previous and newly added found in the city of Addis Ababa is 3,343,856m^2 (table 12). This includes the summation of total service areas of previous UGS of the city as well as newly added service area of the city which consist both sub cities, Arada and Gulele. This covers 0.6% of the total area of the city as calculated by dividing the total current service of the city with in 400m by the city's total area.

Table 12: Service area within 400 meter

Sub-city	Total Area(m^2)	Previous service area (m^2)	Newly Developed service area (m^2)	Newly developed service area %	Current Total service area (m^2)	Current total service area%
Arada	9,499,376	291,999	73,999	0.77	365,998	3.9
Gulele	31,193,194	242,988	35,399	0.11	278,387	0.9
Selected SC Total	40,692,570	534,987	109,398	0.27	644,385	1.6
Total	526,783,653	3,234,458	109,398	0.02	3,343,856	0.6

On the other hand, with in 800m results showed that the service area of the newly developed UGS is totally 509,510m^2 with the sub city of Arada 383,105m^2 and Gulele 126,405m^2 (table 13). This covers only 0.09% area of the total city and 1.3% area of the summation of the two sub

cities, Arada and gulele. This is calculated by dividing the summation of service area of both sub cities by the city's total area and the summation of the area of the two sub cities respectively.

Thus, currently the total service area of UGS in 800m including both previous and newly added are 1,988,638m^2 for the sub city of Arada and 1,514,266m^2 for the sub city of Gulele. This covers 20.9% and 4.9% of the total area of the sub city of Arada and Gulele respectively as calculated by dividing the current total service area of UGS of the sub city by the total area of the sub city. So the two sub cities' service area of UGS currently contributes 3,502,904m^2 totally which make 11.2% of the total area of the summation of the two sub cities. This is calculated by dividing the summation of the both previous and newly added service area of Arada and Gulele by the summation of the total area of the two sub cities (table 13).

Therefore, currently the total service area of UGS in 800m including both previous and newly added found in the city of Addis Ababa is 19,340,493m^2 (table 13). This includes the summation of total service areas of previous UGS of the city as well as newly added service area of the city which consist both sub cities, Arada and Gulele. This covers 3.7% of the total area of the city as calculated by dividing the total current service of the city with in 800m by the city's total area.

Table 13: service area within 800 meter

Sub-city	Total Area((m^2))	previous service area (m^2)	Newly developed service area (m^2)	Newly developed service area %	Current Total service area (m^2)	Current total service area%
Arada	9,499,376	1,605,533	383,105	4	1,988,638	20.9
Gulele	31,193,194	1,387,861	126,405	0.4	1,514,266	4.9
Selected SC Total	40,692,570	2,993,394	509,510	1.3	3,502,904	11.2
Total	526,783,653	18,830,983	509,510	0.09	19,340,493	3.7

II. Population Served

Population served means the number of population that resides and gets service of the facility with in a fixed distance, in this case 400m and 800m. This means the number of peoples who get

the service of the UGS with in fair amount of walking distance. 400m and 800m were chosen because of the reason stated in the above. The number of residents living in the service area was calculated by multiplying the percentages of residential areas outside the service area polygons by the sub-total city's population.

The results showed that the population served by newly developed UGS with in 400m is totally 3,481 with the sub city of Arada 3,132 and Gulele 539 peoples (table 14). This covers only 0.06% of the total population of the city and 0.4% total population of the summation of the two sub cities, Arada and gulele. This is calculated by dividing the summation of population served of both sub cities by the city's total population and the summation of the total population of the two sub cities respectively.

Therefore currently the total served population of UGS in 400m including both previous and newly added are 14,608 for the sub city of Arada and 6,908 for the sub city of Gulele. This covers 3.9% and 1.5% of the total population of the sub city of Arada and Gulele respectively as calculated by dividing the current total served population of UGS of the sub city by the total population of the sub city. So the two sub cities' UGS currently provides service for 21,326 peoples totally which make 2.5% of the total population of the summation of the two sub cities. This is calculated by dividing the summation of the both previous and newly added served population of Arada and Gulele by the summation of the total population of the two sub cities

Thus currently the total served population of UGS in 400m including both previous and newly added found in the city of Addis Ababa is 178,794 (table 14). This includes the summation of total served population of previous UGS of the city as well as newly added served population of the city which consist both sub cities, Arada and Gulele. This covers 3.5% of the total population of the city as calculated by dividing the total current served population of the city with in 400m by the city's total population. (table 14).

Table 14: Population served within 400m

Sub-city	Total population	Previous UGS population served	Newly developed UGS population served	Newly developed population served %	Current Total population served	Current total population served%
Arada	377,365	11,476	3,132	0.77	14,608	3.9
Gulele	475,657	6,369	539	0.11	6,908	1.5
Selected SC Total	853,022	17,845	3,481	0.4	21,326	2.5
Total	5,093,083	175,313	3,481	0.06	178,794	3.5

The results showed that the service area of the newly developed UGS with in 800m is totally 17,160 with the sub city of Arada 15,233 and Gulele 1,927. This covers only 0.33% area of the total city and 2.0% area of the summation of the two sub cities, Arada and gulele. This is calculated by dividing the summation of service area of both sub cities by the city's total area and the summation of the area of the two sub cities respectively.

Therefore currently the total service area of UGS in 800m including both previous and newly added are 75,413 for the sub city of Arada and 40,408 for the sub city of Gulele (table 14). This covers 20.0% and 8.5% of the total area of the sub city of Arada and Gulele respectively as calculated by dividing the current total service area of UGS of the sub city by the total area of the sub city. So the two sub cities' service area of UGS currently contributes 115,821 totally which make 13.6% of the total area of the summation of the two sub cities. This is calculated by dividing the summation of the both previous and newly added service area of Arada and Gulele by the summation of the total area of the two sub cities.

Thus currently the total service area of UGS in 800m including both previous and newly added found in the city of Addis Ababa is 594,964. This includes the summation of total service areas of previous UGS of the city as well as newly added service area of the city which consist both sub cities, Arada and Gulele. This covers 11.7% of the total area of the city as calculated by dividing the total current service of the city with in 800m by the city's total area (table 15).

Table 15: Population served within 800m

Sub-city	Total population	previous UGS population served	Newly developed UGS population served	Newly developed population served %	Current Total population served	Current total population served%
Arada	377,365	60,180	15,233	4.03	75,413	20.0
Gulele	475,657	38,481	1,927	0.4	40,408	8.5
Selected SC Total	853,022	98,661	17,160	2.0	115,821	13.6
Total	5,093,083	577,804	17,160	0.33	594,964	11.7

C. Comparison of Proximity Indicator of existing and newly added recreational public urban green space

I. Service area

Even though the newly added recreational UGS had very large area individually, the proximity indicator analysis says the opposite. These UGS are small in number but high in area this makes them having small accessibility regarding proximity for both in 400m and 800m service area. This means these UGS gives service for few areas within 400m and 800m walking distance. In the other hand, the existing recreational public UGS cover relatively larger areas than the newly added recreational public UGS. Regardless of their small area, these UGS covers larger service area since they are scattered all over the city and have larger numbers of UGS relatively.

II. Population Served

Concerning the population served the proximity of the population living in 400m and 800m distance is lower for the newly added recreational public UGS than the existing one. Since the number of the newly added recreational public UGS has small number, which is three, they served relatively small population within both 400m and 800m distance.

However, the existing recreational public UGS gives service for large number of population within different sub cities. Sub cites with larger number of parks had high population served a larger number of population regardless of the size of the UGS. This is because the more the UGS are available in different places the more they are accessible with large number of population.

4.1.3 Service area gap of existing and newly developed recreational public urban green space

A. Service area gap of existing recreational public urban green space

The data produced from the availability and proximity data is compared to national and international standards in this analysis. The service area gap is highlighted by the gap between available UGS and standard established both by internationally as well as nationally. Based on these criteria, the overall existing UGS service area gap for the city's population was computed, yielding a 4,395ha service area deficit according from International standard and 7,451ha from National standard. The sub cities service area gap ranges from 531ha to 1,358ha from National standard and 307ha to 811 ha from International standard (table 16).

Table 16: service area gap

Sub-city	From WHO	From Ethiopian UGiS
Adis Ketema	-	-
Akaki Kality	395	664
Arada	307	533
Bole	455	785
Gulele	408	693
Kirkos	324	560
Kolfe keraniyo	811	1,358
Lideta	315	531
Nefas Silk	476	812
Yeka	498	836
Total	4,395	7,451

B. Service area gap of newly added recreational public urban green space

Service area gap is the difference of availability in terms per capita from international as well as national standard. It shows the level of deficiency in terms of green space that the city happen to have. The international standard was taken from the standard of WHO and the national standard was taken from Ethiopian UGI.

The result of overall service area gap of newly added recreational UGS for the city was 3,958.8ha service area deficit according from International standard and 7,523.9ha from National standard (table 16). But the recreational public UGS of Gulele had no deficiency according to the standard of WHO (2016). It even had additional 131.9ha of UGS. But the sub city called, Arada, has service area gap of 347ha regarding WHO standard.

Table 17: Service area gap from WHO standard

Sub-city	Previous UGS	Newly developed UGS	Current Total
Arada	309	274.6	243.9
Gulele	409.9	+131.9	+150.1
Selected SC Total	718.9	142.7	93.8
Total	4,415	3,958.8	3,789.9

Table 18: Service area gap from Ethiopian UGIS

Sub-city	previous UGS	Newly developed UGS	Current Total
Arada	573.1	538.8	508.1
Gulele	742.8	201	182.8
Selected SC Total	1,316	739.8	7,856.3
Total	8,100	7,523.9	7,355.1

C. Comparison of Service area gap of existing and newly added recreational public urban green space

The existing recreational public UGS had larger service area gap according to both of the standards since it contributes lower size of area to the city. Some of the sub cities were in a very serious deficiency state, but others were a little bit better than those. The newly added recreational public UGS contributes high amount of UGS to the city. It minimizes the deficiency in some amount.

4.2 Discussion

4.2.1 Availability of urban green space

Green spaces in cities have crucial environmental, social, and economic benefits. Green spaces and parks are extremely important for both ecological balance and individual wellbeing (Al-Ballaa et al, 2010). They have an important role in minimizing the harmful impacts of urbanization and increasing people's physical activity (Mytton et al, 2012). Urban green spaces are regarded as the city's green lung, and they often serve crucial purposes like as collecting precipitation and pollutants, as well as reducing urban heat. They can also have significant socioeconomic benefits, such as socialization and rest and reparation (Peschardt et al, 2012), as well as raising property prices (Lin et al, 2013). Green space is increasingly being used to assess the environmental quality and ecological viability of metropolitan areas (Gupta et al, 2012). In spite of that, the number and size of urban green areas are frequently insufficient in many cities, particularly in large and rapidly increasing cities such as developing countries.

Generally, spatial distribution and disparity of different elements of urban green space availability within the city at the sub-city level is quite distinct. Sub cities in the city's southern, eastern, and western portions had very low urban green space coverage, whilst sub cities in the city's northern half had comparatively high urban green space coverage. Since the topography of the northern part of the city such as Gulele and Yeka are more undesirable for settlement more green space availability is shown. This means the more settlement and expansion there is in a place the more activities and built up areas are going to exist. This will intern affect the existence and availability of natural surfaces such as green spaces. Most core districts are dominated by commercial land, and space is limited in these regions due to urban densification and inadequate, uneven, dispersed, and fragmented urban green space (Haaland and van Den Bosch, 2015). The inner part of the city like Lideta, Kirkos and Adis Ketema had very low urban green space availability. These sub cities are mostly covered with built up areas and high population density. Therefore there are no enough spaces for the green space in those areas.

In the other hand, the availability of recreational public UGS varies in the existing and newly developed UGS. The existing UGS are mostly dispersed and are found in many parts of the city while the newly added ones are concentrated in one area. But the newly added recreational

public UGS has a very large size compared to the sum of all existing recreational public UGS. In terms of the number, the existing ones have larger number than the newly added ones.

The newly added UGS have contributed additional 560ha to the city. Even though this number is not still enough to fulfill the city's demand, but it helps to enhance the deficiency in great amount since the new UGS is 8.6 times larger than all of the existing added together. Therefore generally, in terms of availability the benefit of the newly added recreational UGS plays an important role to the city.

Another indicator of availability is per capita of UGS. It is a key measure of a healthy urban ecology with more available green space implying better city livability (Jim, 2012). As per capita urban green space decreases, everyday exposure to more natural surroundings decreases (Barton and Pretty, 2010). Lower exposure to natural surroundings has been linked to obesity, diabetes II, and stress-related diseases like heart disease and mental illness (Mitchell and Popham, 2008).

The average UGS per capita in Addis Ababa was calculated and found to be $0.37m^2$ for the existing and $1.2m^2$ for newly added recreational public UGS. This is much far from the international as well as the national standard. Sub cities with high population density such as Lideta and Adis Ketema share a very less park per capita compared to less dense sub cities. Other sub cities with less population density has a better park per capita ratio but still it is very in sufficient for the population that is increasing tremendously.

Since the newly added recreational public urban green space has a wide size of area; it plays a great role in increasing the per capita of the city compared to the existing ones. However, the sum of both recreational public UGS does not qualify the amount of UGS required by the standard set by both nationally and internationally. Therefore, a great number of UGS are needed to be provided to fulfill the need of the city

Considering previous studies ratio of urban parks had shown moderate increase since it has been given a little more attention in this past few years. This helped the city to improve the status of the UGS better than before. But still in the city of Addis Ababa, more enough attention should be given to this section. Study by Richards et al. identifies that cities in developing countries has given less attention and effort than cities in developed countries.

4.2.2 Physical accessibility of green space

According to studies, park accessibility and use are influenced by park proximity, park size, and park quality, according to studies (Gupta et al., 2016; Rigolon, 2016). In order to perform physical accessibility analysis, proximity indicator was employed. This indicator was used because of the purpose and frequencies of visits to the green space are influenced by its proximity and the appropriate distribution of green spaces has an impact on their social significance (Chiari and Seeland, 2004). The European Environment Agency (EEA) proposes that individuals should have access to green space within 15 minutes of their homes, while English Nature (EN), a UK government agency, suggests that the distance to green space should not exceed 300 meters (Barbosa et al 2007). Toftager et al (2011) discovered that those who lived more than 1 km from green space had a lower likelihood of accessing green space to exercise and stay in shape than people who lived less than 300 meters away.

In the context of Addis Ababa for the accessibility analysis in this study, urban parks are type of urban green space that is used for recreational purposes in Addis Ababa. Urban green spaces types such as urban forest, urban agriculture, river and river side green that are found in Addis Ababa neither qualify recreational purposes nor are suitable to fulfill the purpose of recreation. Therefore only urban parks are considered in the analysis of physical accessibility of green spaces.

The result of the study showed that majority of the residents does not have access to the parks with in 400m and 800m walking distance. The service area of the parks has wider area in the inner parts of the city than the outer part of the city because parks with wider area are more accumulated in the inner part than the outer part. And also more parks are found in the inner part of the city. But the density of the population in the inner parts such as Lideta and Kirkos is higher which will make the accessibility difficult to most residents. So the majority of the residents are forced to walk more than 800 m to access the parks. This kind of lack of access to urban green space can result in social inequity, social exclusion, and negative health consequences (Wolch et al, 2014).

The proximity to the residents of the existing recreational public UGS is better than the proximity of the newly added ones since the proximity of UGS is directly proportional with the

number of parks available and their distribution rather than the size of it. And the existing recreational public UGS are scattered all over the sub cities rather than accumulating in one area, which will make them more available for more population. Therefore in terms of proximity the newly added ones are less accessible to the majority of the city residents.

4.2.3 Service area gap

The service area gap of the study is usually analyzed by finding the difference between the available park area and standards put nationally and internationally. This analysis helped to find the gap that the municipality should overcome. The standards used in the analysis of service area gap is national standard which recommends $15m^2$ area of UGS for every person and the international standard set by WHO recommends that $9m^2$ area of UGS for every person. In order to overcome the gap, municipalities should plan and execute for the needed green space since the population is increasing enormously. The amount of green space should match the population.

To overcome the gap at least additional 7,355.1ha of urban park is needed to be provided to fulfill the national standard and 3,789.9ha is needed to fulfill the international standard. This much hectare of UGS is needed even after the newly added urban green spaces was add to the existing ones. Since the summation of all recreational UGS still lacks to fulfill the demand of UGS of the city, focus should be given to this area.

Even though the current UGS, which means both existing and new UGS, doesn't meet the standard given both internationally and nationally, the newly added ones minimized the gap from 4,415ha to 3,789.9ha from the WHO standard and from 8,100ha to 7,355.1ha from Ethiopian UGIS standard. This shows a great contribution to minimize the city's deficiency of UGS.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Green spaces are the significant components of the urban landscape and provide multiple benefits as composite functions that include environmental, socio-cultural and economic benefits. Urban green areas in the densely populated cities of today are valued more than before while at the same time are suffering shrinkage due to pressures for more lands for housing development. Addis Ababa is one of the fastest growing cities in Africa. This puts the city under pressure of high demand of green space due to tremendous population increase and expansion of the city.

In general, this study contributes important findings in the accessibility of green space specifically in comparison of exiting and newly added recreational public UGS availability, physical accessibility and service area gap. The total amount of available existing recreational public UGS is 168.7ha which covers only o.32% while the newly added one comprises 625ha which cover 1.2% of the total area of the city. In terms of per capita the existing recreational UGS contributes $0.37m^2$ UGS per individual while the newly added one contributes $1.2m^2$. Therefore, in terms of availability the newly added recreational public UGS plays a great role compared to the previous ones.

In other hand more than 88.7% of the population has to walk distance longer than 800 m to reach the nearest existing UGS and more than 96.9% of the population has to walk distance longer than 400 m to reach the nearest existing UGS. But more than 99% of the population has to walk 400m and 800m to reach the newly added recreational public UGS. The service area of existing parks covers only 3% of the city while the newly added covers less than 1% of the city. Generally, the newly added UGS has very less proximity to most of the population compared to the existing ones.

Moreover, it’s needed to establish recreational public UGS with the area of 4,176ha which is 5 times the sum of all recreational public UGS to fulfill the World Health Organization standards. To reach the Ethiopian UGIS standards, it's needed to establish urban park with the area of 6,794ha which is 8 times the sum of all recreational public UGS.

This kind of research has an impact of revealing the extent of accessibility of different urban features in different aspects. It also shows the contribution of these new facilities for the city. For that reason this research has also helped to determine the contribution as well as the gap that both the existing and the newly added UGS have.

5.2 Recommendation

- In order to boost recreational public UGS accessibility in terms of proximity, more dispersed recreational public UGS with higher number of UGS should be provided.
- The accessibility of the UGS can be increased by evenly distributing the facility all over each sub city by considering both the population and the size of the sub city instead of accumulating the facility in one area.
- During providing the UGS, its size should more represent the total population of the sub city in order to increase accessibility and inclusiveness to all socioeconomic status.
- Serious urban planning measures should be taken to increase the quantity of urban green spaces in different parts of the city rather than only focusing in one sub city.
- Establishing greater number of parks in the sub cities which are found in the south, east and west outer part of the city with very few numbers of available parks would be better since those parts of the city have extra spaces than those that are found in the inner and they are highly in park shortage.
- To alter rapidly deteriorating urban environments and increase livability, the present spatial planning system must transition from a traditional planning method to a more pragmatic one, adopting a micro-level urban green space planning strategy.
- Because the city is currently running out of extra spaces, urban planning and design must find a balance between economic expansion and urban green space design.
- Developing and maintaining different size of parks in previously proposed locations, as well as areas with new growth and regeneration areas of the city, is an option for increasing recreational UGS access.
- The city's development strategy should focus on vertical built-up expansions rather than horizontal expansions, and effective planning should be performed by addressing urban green space development.

- Green space coverage data should be regularly analyzed and applied with appropriate measures. The government must plan carefully and strategically to construct public urban green areas in order to provide citizens with a high-quality of life.
- By raising the standards in Addis Ababa's master plan, transferring funds from municipal governments to sub-city governments with limited resources for park construction and maintenance, and integrating different levels of green space planning within the city, policymakers can improve green space accessibility for the city.

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APPENDIX

Appendix: coordinates of access points

No	X	Y
1	473924.6	996797.2
2	476645.1	981185.9
3	472924.8	996,695
4	474179.6	995854.6
5	472649.2	996882.1
6	472229.7	997356.9
7	474265.1	1000991
8	472574.1	999760.8
9	470931.2	996493.4
10	473776.8	999287.2
11	475270.8	982642.4
12	473697.3	992537.9
13	475197.2	994699.8
14	471309.8	1001017
15	477515.1	997382.6
16	473916	996766.2
17	473016.1	989948.6
18	472558.2	998274.1
19	473722.4	998274.1
20	469057.2	997057.3
21	475076.3	998868.7
22	468131.3	998991.3
23	471662.2	997769.9
24	474014.36	997339.42
25	473778.37	997438.56
26	473892.29	1004433