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Building Ethiopia Since 1954

Challenges and Opportunities of Urban Green Infrastructures in Inner Sub Cities of Addis Ababa: *the case of Lideta and Kirkos Sub Cities*

MSc thesis in Environmental Planning and Landscape Design

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ABSTRACT

Urban green infrastructures are essential elements of cities and contribute to the quality of life in numerous ways by maintaining and regulating the environment. However, increased urbanization and development have placed urban green infrastructures under extreme pressure, while unplanned urban growth has resulted in the loss of urban landscape and ecosystems. Among the Urban green infrastructures in Addis Ababa such as Street sides and medians trees, permeable pavements, recreational parks, and river banks have challenges in inner city Areas. This study has assessed Challenges and opportunities of urban green infrastructures in Inner sub Cities of Addis Ababa: the case of Lideta and Kirkos Sub Cities; specifically assessed urban green infrastructures and challenges of recreational parks, Street sides and medians trees, and Cobblestone roads of the study area. Thus, the study used both qualitative and quantitative approaches with case study methodology where questionnaires (majorly close ended), structured open ended interviews, and observation were used as data collection methods and the analysis was done by using SPSS and Arc GIS. The sampling techniques used to do this research were purposive sampling for selection of study cases, nonprobability convenient sampling for collection of data from park users, and Stratified random sampling to collect data about Cobblestone roads. Different challenges of recreational parks were identified such as social, economic, management, technical, physical, and environmental. Furthermore the study has revealed physical, management, technical, and environmental challenges are the challenges of street sides and medians trees, and cobblestone roads in the study areas. On the other hand the study has identified opportunities of UGIs such as UGI proclamations, standards, strategies, policies, and principles among others. Based on the findings of the study it is concluded that urban green infrastructures, in Inner sub Cities of Addis Ababa, faced different challenges including social, physical, economic, environmental, technical and management challenges. Therefore, recommendations are forwarded to address these challenges and bring Sustainable UGI development and management.

Key words: *challenges, opportunities, urban green infrastructures, inner cities, Addis Ababa*

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Table of Contents

ABSTRACT	II
ACKNOWLEDGEMENT	III
List of figures	VII
List of Tables	X
Acronyms	XI
CHAPTER 1: INTRODUCTION	1
1.1 Background of the Study	1
1.2 Problem Statement.....	4
1.3 Research Objective	4
1.4 Research Questions.....	5
1.5 Scope of the Study	5
1.6 Significance of the Study	6
1.7 limitation of the study	6
1.8. Organization of the Research.....	6
CHAPTER 2: LITERATURE REVIEW	7
Conceptual Framework	7
2 .1 Definition of Green Infrastructures.....	8
2.1.2 Urban Green Infrastructure	9
2.2 Elements of Green Infrastructures.....	9
2.2.1 Urban Green spaces	9
2.2.2 Permeable Pavements.....	13
2.3 Challenges of Integrating Green Qualities in Development plans	15
2.3.1 Collaboration and Communication	15
2.3.2 Lack of knowledge	16
2.3.3 Tools	16
2.4 Strategies That Support Sustainable Communities and Urban Green Infrastructures.....	17
2.5 Case study for Challenges of Urban Green infrastructures in inner City of Johannesburg and its solution.....	17
2.5.1 Challenges of Urban Green Infrastructures in inner city of Johannesburg	17
2.5.2 Solutions taken for Challenges in inner City of Johannesburg.....	18
2.6 Urban Green Infrastructure Standards of Ethiopia.....	19

2.6.1	General Standards	19
2.6.2	Urban Green Infrastructure Elements Standards	22
2.7	Green Infrastructures in Addis Ababa.....	24
2.7.1	Availability and Accessibility of Green Spaces in Addis Ababa.....	24
2.7.2	Recreational Parks of Addis Ababa	27
2.7.3	Street trees	29
2.7.4	Cobblestone Roads in Addis Ababa.....	29
2.7.5	Challenges and Opportunities of urban green infrastructures in Addis Ababa	30
CHAPTER 3: DESCRIPTION OF THE STUDY AREAS AND RESEARCH METHODOLOGY		31
3.1	Description of the Study Areas	31
3.2	General Research Methodology	33
3.3	Research design.....	33
3.4	Case study selection criteria.....	34
3.5	Types and Sources of Data	34
3.6	Data collection methods	34
3.7	Data Analysis methods.....	35
3.8	Sampling Method.....	35
CHAPTER 4: RESULTS AND DISCUSSION		38
4.1	Respondents' Information in the Study areas	38
4.2	Urban Green Infrastructures in the Study areas.....	39
4.2.1	Recreational parks in Lideta and Kirkos sub cities.....	44
4.2.2	Availability and Distribution of Street sides and medians trees	47
4.3	Challenges of Recreational Parks in the Study areas	48
4.3.1	Social challenges	49
4.3.2	Economic challenges	57
4.3.3	Poor Capacity Building.....	59
4.4	Challenges of Street sides and medians trees in the study areas	70
4.4.3	Environmental challenges	82
4.4.4	Poor Institutional and management challenges	83
4.5	challenges of Cobblestone roads in the study areas.....	84
4.5.1	Physical Challenges.....	85
4.5.2	Environmental challenges	87

4.5.3 Institutional and management challenges	90
4.6 Opportunities for Urban Green Infrastructures in the study areas	91
CHAPTER 5: CONCLUSION AND RECOMMENDATIONS	100
5.1 conclusion.....	100
5.2 Recommendations.....	102
References	105
Annex I: Check lists, Questionnaires and Interviews	X
Annex II: supporting tables	XVIII

List of figures

Figure: 2. 1: conceptual frame work	7
Figure: 2. 2 Existing Environmental map of Addis Ababa in 2002	25
Figure2. 3 proposed Environmental map of Addis Ababa from 2017- 2027	26
Figure: 2. 4: bole woreda 3 zone 19 community development center	28
Figure: 3. 5: location of the study Areas	31
Figure: 3. 6: Location of thematic cases	32
Figure: 4. 7 ecosystem services provision and need assessment respectively in Addis Ababa 2011.....	40
Figure: 4. 8 : Availability, distribution, and connectivity of Urban Green Infrastructures in Lideta and kirkos Sub Cities in 2012.....	41
Figure: 4. 9: Availability, distribution, and connectivity of Urban Green Infrastructures in Lideta and kirkos Sub Cities in 2002.....	41
Figure: 4. 10: Distribution of Parks in Kirkos and Lideta sub cities.....	43
Figure: 4. 11 : partial view of Tekle Haymanot Park	44
Figure: 4. 12 partial view of Gola Park	45
Figure: 4. 13: partial view of Lideta Park	45
Figure: 4. 14 view of Ethio Cuba Park	46
Figure: 4. 15 partial view of Africa Park.....	47
Figure: 4. 16: sample pictures from streets from Gofa Mazoriya to Chrkos church and National area to Amestigna.....	47
Figure: 4. 17 A and B: Area coverage of road surface types in KM ² in Lideta and Kirkos Sub Cities respectively	48
Figure: 4. 18: Park users response in Africa and Tekle Hymanot Park about Distance from near park.....	49
Figure: 4. 19 Park users Response in Africa and Tekle Hymanot Park about Time taken to reach near park.....	50
Figure: 4. 20 level of Satisfaction of Park users in the distribution of sub city parks	50
Figure: 4.21 Satisfaction sub city park accessibility	50
Figure: 4. 22 : Total satisfaction of Park users about the sub city parks	51
Figure: 4. 23: Satisfaction of respondents in quality of the parks.....	51
Figure: 4. 24: Park users' age in Africa and Tekele Hymanot Park.....	52
Figure: 4. 25 Park users in Africa and Tekele Hymanot Park	52

Figure: 4. 26 Absence of facilities for elders in Africa Park	53
Figure: 4.27: Park users satisfaction in children’s playground Africa and Tekele Hymanot Park	53
Figure: 4. 28 alcohol drinks area(A) and gambling houses(B) in Tekel Hymanot Park.....	55
Figure: 4. 29 security issues in Africa Park.....	56
Figure: 4. 30: entry prices of Africa Park and Tekele Hyamont Park.....	57
Figure: 4.31 respondents level of participation in recreational parks development	59
Figure: 4. 32: External and internal relation of concerned organizations to recreational park ...	61
Figure: 4. 33 ornamental trees in Tekle Hymanot Park and no ornamental trees in Africa park .	63
Figure: 4. 34 : fencing materials in Tekel Hymanot and Africa Park.....	64
Figure: 4. 35 Facilities mentioned by Park users to be added in Tekele Hymanot and Africa Park	65
Figure: 4. 36 : park user’s response to disturbance types	66
Figure: 4. 37 : waste dumping adjacent to Tekele Hymanot Park.....	66
Figure: 4.38: Aesthetically unpleasant area in theTekele Hymanot Park	67
Figure: 4. 39 : Responses of park users on improvements of facilities in Africa and Tekel Hyamnot Park	68
Figure: 4. 40: lack of comfort and connivance of play grounds and other facilities in Africa and Tekel Hymanot Park.....	69
Figure: 4.41 :damaged plants in the study areas.....	70
Figure: 4. 42: medians for parking and marketing area on street from Gofa Mazoriya to Kirkos Church	71
Figure: 4. 43: houses supported by street trees	71
figure : 4.44: street vendors intervention to street trees.....	72
Figure: 4.45 Gravilla along street medians and side in Africa union Round about to Bulgaria Round about	73
Figure: 4.46: phoenix recilenta along street side and medians on Gofa Mazoriya to Kirkos Church	74
Figure: 4. 47: columnar shape plants on the street from Gofa Mazoriya to Kirkos Church and spreading plants on the National Bank Area to Amistegna police station respectively.....	75
Figure: 4.48: trunk diameters greater than 30 cm on streets from Maryam Tseble to Bulgaria Round about and National Bank Area to Amistegna police station respectively	76
Figure: 4.49: shrubs with height greater than 1 m on street from National Bank Area to Amistegna police station	77
Figure: 4. 50: in appropriate location of street side trees	78

Figure: 4. 51: Traffic signs located against the standard on the street from Maryam Tseble to Bulgaria Round about and National Bank Area to Amistegna police station	78
Figure: 4.52: in appropriate location of street side trees and utility manholes	79
Figure: 4. 53 in appropriate location of street utility poles	80
Figure: 4.54: street side trees near the fences and buildings in the study areas.....	80
Figure: 4. 55: incompatible color and pointed fences on street from National Bank Area to Amistegna police station	81
Figure: 4. 56 : street side trees near the fences and buildings in the study areas.....	82
Figure: 4. 57 : waste dumping at the street trees in the study areas.....	82
Figure: 4. 58: selected Cobblestone roads in Lideta and kirkos subcities	84
Figure: 4. 59 : degraded Cobblestone roads in the study areas	85
Figure: 4.60 : traffic congestion in the study area	85
Figure: 4.61: water clogged Cobblestone roads	86
Figure: 4. 62: respondent's reaction to Cobblestone roads comfort for different activities	86
Figure: 4. 63 respondents' satisfaction in Cobblestone roads of the study areas.....	87
Figure: 4.64 :pollution of Cobblestone roads by liquid and solid wastes	88
Figure: 4. 65 : Temporal dimension of pollution.....	89
figure : 4.66 : weekly sweeping of the roads by government	89
Figure: 4. 67 dust problems in the study areas.....	89

List of Tables

Table: 2.1: street trees clearance standard from street scape elements	12
Table 2.2 Area coverage of different green spaces in Addis Ababa	24
Table: 2. 3 functional parks of Addis Ababa in 2014	28
Table: 2. 4 Summary of Cobblestone development status in AA from 2002E.C to 2009 E.C	30
Table: 3. 5: Summary of data collection and analysis methods.....	37
Table: 4. 6: Respondents' information in the Study Areas	38
Table: 4. 7: Age of Respondents in the park.....	38
Table: 4. 8 urban green infrastructures in Kirkos and Lideta sub cities.....	42
According to AASBPDA reports of 2016 reports shown in annex II Table 9, there are 21 street sides with total area of 21425m ² in kirkos sub city and 7 with total area of 8400m ² in Lideta sub city. Most of them are developed by the government and the rests are developed by private developers.....	47
Table: 4. 10 : Park users Response on forbidden activities in the park.....	54
Table: 4. 11 Respondent's affordability in Africa Park and Tekele Hyamont Park	57
Table: 4. 12 : problems mentioned by the respondents in the study areas	88
Table: 4. 13 summary of major research findings.....	94
Table 14 some urban green spaces in Kirkos and Lideta sub cities in 2008 E.C	XVIII
Table 15: Availability and Distribution of recreational parks in Kirkos and Lideta sub cities in 2008 E.C.....	XVIII
Table: 16 Availability of Roundabouts in the study areas	XIX
Table 17 : Availability and Distribution of street islands in Kirkos and Lideta sub cities	XIX
Table 18 Availability and Distribution of street medians in Kirkos and Lideta sub cities.....	XX
Table 19 Availability and Distribution of street sides in Kirkos and Lideta sub cities	XXI

Acronyms

AA	Addis Ababa
AACRA	Addis Ababa City Road Authority
AACGSBPDA	Addis Ababa City Government Sanitation, Beautification, and Park Development Agency
AADPPO	Addis Ababa Development Plan Preparation Office
AAEPA	Addis Ababa Environmental Protection Agency
AAWSA	Addis Ababa Water and Sewerage Authority
AAUPI	Addis Ababa Urban Planning Institute
CBD	Central Business District
CPCO	Cobblestone Project Coordination Office
CLUVA	Climate Change and Urban Vulnerability in Africa
EIA	Environmental Impact Assessment
EUNIS	European nature Information System
FSS	Forum for Social Studies
GIS	Geographic Information System
GI	Green Infrastructure
Ha	Hectare
IBRD	International Bank for Reconstruction and Development
MoUDH	Ministry of Urban and Housing
UGI	Urban Green Infrastructures
UMTs	Urban Morphology Types
UN-Habitat	United Nation Habitat
SPSS	Statistical Package for Social Science
SBPDA	Sanitation, Beautification, and Park Development Agency

CHAPTER 1: INTRODUCTION

1.1 Background of the Study

More than half of the world's population now lives in urban Areas. By 2050 more than half of Africa and Asia's population will live in towns and cities (David, 2013). A range of strategies are used to integrate the environment in urban planning and management.

As cited in Tsige(2015),Rouse and Bunster(2013) listed six principles should be fulfilled in the planning and design of green infrastructures .Thus include (1)multi functionality, (2)connectivity, (3)habitability, (4)resilience, (5)identity and (6)return on investment Resiliency: it is the ability to recover from or adapt to disturbance and change. Green infrastructure can play roles, such as tree and green buildings for heat islands, maintaining flood absorption, permeable pavement etc.

Besides these principles; discussing the importance of participation, politics, and political commitment; harmonization and multi-level governance; and identifying and overcoming gaps and challenges of urban Areas are important to integrate environment in planning through environmental strategies like urban green infrastructure planning (Cheng, 2013).

Urban green infrastructures are one of the environmental strategies for climate change adaptation and emerging planning innovation as the interplay between greening and reducing social vulnerability (Cheng, 2013). So that as stated in David (2013) urban green infrastructures should be supported by the above key underlying principles especially in inner city areas where the many people live and many activities are held.

It wasn't until the 19th century that the importance of urban green infrastructures for residents was recognized to some extent (Swan wick *et al.*, 2003). Today, it is understood that urban green infrastructures are essential for well-functioning and livable cities because they play a significant role in everyday life; contribute to the conservation of biodiversity; contribute to the cultural identity of the city; help maintaining and improving the environmental quality of the city; and bring natural solutions to technical problems. Urban Green infrastructures bring natural solutions for sewage treatment through assimilation, purification and etc in cities (Sandstorm, 2002).

Demuzere (2014) discusses Green urban infrastructure has been indicated as promising for reducing the adverse effects of climate change in urban Areas, for example, by balancing water

flows to alleviate flooding, providing thermal comfort by shading vegetation, and supporting coping capacities by providing people with opportunities to grow food for themselves.

Urban green infrastructures are essential elements of cities, contributing to the quality of life in numerous ways. However, densification strategies create a complex relationship between urban development and the quality, as well as the quantity, of urban green space (Yigitcanlar, 2015). On the same way increased urbanization and development have placed urban green infrastructures under extreme pressure, while unplanned urban growth has resulted in the loss of urban landscape and ecosystems (Wright *et al.*, 2002).

Due to the changes in social, economic and spatial conditions that have occurred currently and those that are expected in the future, urban planning is forced to shift its emphasis to meet new challenges such as “inner development” of settlements (inner development, means the mobilization of brown fields, underused Areas, former railway Areas and vacant buildings for settlement purposes, inside the already settled Area of cities and towns) (Elgendy, 2004). This implies currently and in the future in inner and dense part of cities green infrastructures will not be given priority, it is one of the challenges of urban green infrastructures. Spatial planning in the future should emphasize inner development rather than urban growth. Because in the future negative demographic trends, limited public resources, economic crisis, and ecological problems will happen. The highest slum concentration in the world is situated in Africa with 72% of its urban residents (UN-HABITAT, 2009).

Elias (2008) stated that like in many developing cities, a rapid population growth and high rural-urban migration poses many environmental problems to the city of Addis Ababa, especially in the old settlement Areas. These old and unplanned inner city settlements of Addis Ababa, which only cover less than 15% of the total area(54,000 ha), house 40% of the city’s population.

Moreover, inner city residential neighborhoods are characterized by overcrowding, inadequate services, scarcity of water supply, and lack of toilets and are susceptible to flooding and natural as well as manmade hazards. According to the structural plan of the city (2002), urban renewal strategy is strongly desired in these inner city areas to overcome the problems and in order to enhance the underutilized inner city land which in turn will transform the image of the city (Munir, 2012).

As cited in Samson (2014), Dimoudi *et al.* (2003) Green infrastructure in urban areas has an important role to play in ameliorating the warming effects of climate change and the urban heat

island. Provision of green infrastructure can reduce higher urban temperatures through evapotranspiration, direct shading, and conversion of solar radiation to latent heat. Increasing the current area of green infrastructure in Great Manchester by 10 % (in areas with little or no vegetation cover) could result in a cooling of up to 2.5°C.

Kumelachew (2015) suggests the existence of a considerable surface urban heat island in Addis Ababa. The difference in surface temperatures across the UMTs of built and green surfaces is around 28°C which considers inner cities and outer areas of Addis Ababa. Jing *et al.* (2016) states Areas with high building density have more UHI, in contrast to urban green spaces and their surrounding areas where no, or only weak, heat islands were found.

Green infrastructures are very critical to bring sustainable development by maintaining and regulating the environment. Since Sustainable development aims to provide for the social and economic needs of society, while protecting environmental resources and values for the future (Randolph, 2004).

Thus this paper assesses the challenges and opportunities of urban green infrastructures in Inner sub cities of Addis Ababa in order to bring sustainable development of them.

1.2 Problem Statement

Today, cities are facing enormous challenges, such as climate change, demographic aging, and natural resource depletion. According to Marthe *et al.* (2016) cities are particularly prone to the effects of climate change. Demuzere (2014) Stated Urban areas are facing increasing challenges from climate change, such as, floods, droughts, heat waves and other threats to human comfort and environmental injustice. In third world countries Inner cities have old aged infrastructure and infrastructure challenges especially in urban green infrastructures (gossye, 2015).

Like other cities, Addis Ababa faced challenges from flooding, threats to human comfort and environmental injustice (Dubbale *et al.*, 2010) which could be mitigated by urban Green infrastructures. It is one of the cities of Ethiopia that has experienced environmental deterioration and, in some cases, the disappearance of its green Areas particularly Inner parts (Yewoinesh, 2007). However, Munir (2012) indicated some opportunities that Inner Sub Cities of Addis Ababa cannot benefit from yet regarding urban green infrastructures due to management challenges like Master plan of Addis Ababa that was developed in 2002.

Among the Urban green infrastructures in Addis Ababa such as Street sides and medians trees, permeable pavements, recreational parks, and river banks have challenges in inner city Areas of Addis Ababa. So that it is a need to study the challenges and opportunities of them to develop Urban Green Infrastructures sustainably. Thus; the consolidated problem statement of this study is challenges of urban green infrastructures particularly recreational parks, Street sides and medians trees, and Cobblestone roads in inner sub cities of Addis Ababa that would be assessed with the opportunities of them in this study.

1.3 Research Objective

The General Objective of the paper is to study the challenges and opportunities of urban green infrastructures in Inner Sub Cities of Addis Ababa and to forward valuable recommendations.

It has the following Specific objectives

1. To assess the spatial distribution and connectivity of Urban Green Infrastructures in the study Areas.
2. To assess the challenges of recreational parks, Street sides and medians trees, and Cobblestone roads in the study Areas.

3. To identify the opportunities for urban green Infrastructures in the study areas
4. To forward valuable recommendations for providing GIs in the Inner Sub Cities of Addis Ababa.

1.4 Research Questions

Basically the research questions are based on what drawbacks and constraints urban green infrastructures have in inner sub cities of Addis Ababa; what do they lack regarding the services they give and what challenges they face.

The study tries to answer the following questions

1. What are the types of urban green infrastructures and how they are distributed in the study areas?
2. What are the challenges of recreational parks, Street sides and medians trees, and Cobblestone roads in the study Areas?
3. What opportunities do urban green infrastructures have in the study areas?
4. How can UGI be enhanced and develop sustainably?

1.5 Scope of the Study

Spatial Scope

The study is geographically demarcated in the inner sub cities of Addis Ababa; LIDETA Sub City and KIRKOS Sub City.

Thematic Scope

The thematic scope of the study is limited to urban green infrastructures particularly recreational parks, Street sides and medians trees and permeable pavements particularly Cobblestone roads: It only focuses on : assessment on spatial distribution and connectivity of urban green infrastructures; social inclusivity of elderly and children in recreational Areas ,economic considerations of urban poor, political (level of community participation ,hierarchy of management and follow up), social (land use change, compatibility ,accessibility, suitability) and ; physico- environmental challenges of street medians and trees ; and challenges of permeable pavements particularly Cobblestone Roads in terms of comfort to residents, environmental pollution, and physical degradation.

1.6 Significance of the Study

Beside the ecological and environmental benefits, urban green infrastructures play a role in social wellbeing. Urban green infrastructures are emphasized in policy documents across the world and are considered as a key dimension of the sustainable city. This study can have management related, socio-economic, ecological, and academic significance. So the study is hoped to create a better understanding about the challenges and opportunities of urban green infrastructures in inner city Areas of Addis Ababa so as to give the right response towards bringing sustainable and livable city. This research is also valuable towards providing information to residents, passersby, Investors, government, planners, and other stake holders by identifying challenges and opportunities of green infrastructures. Besides, this study may also lay baseline information to the next work who would like to conduct detailed and comprehensive studies in this study Area and other study Area.

1.7 limitation of the study

During the data collection some of the Respondents did not openly and timely respond on questionnaires which had been made the data collection period long. Absence of sufficient and latest literature regarding Cobblestone roads and its importance to the environment in Ethiopian context is another limitation.

1.8. Organization of the Research

The research paper is divided into five chapters .The first chapter gives a brief introduction to urban green infrastructure and describes the research problem, research questions, research objectives, limitations, and scope of the study. The second chapter enlightens the reader about urban green infrastructures. It also provides definition of terms and concepts. In Chapter 3 the study area and Research methodology are described. In chapter 4 Presentation of results and Discussion are presented according to the research objectives with the main findings of the research paper. Finally chapter 5 contains recommendations based on the findings of the study and concludes with suggestions for issues to be considered. Conclusion, planning, and management Recommendations are forwarded.

CHAPTER 2: LITERATURE REVIEW

Conceptual Framework

Assessment of the challenges and opportunities of urban green infrastructures in Inner Sub Cities of Addis Ababa would provide essential information that is used in green infrastructure planning of cities especially Inner Cities. The researcher came up with expected results of the paper with proper approach. First Literatures were reviewed about challenges, benefits, and opportunities of urban green infrastructures. Among the components of green infrastructures recreation parks, Street sides and medians trees, and Cobblestone roads were reviewed in terms of challenges, benefits, opportunities, standards, accessibility, and suitability and etc. After the literature review questionnaires and interviewers were developed and collection of data was held.

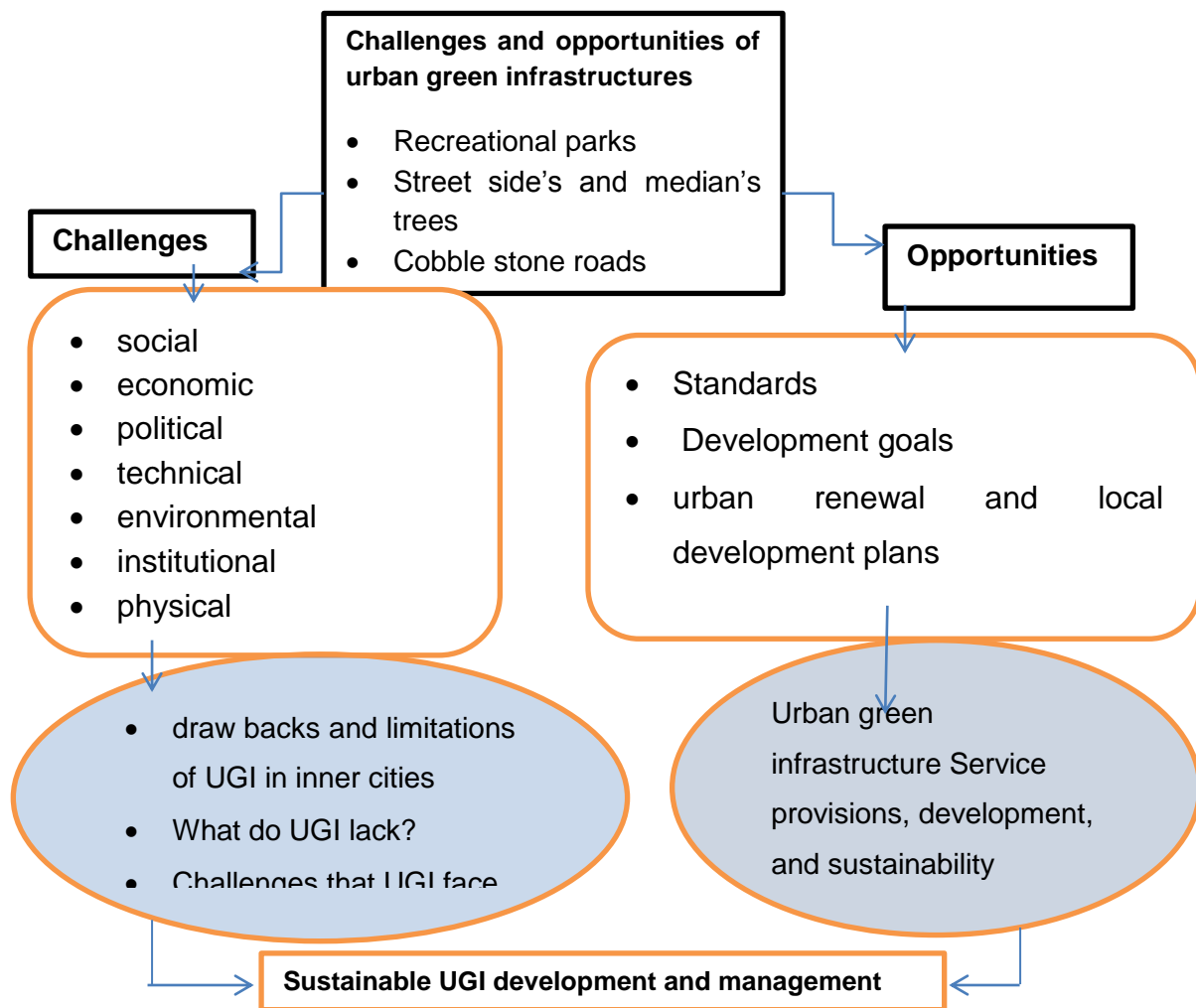


Figure: 2. 1: conceptual frame work

Source: computed by the researcher, 2017

2 .1 Definition of Green Infrastructures

The definitions of green infrastructures are defined in different scholars with regard to their backgrounds and disciplines.

Originally, “green” infrastructure was identified with parkland, forests, wetlands, greenbelts, or floodways in and around cities that provided improved quality of life or “ecosystem services” such as water filtration and flood control. Now, green infrastructure is more often related to environmental or sustainability goals that cities are trying to achieve through a mix of natural approaches (Josh et al. , 2011).

According to Anna Serra-Llobet(2016) ‘green infrastructure’ refers both to a set of storm water best practices that provide multiple benefits, and more broadly to interconnected networks of green spaces that provide multiple benefits for wildlife, human recreation, and water quality (Matthews, *et al.* 2015), or “natural, semi-natural, and artificial networks of multifunctional ecological systems within, around and between urban Areas” (Tzoulas *et al.*, 2007).

As mentioned in Joshua *et al.*(2012), Benedict & McMahon (2002) define UGI as it is the networks of wild lands, woodlands, waterways, and wetlands that, when combined with green roofs, permeable paving, vegetative swales, parks, and green streets, support ecological processes and contribute to human health and quality of life.

based on Sri Maryatia (2015) Green infrastructure (GI) is defined as a set of techniques, technologies, management approaches, and practices that can be used to eliminate or reduce amount of storm water and nonpoint source runoff including water and pollutants that run into combined sewer overflow system.

Green Infrastructure can be broadly defined as a strategically planned network of high quality natural and semi-natural Areas with other environmental features, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity in both rural and urban settings. More specifically GI, being a spatial structure providing benefits from nature to people, aims to enhance nature’s ability to deliver multiple valuable ecosystem goods and services, such as clean air or water (EuropeanCommission, 2013). Asmelash (2013) Defined green infrastructure as parts of urban Area with a mix of street trees, parks, cultivated land, wetlands, lakes, and streams that are interconnected.

Generally green infrastructures are those infrastructures that give benefits to the people without affecting the environment in other words those infrastructures that are eco-friendly with the environment are called green infrastructures. So that this and paragraph 4 of page 8 were working definitions of this study since they categorize preambles pavements like cobblestone under GI.

2.1.2 Urban Green Infrastructure

Urban green infrastructure can be interpreted as a hybrid infrastructure of green spaces and built systems, e.g. forests, wetlands, parks, green roofs, and walls that together can contribute to ecosystem resilience and human benefits through ecosystem services (Marthe *et al.* , 2016). They are green infrastructures that are found in the urban Areas.

2.2 Elements of Green Infrastructures

Elements of green infrastructure include open Areas such as urban forests, large public parks, gardens, playing fields, rights-of-way along streams and roads, and constructed features such as green roofs, permeable vegetated surfaces, swales, rain gardens, and “green streets” (Mell *et al.*, 2013 ; Matthews *et al.*, 2015) (Anna *et al.* , 2016).

“Green” infrastructure and technological practices include green, blue, and white roofs; hard and soft permeable surfaces; green alleys and streets; urban forestry; green open spaces such as parks and wetlands; and adapting buildings to better cope with floods and coastal storm surges (Josh *et al.*, 2011).

European Commission (2013) Discusses that Green Infrastructure is made up of a wide range of different environmental features which can operate at different scales, from small linear features such as hedgerows or fish ladders or green roofs to entire functional ecosystems, such as intact floodplain forests, peat lands, or free-flowing rivers. Each one of these elements can contribute to GI in urban, peri-urban, and rural Areas, inside and outside protected Areas.

2.2.1 Urban Green spaces

Urban Green Areas include any natural elements in towns and cities that provide an ecological or ecosystem service function (Losarcos, 2010) . This includes urban elements such as green parks, green walls, and green roofs that host biodiversity and allow ecosystems to function and deliver their services by connecting urban, peri- urban and rural Areas.

Under the Habitats complexes category of the EUNIS habitat classification, green urban Areas include the following habitats:

- Large parks: large, varied green spaces within towns and cities, usually >5 ha. These include small woods, mown lawns, water bodies (semi-natural or artificial), flower beds and shrubberies and semi-natural grassland or woodland enclaves.
- Small city-centre non-domestic gardens: usually <0.5 ha often partitioned by walls located inside city blocks and completely or almost completely surrounded by architectural structures. They may contain mown lawns, flower beds and native or ornamental trees. For the purposes of this project, it will also be understood to include green roofs.
- Large non-domestic gardens: typically 0.5-5 ha, more restricted in diversity than large parks, usually similar composition and aspect to small city-centre non-domestic gardens.
- Domestic gardens of cities and town centres: usually <0.5 ha with very mixed species-rich flora and fauna.
- Domestic gardens of villages and urban peripheries: usually <0.5 ha, with very mixed species-rich flora and fauna, in close proximity to human dwellings, agricultural land, natural or semi-natural habitats.

2.2.1.1 Recreational parks

As stated in Sipe(2010) Parks can be variously described as urban parks, nature parks, pocket parks, district parks, community parks, neighborhood parks, sporting fields, urban forests, and the like. But there are other ways of classifying parks too. These include factors such as the activities that occur within the park (e.g. cricket oval, Skateboard Park, bowling green), the agency responsible for managing the park (e.g. national park, state park, city park), the history of the park (e.g. heritage rose garden or Bora Ring park), the condition of the park, the land use history of the Area (e.g. Victorian-era park or street-corner neighborhood park), the types of people who use the park, landscaping and flourishes (e.g. sculpture park, dog park, bike park or Chinese garden) and the philosophy behind the park's development (e.g. recreation reserve or civic square).

2.2.1.1.1 The challenges faced by urban parks

In large cities, park expenditures have been flat or declining despite the encouragement of taxpayers to increase spending (Association, 2011). There has been inadequate investment in landscaping, playscapes, ball fields, walking and biking trails, recreation centers, and other

community facilities, which are not replaced when they come to the end of their useful lives. According to LeVario(2011) crime is one of the challenges face urban parks ,some of the crimes that are happened regularly in the park are Murder, Arson, Rape, Theft, Assault, Robbery, Vehicle, Theft, and Burglary.

Undertaking the revitalization or creation of a new urban park or recreation Area, agencies face challenges to the mission and programs of public parks as well as other issues that impact the viability of successful park and recreation programming including:

- ✓ Catering to a variety of constituencies that have different expectations and goals;
- ✓ Diminished funding and resources limit the ability of park and recreation agencies to respond to community needs;
- ✓ Public perception that access to urban parks and recreation programs should be free;
- ✓ Park and recreation departments are losing the competition for general fund dollars; and
- ✓ Deferred maintenance totals over \$1 billion in many large cities.

2.2.1.2 Street sides and medians trees

Street trees are planted trees on pedestrian roads, in road medians and road corridor and they are part of the overall green infrastructure component of cities (Kumelachew,2015).

Street trees are the most important organizing element of the streetscape environment. Appropriate tree species selection and location and design of the planting site will ensure the healthy growth and longevity of trees, enhance streetscape character, and maximize the City's investment. It has been demonstrated that street trees enhance property values in residential neighborhoods and commercial Areas (Christopher *et al.*, 2011).

2.2.1.2.1 Challenges of Street Trees

Planting a diverse urban forest with the right tree in the right place can enhance a city streetscape and reduce the long-term cost of tree replacement and maintenance (Farley, 2013).

Although essential in an urban forest, street trees create numerous challenges for municipalities as well as private owners. Lack of species diversity is usually pronounced. In addition, inappropriate species are commonly planted along streets. Numerous variables such as proximity to buildings or vehicular traffic, soil Area, exposure, and road salt usage should also be considered when planting any tree.

2.2.1.2.2 Street Trees Design Guideline case study

As stated in journal of (Christopher *et al*, 2011) a guide to street design in urban India; many guidelines are stated about street trees and street medians as follows with related to other street elements and street amenities like street benches, utility lines, man holes and etc. In Ethiopia, There are guide lines generally about green infrastructures and specifically about street green elements that can secure green elements of the streets but there are problems and challenges of street trees especially regarding guidelines and standards.

Appropriate tree species selection should consider: form, mature size, color, and texture to reflect the urban design goals of a street; the mature tree canopy with respect to how it may affect street and pedestrian lighting or views of signage and building fronts; the potential for root systems to affect sidewalks, curbs, and utilities; and impacts and constraints created by local climate.

Trees adjacent to streetscape elements: Minimum guidelines for sidewalk element clearance from street trees on a public sidewalk are:

Table: 2.1: street trees clearance standard from street scape elements

Parking Sign (0.9m)	Utility Boxes (0.9m)	Fire Escapes (3 m)
Parking Meters (0.9m)	Pedestrian Furniture (0.9m)	Utility Poles (1.5 m)
Sewers (1.5 m)	Fire Hydrants 5 feet (1.5 m)	Traffic Sign (1.5 m)

Source: Christopher kost, m. n. (2011), better streets, better cities: environmental planning collaborative.

Trees in Street Medians: as stated in Christopher *et al*. (2011) Trees may be planted in medians 4 feet or wider, including curbs. Trees planted in medians should have arching canopy structures that provide visibility without excessive pruning, or be upright and columnar in form. Tree species selected for planting on median strips that are 4 to 6 feet wide should be expected to grow to trunk diameters no greater than 12 inches. On median strips greater than 6 feet wide, trees obtaining larger diameters may be used. Trees located in medians should have a vertical clearance of the lowest branch of 8 feet in height over the median, and 14 feet in height for any portion of the tree that overhangs the roadway. Shrubs located in the median should not exceed 3 feet (1 m) above the roadway. Tree branches that extend into the path of travel must maintain 80 inches (2m) of vertical clearance.

2.2.2 Permeable Pavements

2.2.2.1 Cobblestone

Berihun (2015) defined Cobblestone (Dressed stone) - as Cubic pieces of stone larger than setts, usually shaped by hand and built into a road surface layer or surface protection. They are larger granular materials and their sizes generally range from approximately 6” to 24” diameter and are available in a variety of stones and colors.

According to UN-Habitat (2013) In the secondary cities where formal administrations have recently been established, urban population pressure particularly causes delays in urban service provision, with a significant impact on peoples’ living conditions. Generally in Ethiopia the growth of urban infrastructure is not harmonized with that of the ever growing number of urban population. In most cities across Ethiopia’s urban roads are in urgent need of upgrading, since many secondary or internal roads were dusty, sandy or graveled. And the government of Ethiopia uses Cobblestone as one source of materials for road construction in urban Areas.

Cobblestone uses natural and local materials; does not require imported machinery; creates jobs and opportunities for construction entrepreneurs; does not depend on imported oil, as asphalt does; is cost-effective compared to concrete or asphalt roads; makes towns and cities more beautiful (UN-Habitat, 2013).

Defined Permeable pavements or pervious surfaces are those pavements that accumulate and then allow water flow across and in when water passes on them such as storm water runoff. Permeable pavement allows storm water to slowly seep through (infiltrate), reaching the soil and groundwater below the surface (ortiz).

A variety of permeable pavement materials are available, such as interlocking pavers, porous asphalt, pervious concrete, and manufactured grass pavers. Interlocking pavers consist of precast blocks (primarily brick or concrete) that are aligned in such a way that water is able to pass between the blocks into the soil below.

In Ethiopia Cobblestone is one of the best materials that could make permeable surfaces and which are important for making streets, parking, and different pavements. It has Objectives of Reduce storm water runoff volume from paved surfaces, Reduce peak discharge rates, Increase recharge through infiltration, Reduce pollutant transport through direct infiltration, and Improve site landscaping benefits.

2.2.2.1.1 Factors that Determine Suitability for Permeable Pavements (Cobblestone)

Traffic load: - Permeable paving is well suited for many residential and commercial applications. However, because its load-bearing capacity is lower than that of conventional pavement, permeable paving should not be used in Areas subject to excessive loads or high-speed traffic (ortiz). Permeable paving is most appropriate for pedestrian-only Areas and for very low-volume, low-speed vehicle Areas such as overflow parking Areas, residential driveways, alleyways, and parking stalls. It should not be used in Areas with high pollutant loads because the storm water is not pre-treated before infiltration.

Slope: - Exclude any surfaces that accumulate a lot of sediment and debris as this can clog the surface and reduce the effectiveness of the system. Only include Areas that have a gradient, or slope, that will direct water away from the foundation of your home or other nearby structures, and include only those Areas with a slope of less than 5%.

Soil: - The type of soil found on your property is an important consideration. Soil conditions do not constrain the use of permeable pavement, although they do determine whether an under drain is needed. Soils such as sand and loam are permeable and allow water to infiltrate fairly rapidly. In contrast, clay soils can be impermeable and will probably require an under drain system to prevent ponding (ortiz).

Similarly factors that determine suitability for permeable pavements stated by (Planning Council) as Permeable paving is appropriate for pedestrian-only Areas and for very low-volume, low-speed Areas such as overflow parking Areas, residential driveways, alleys, and parking stalls Permeable paving is an excellent technique for dense urban Areas because it does not require any additional land. (Planning Council).

Permeable paving is not ideal for high traffic/high speed Areas because it has lower load-bearing capacity than conventional pavement. Nor should it be used on storm water “hotspots” with high pollutant loads because storm water cannot be pretreated prior to infiltration.

2.2.2.1.2 Limitations of Cobblestones

Cobblestones can be prone to **clogging** from sand and fine sediments that fill void spaces and the joints between pavers. As a result, it should be used carefully where frequent winter sanding

is necessary because the sand may clog the surface of the material. Periodic maintenance is critical, and surfaces should be cleaned with a vacuum sweeper at least three times per year.

As Permeable paving should not receive storm water from other drainage Areas, especially any Areas that are not fully stabilized Cobblestone should not too.

Cobblestone can only be used on gentle slopes (<5%); it cannot be used in high-traffic Areas or where it will be subject to heavy axle loads.

Sources of Pollution: - The introduction of dirt or sand onto the paving surface, whether transported by runoff from elsewhere or carried by vehicles, will contribute to premature clogging and failure of the paving (Planning Council).

2.3 Challenges of Integrating Green Qualities in Development plans

When it comes to land use planning, conflict arises for several reasons, including the competing demands for the use of land, uneven distribution of costs and benefits resulting from the development, and the environmental impacts arising from land use changes (Short *et al.*, 2013). Challenges could be clustered in four broad categories: collaboration, green quality management, implementation of densification, and tools. These challenges include: a lack of collaboration and communication; lack of knowledge regarding green spaces and qualities; and the inefficient use of Environmental impact assessment tools (Sara *et al.*, 2015).

2.3.1 Collaboration and Communication

Weak collaboration and communication were found for creating professional barriers as well as hindering the exchange of knowledge between them.

As stated by Håkansson (2000), “a municipal public administration is not a unified organization, but is instead populated by a number of different professional groups, each an expert in its own field. Experts belong to various municipal administrative units, all of which have developed their own traditions and procedures, which influence their work.” This separation amongst the municipal departments was quite evident in the municipalities. Each department was focused on their specific specialization, often overlooking and not showing interest in issues outside of their professional knowledge, such as green qualities.

With improved communication and collaboration the different municipal departments could share and develop knowledge and thereby bring their professional expertise to bear on

integrating green qualities. However, even with the understanding and acceptance of the importance of collaboration and communication, methods for collaboration were not well developed (Sara *et al.*, 2015).

2.3.2 Lack of knowledge

Another challenge is lack of knowledge regarding the value of existing urban green spaces, as well as the qualities associated with them. This problem led to many other challenges. The lack of knowledge on green qualities of cities or urban regions leads to land use planning and management decisions based on inadequate information on the benefits that humans can derive (Niemelä *et al.*, 2010).

As stated by Sara *et al.* (2015) lack of knowledge regarding the value of certain green spaces led to challenges in decision-making regarding where to develop for human benefits rather than biodiversity and vice versa. Moreover, it was difficult for the municipal planners to decide which urban green spaces to enhance, preserve, or integrate in the municipal densification plans and projects. Furthermore, this lack of knowledge led to a conflict of views between the developers and planners. This was mostly due to developers not being aware of the long-term benefits of enhancing, preserving, or integrating green qualities simultaneously with the development. The planners revealed that in most cases the developers were more concerned for the short term-economic benefits, rather than the long-term environmental and social benefits.

2.3.3 Tools

Policies and tools are not well developed for green space planning (Pauleit *et al.*, 2003). Baker *et al.* (2013) also mention that IA tools are being viewed more as a hurdle rather than a useful tool for decision-making. When the municipalities were asked specifically about the role of SEA and EIA for the integration of green qualities into their densification plans and projects, many revealed the limited use of these tools. In most cases, the proposed development projects were foreseen to not have negative impacts, overlooking the potential impacts on surrounding urban green spaces; and so they were screened out at a very early stage. Also, most of the municipal comprehensive plans lacked focus on green qualities. In the instances when EIA or SEA was used, they were limited to the assessment of impacts while poorly addressing mitigation and compensation measures, as well as monitoring plans.

2.4 Strategies That Support Sustainable Communities and Urban Green Infrastructures

Sustainable communities that fully integrate urban green infrastructure approaches use community design to help simultaneously achieve environmental, economic, and social goals (Kramer, 2014). These goals include improving water quality, revitalizing neighborhoods, reducing flood risk, and providing recreational Areas that encourage physical activity.

The following strategies illustrate how urban green infrastructure can enhance sustainable communities' approaches and help achieve a wide range of goals, including to:

- ✓ Preserve and Restore Open Space, Natural Beauty, and Critical Environmental Areas.
- ✓ Create Parks, Community Gardens, and Other Public Green Spaces.
- ✓ Direct Development Toward Existing Communities.
- ✓ Create Compact, Mixed-Use Development Promote Green Building Practices.
- ✓ Build Neighborhood Streets and Trails That Encourage Walking and Biking.
- ✓ Cultivate Communities with a Strong Sense of Place.
- ✓ Encourage Community and Stakeholder Collaboration in Development Decisions.

Martina et al. (2017) stated the main principles in the planning of UGI are related to green structure (multi-object approach, integration, connectivity, multi-functionality, and multi-scale approach) and governance processes (strategic approach, social inclusion, and Trans disciplinarily)

2.5 Case study for Challenges of Urban Green infrastructures in inner City of Johannesburg and its solution

2.5.1 Challenges of Urban Green Infrastructures in inner city of Johannesburg

The inner city lies at the heart of Gauteng, the economic hub of Southern Africa. It is home to some 211,000 people, with the population expected to 256,000 in 2010. The inner city has suffered a long period of decline (Johannesburg Development Agency, 2001).

A number of factors contributed to this: high land values and rentals in the Central Business District, congestion, lack of parking spaces, and a restructuring in the office market that saw demand for office parks grow, and the subsequent development of suburban shopping malls. The process of decentralization was intensified by problems of crime and grime, unregulated

street trading, inadequate facilities for taxis. In turn, these factors lead to further symptoms of urban decay in the inner city: vacant buildings, badly maintained buildings, and squatting, illegal conversions, overcrowding, poorly serviced, and unmanaged public areas (Johannesburg Development Agency, 2001).

Johannesburg Development Agency (2001) states Some of the urban green infrastructures challenges in the Gauteng which include lack of enforcement of Municipal by-laws, particularly in relation to land-use; building control regulations, especially in relation to illegal conversions of office buildings and factory space to residential use and overcrowding of existing residential properties; and, illegal dumping and littering.

Serious problems arising from deregulated and unmanaged informal and street trading; Decay of residential buildings, lack of re-investment and maintenance, overcrowding, and illegal occupation of buildings; vulnerability of children living on the streets; homelessness; limited and inadequate public spaces and recreation facilities; Service delivery problems, particularly in regard to waste management in residential areas and street and traffic light outages(Johannesburg Development Agency, 2001).

2.5.2 Solutions taken for Challenges in inner City of Johannesburg

Focusing on the basics: Efficient service delivery, especially in regard to waste management; rapid and effective enforcement of municipal by-laws, especially in regard to building control, land use management, and street trading; effective policing and enhancement of green in the inner city; and, Expeditious decision-making.

Working Collaboratively: The document further discussed that addressing the problems of the inner city; and securing its revitalization requires the combined effort of a range of role players. Inter-governmental collaboration, and working with and securing the support of other key stakeholders for success and sustainability.

As Chirisa (2014) discussed the inner city in Johannesburg emerges that collaboration with the private sector yield best results in revitalization initiatives. And they have done five critical issues, these are.

- The city is an ecosystem with natural, social, political, and economic organisms and processes.

- To achieve sustainability in inner-city revitalization and from an ecological lens, interaction of the processes in the city ecosystem must be tapped, harnessed, and capitalized upon.
- Conceptualization and rethinking of the concept of sustainable development in cities through ecological planning and paradigms such as garden city, garden suburb, and eco-cities is long overdue.
- The principal objective of inner-city development is the redress of physical decay in cities to increase the economic base for the city and its inhabitants.
- Multi-pronged approaches for inner-city development are required and often prove to have varying degrees of success, but the best method is full participation of all stakeholders taking into account a full detail and inventory of the socio-economic and environmental assets in the inner city.

2.6 Urban Green Infrastructure Standards of Ethiopia

2.6.1 General Standards

According to MoUDH(2015) Urban green infrastructure (UGI) shall be managed and administered in the interests of the local community and shall address its needs. It provides brief note on the location, accessibility, and capacity of green and gray components of UGI.

2.6.1.1 Location, Capacity and Accessibility

- Urban Planning preparation and Implementation Strategy should allocate 30% of the land for roads and infrastructure, 30% for green Areas and shared public use and 40% for building construction in their urban land management plan.
- Accessibility standard should override the quantity standard. In circumstances where a settlement or neighborhood has a relatively high level of public green open space but some houses do not meet the accessibility standard this shall be addressed.
- Public green open spaces shall be evenly distributed within the city to keep the distances people have to travel to a green open space low
- Public green open spaces should be connected (1) with each other to create one large UGI network within the city, and (2) with green and nature in the urban fringe and outside the city. Existing natural / water / topographical characteristics of the Area should be used as starting points to guide the planning of the network and the location of the green open spaces.

- Economy: - Competent authorities may require members of the public to pay an entry fee to use public green open space. However, authorities shall keep in mind that many spaces are used by people who have no other free access to green spaces where they live, do not have gardens, do not have cars and might not be able to afford entry fees.

2.6.1.2 The Green Components

- Wherever possible, existing vegetation (especially trees) should be preserved.
- For planting in all green infrastructure elements, indigenous plant species shall be preferred and plants with invasive character shall be avoided.
- There should be diverse plant selection to improve the social, economic, and environmental value of a particular space, unless otherwise stated in different UGI elements standards.
- There should be enough space that is provided for plants to grow healthy.
- Type and size of plants, especially trees, and the required clearances and spacing etc. shall always be appropriate to the space available. Narrow Areas suggest a narrow tree and wide Areas suggest a wide tree. Wider spacing is recommended for ensuring sunny Areas, reduced spacing is recommended to provide more shady Areas.
- When selecting plants it is essential that the mature height, trunk diameter and root zone is appropriate for the location. Location and mature size of plants shall never conflict with structures and services.
- Root deflection barrier panels should be used in planting Areas located within the standard clearances.
- The location of plants should not create visual and physical obstacle (even at maturity).

2.6.1.3 The Gray Components

Pavements

- Pavements within green open spaces should be made of permeable materials, preferably cobblestones, in order to improve storm water management and groundwater recharge. Only access roads and entrances may have impermeable surfaces.
- Pavements should be of long term service with the required comfort and convenience.

- Competent authorities shall ensure a clear, unobstructed path of travel of a minimum width of 1.3 m on all pathways in green open spaces.

Fences and walls

- Living fences and walls should be preferred in all green open spaces.
- Fences and walls should be made of durable and as much as possible out of locally available materials.
- Fences shall not contain pointed finials and sharp edges.

Facilities

- All play facilities like Playgrounds should be in safe condition at all times.
- Playgrounds should have at least 5 types of play equipment.
- Pavements on playgrounds should have protective surfacing.
- Playgrounds may include seating Area for parents around the play equipments

Tree pruning

Pruning improves public safety, tree health, and overall tree appearance. Trees should be pruned away from structures, surfaces, lights, and utility lines as follows:

Buildings: all branches shall be pruned to allow approximately 1 m clearance from a building.

Street/Road – all branches shall be pruned to allow approximately 4 m clearance over the centre of the street surface and 3 m clearance at the street surface edge.

Sidewalk / path – all branches shall be pruned to allow a minimum 2 m clearance over the Pedestrian / through zone of a sidewalk or a path.

Lights – all branches shall be pruned to allow a minimum 15 cm clearance from any light.

Overhead electrical distribution / power lines – all branches shall be pruned to allow a minimum 1.5 m clearance from any overhead electrical distribution / power line.

2.6.2 Urban Green Infrastructure Elements Standards

2.6.2.1 Recreational Parks

Recreation parks are the main element in most urban green infrastructure networks or systems. Competent authorities shall establish a hierarchy of parks: Neighborhood Park, Woreda Park, Sub-city Park, and City Park.

2.6.2.1.1 Location, Capacity and Accessibility

- Parks should be located within the city so that every inhabitant can reach from his/her home within a maximum distance of: 1,000 m to 1,500 m a Woreda park (or a bigger park); and 4,000 m a Sub-city park (or a bigger park).
- A Woreda Park should be around 3 ha, can serve up to 40,000 people in a radius of 1,000 to 1,500 m, with a carrying capacity of 0.075 ha/1,000 pop., shall be located on local or collector streets, not arterial streets, and should be well accessible by public transport.
- A Sub-city Park should be around 8 ha (sub-city), can serve up to 160,000 people in a radius of 4,000 m, with a carrying capacity of 0.05 ha/1,000 pop., may be located on arterial streets ensuring safe and practical street crossings, and shall be well accessible by public transport.
- All parks should have easy, comfortable, and safe pedestrian access. All parks should be designed in a way that considers equal access for all people – people with and without disabilities, people of all age groups, and people of all socio economic statuses.
- A minimum of 30 % of the total park Area shall be appropriately laid out for people with disabilities, i.e. no steps and steep ramps shall restrict access.
- Competent authorities may choose to charge entrance fees to generate income for maintenance and operation of parks. However they shall ensure that access for low income groups is not denied.

2.6.2.1.2 Components and Facilities of Recreational Parks

The Green Components

Green coverage in all parks should be in a ratio of at least 75 % green components (i.e. trees, grasses, other plants) and at most 25 % other components. Within a park, at least 50 % of trees should be fruit trees to support food security. A diversity of plant species (ornamental trees, fruit

trees, shrubs, vines, groundcovers, grasses, and herbaceous plants) should be assured in order to guarantee the biodiversity of parks.

Woreda Park: Shall be located on local or collector streets, not arterial streets.

Gray components and facilities

Shall have a playground for children in the age group 2-10 years; shall have small formal sport facilities (e.g. half hard surface basketball court, table tennis); may have bigger formal sport facilities (e.g. hard surface basketball court, volleyball court); shall have seating and tables, litter bins, adequate lighting; should have on-street parking space; may have some off-street parking space; May have public toilets.

Sub-city / City Park: May be located on arterial streets ensuring safe and practical street crossings; and shall be well accessible by public transport.

Green components: - Shall have mostly open Areas, i.e. lawn, for passive recreational use and informal active recreational use (e.g. informal ball games); shall have more than 40 trees per ha, i.e. approx. 200 to 400 in a park of 5 to 10 ha, providing a good amount of natural shady Areas; should have ornamental shrubs and flower beds; may include some natural and semi-natural Areas.

Gray components and facilities:

Shall have a playground for children in the age group 2-10 years; should have additional playground facilities like an adventure playground; shall have formal sport facilities (e.g. hard surface basketball court, volleyball court, football field, table tennis) of which some should be lighted for night use; shall have seating and tables; shall have litter bins; shall have adequate lighting; shall have adequate number of toilets; shall have on-street as well as off-street parking space; should have storage facilities and service buildings; should integrate some storm water management practices; may have sculptures; should have food corners and small retail shops; should have first aid services; should include some urban agriculture; should have composting facilities; may have an internet café; may have a bank or ATM machine; may have a swimming pool.

2.7 Green Infrastructures in Addis Ababa

2.7.1 Availability and Accessibility of Green Spaces in Addis Ababa

Kumelachew (2015) categorized the green spaces in Addis Ababa into field crop, vegetable farm, public recreational parks, riparian vegetation, plantation forest, institutional forest (mixed forest), street plantation, and grassland. As cited in (Tekle, 2016), (ORAAMP, 2000) revealed that In Addis Ababa the functional recreational parks cover 69 ha and street plantation is estimated to cover 28 ha In recent years there have been additional development of recreational parks in urban renewal sites of Addis Ababa, like at Lideta 4.3 ha, at Basha Wolde 1.17 ha, and development of some of the proposed parks like ECA park found North of St. Estifanos church 5.2ha and at the Nations and Nationalities square, 30.5 ha bringing the per capita estimated green space to 0.46 m² when all of the proposed parks are completed and starts work (Tekle, 2016). As stated in (Tekle, 2016) the World Health Organization (WHO) standard is 9 m² and that of Africa is 7 m², hence to meet the WHO standard, Addis Ababa needs additional 2430 ha of publicly accessible green space. Seventeen proposed but not developed parks distributed in eight sub cities occupy 271.5 hectares. According to AADPPO reports of 2017, one reasons for low per capita green space in Addis Ababa (currently 0.3m²) is lack of implementing these public parks as proposed by the outdated master plan of 2002.

Table 2.2 Area coverage of different green spaces in Addis Ababa

No.	Green space	area (ha) in 2011	area (ha) in 2014
1	Field crop	14,578.3	9,834.7
2	Vegetable farm	341.1	341.1
3	Public recreational parks	69.3	69.3
4	Riverside (Riparian) vegetation	1,803.8	1,535.8
5	Plantation forest	3,372.8	3,372.8
6	Institutional (mixed) forest	1,598.8	1,549.1
7	Grassland	824.9	823.1
8	Street plantation	No data	No data
	Total Green area	266616.37	17525.84

Source: Kumelachew, Y. (2015). *Green area Typologies and mapping of green structures in Addis Ababa* ORAAMP (2000) estimated that functional recreational parks cover 69 ha and street plantation is estimated to cover 28 ha as cited in (Tekle, 2016). Recreational parks has similar coverage in study of (Kumelachew,2015) however there is no data about street tree plantations which shows that there are challenges regarding implementations, management and development that would be reveled in this study. The table above depicts that the cover of field crop, riverside, and institutional forests decrease. Whereas plantation forests and recreational parks stay constant.

Existing Environmental Map of Addis Ababa in 2002

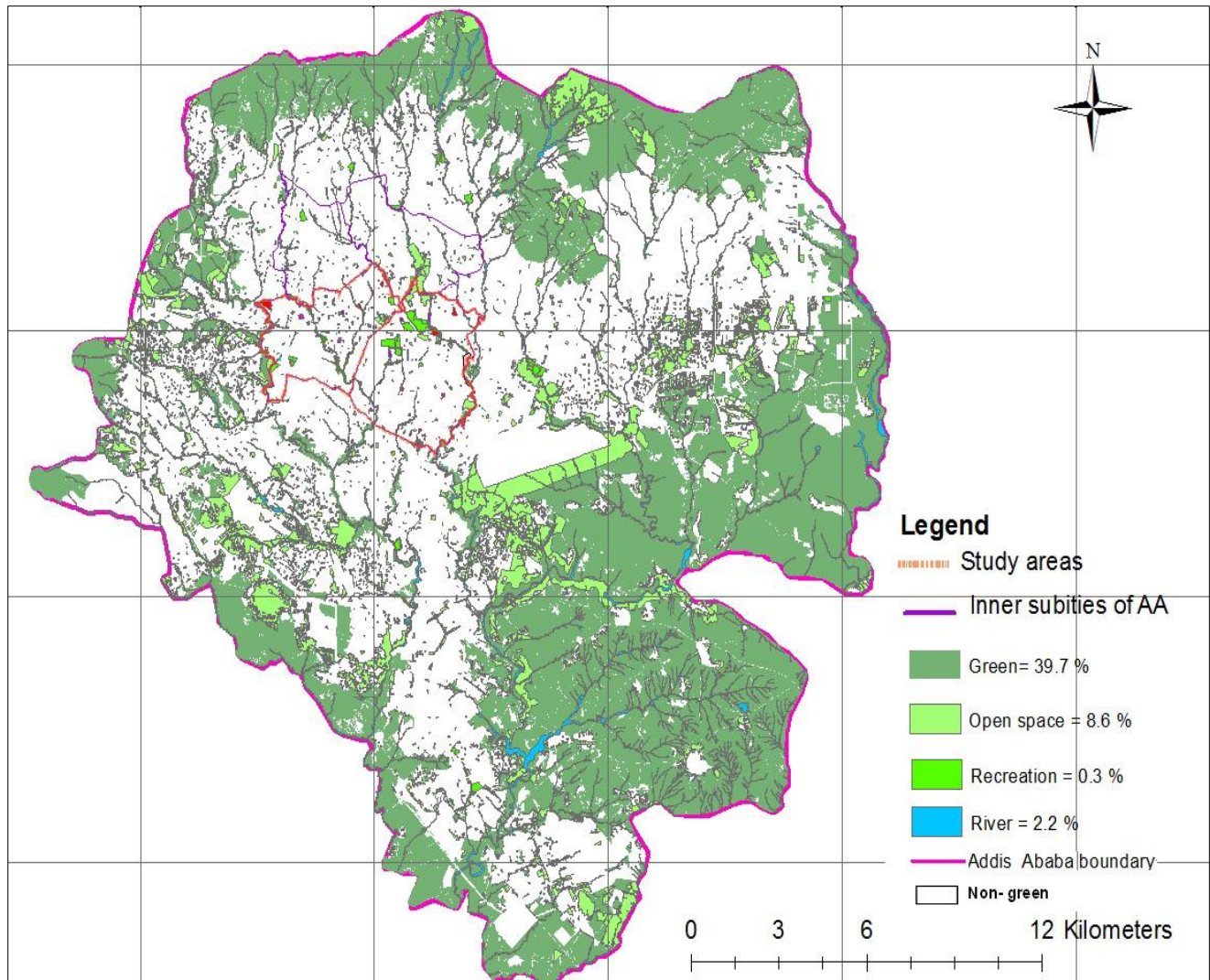


Figure: 2. 2 Existing Environmental map of Addis Ababa in 2002

Source: Office for the Revision of the Addis Ababa Master Plan 2017(illustration, 2017)

According to the figure above, from the total Area of Addis Ababa (54000 ha) 50.8% were covered with non-built functions; out of them almost 40 % of it was covered with green. As shown in the above map Inner Cities have no sufficient green spaces. The green spaces in Inner Cities can be said null as compared with other sub cities. As it is shown in the picture only 0.3 % of recreational areas that were less significant share since the demand of using recreational parks increase time to time (10th development plan of Addis Ababa reports of 2017). The presence of the green areas was beyond the standard that is provided in 10th development plan of Addis Ababa (30% of the land for roads and infrastructure, 30% for green Areas and shared public use and 40% for building construction).which shows that there is a loss of green

areas from time to time as (Kahsay, 2016) indicated 4,501 ha (15.5%) of the evapotranspiring surfaces present in 2006 were lost by 2011.

Proposed Environmental Map of Addis Ababa 2017

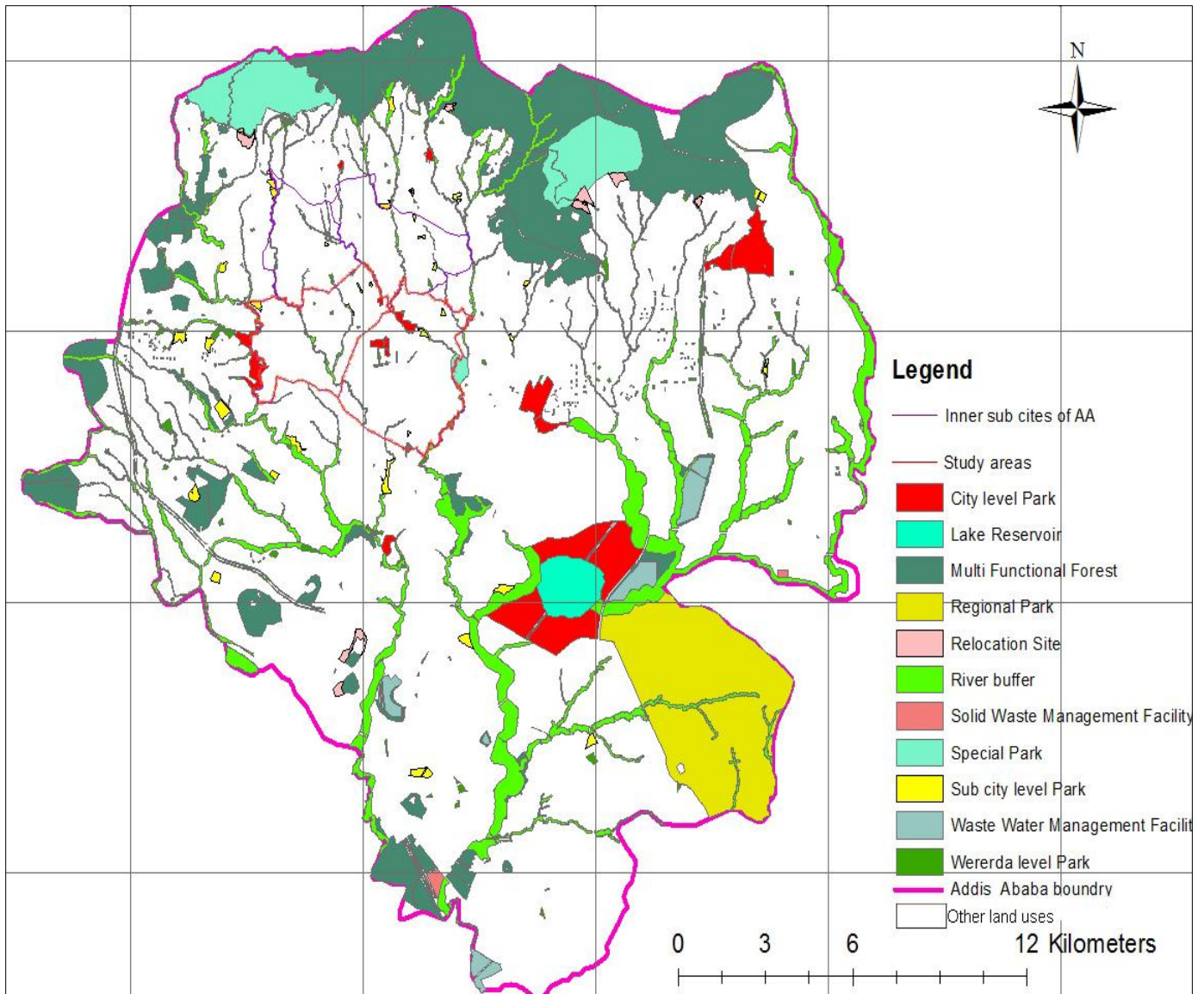


Figure2. 3 proposed Environmental map of Addis Ababa from 2017- 2027
 Source: Office for the Revision of the Addis Ababa Master Plan 2017(illustration, 2017)

In this structural plan, 15600 ha (nearly 30 %) of land are proposed for the environmental quality purpose. There will be 22 city level parks with the total Area of 1155.8 ha (2.1%) of land by increasing 7 city level parks from 15 as discussed by (Gebeyehu, 2014). According to 10th development plan of add Ababa, There will be 414 Woreda level parks in Addis Ababa with total Area of 357 ha (0.66%).

2.7.2 Recreational Parks of Addis Ababa

Parks are enclosed, designed and constructed green spaces covered with both trees and shrubs (perennial) and herbs and grasses (annual) (Kumelachew, 2011). Parks in Addis Ababa provide recreational and social (public gathering, wedding and birthday ceremony) services to the public.

SAMSON (2014) Mentions, by the time of his publication there were 16 parks owned by the government with a total Area of 122ha. Furthermore the city administration designates 342ha of the city's surface Area for public recreational parks. Among the proposed 17 public parks in the master plan, no one of them were realized in the given time period.

In Addis Ababa the functional recreational parks cover 69 ha (Tekle, 2016). At present there are 18 recreational parks in Addis Ababa, ranging in size from 0.6ha to 14.3 ha, providing recreational and social service to the city's residents.

Kumlachew (2013) Indicates Addis Ababa faces enormous challenges in providing ecological services to its residents. According to UN World Health Organization (WHO) 2012 standards, there should be a per capita distribution of 7 square meters of green Areas and parks in Africa's urban centers. What is available in Addis Ababa (0.3 square meter access to green Areas and parks) is very low by international standards. For the city of Addis Ababa to reach the minimum requirement, 2,700 hectares of accessible green areas and parks need to be developed (15th Annual General Assembly Meeting of FSS Held, 2013).

Addis Ababa's just ended ten-year Master Plan (2002- 2012) envisaged the implementation of 13 ecological/ park development projects. Only one of these projects was implemented in the last ten years. On the other hand, Areas which were designated by the Master Plan for greening and urban agriculture were used for different purposes, including condominium housing.

Gebeyehu(2014) discussed when we talk about availability of green spaces; we should consider the Area coverage and their per capita, biodiversity, location and accessibility of city parks and other green Area components. There are 15 functional parks having an Area of 81.7 hectare, which is less than the MUHDC, 2012 data (89 hectare). The total Area of existing forests and city parks is 15.24% of the total Area of Addis Ababa (54,000 hectare). Of course this size will increase if we add the other components of green Areas that are found in pocket Areas of the city like road medians, residential and institutional gardens, buffer zones, churches, private gardens, etc.

Table: 2. 3 functional parks of Addis Ababa in 2014

No	Name of the park	Sub city location	Total Area in meter square
1	Hamle 19 Park	Gullelle	67,968
2	Yekoreazem/memorial park	Gullelle	30,209
3	Sheger Park	Gullelle	54,000
4	Anbesa Gibi Park	Arada	12,000
5	Ferencay Park	Yeka	48,575
6	Yeka Park	Yeka	22,000
7	Golla Mikael Park	Lideta	9,625
8	Ethio-Cuba Park	Lideta	29,803
9	Teklehaymanot Park	Lideta	4,371
10	Ambasader Park	Arada	9,393
11	Africa Park	Kirkos	45,702
12	Akaki Park	AkakiKaliti	62,518
13	Bihere-tsigie Park	Nifas Silk Lafto	140,000
14	Kolfemenafesha	KolfeKeraniyo	20,000
15	Maekelawi (peacock)Park*	Bole	261,000
Total			817,164

Source: Gebeyehu, A. (2014). An Assessment of Green Area Development in Addis Ababa with Particular reference to Gullelle Sub city.

Gebeyehu (2014) reveals as there were no park in Addis Ketema. Lideta Condominium Park was underdevelopment but currently Lideta Condominium Park gives function. There are some recreational areas that could be representative in terms of facilities provision, affordability and social inclusivity especially elders like Bole Woreda 3 Zone 19 community development center.



Figure: 2. 4: bole woreda 3 zone 19 community development center

Source: captured by the researcher, 2017

Enough parking spaces, 4 ground tennis playing areas (for children's and adults), different games for elders like Dama, and other services that should be present in other recreational parks of the subcities.

2.7.3 Street trees

Street trees are part of the overall green infrastructure component of cities; Street tree plantation in Addis Ababa was based on aesthetic values (beautification) (Kumelachew, 2015). However, the shade provision services of street trees are found to be more important as the climate of cities gets increasing for keeping clean by sucking dusts and emissions from vehicles. Street plantation on the pedestrian roads and medians of Addis Ababa are few. Those that have been planted are not establishing and growing well because of improper site management and follow up. Tree species selection for plantation is also a problem. In several places trees planted along median create visual problem of vehicular movement thereby hindering smooth traffic flow. Many pedestrian roads are not planted with shade providing tree. Therefore, all roads with pedestrian walkway are not safe in harsh sun (Wuhan, 2013).

2.7.4 Cobblestone Roads in Addis Ababa

Cobblestone road construction project is the one that is being implemented in the urban Areas of the country in order to increase the employment opportunities and to enhance environment (Mulaw, 2015). Addis Ababa city is also the one that uses the Cobblestone project highly for the purpose of street construction, parking Areas and different pavements.

According to AACRA 2007 report, from all roads of Addis Ababa 75 % of them is constructed with in the past 25 years and 2025 km were constructed with Cobblestones with the total production of 1,420,000,000 cobbles. The constructions of Cobblestone streets are done with MSE which creates an opportunity for the employment.

According to AACRA 2007 report, 138,346,996 Cobblestones are produced with the sizes of 10*10*10, 15*15*17, and 10*20*40. It creates an opportunity for 3,846 stone crushers, 24,977 cobble chiselers , and 2,340 cobble pavers.

Destruction of some of the Cobblestones from the road part, putting any dry waste materials on the roads, destruction of curve stones from the edge of the roads, accumulation of water on the body of some of the roads and the up-side-down of the roads because of large load vehicles are some of the challenges of Addis Ababa Cobblestone streets (mulaw, 2015).

Table: 2. 4 Summary of Cobblestone development status in AA from 2002E.C to 2009 E.C

Activities	No of Job opportunities	Cobblestone road construction in KM
Cobble chiseling	188,734	With government = 276.4 km
Stone crushing	6,730	unknown
Cobble paving	3,854	With community participation=1,550 km
Total	199,318 persons	1,827.3 km

Source: Cobblestone project coordination office, February 2017

Computed by: the researcher

According to the reports of (Cobblestone Project Coordination Office,2006) Cobblestones are really important for the job opportunities and increasing living standards of the community but it should be properly constructed in order to bring high satisfaction of the people and sustainable development. MoUDH(2015) recommends Cobblestone as it is more preferable permeable materials for making pavements of different infrastructures. Example Pavements within green open spaces should be made of permeable materials, preferably cobblestones, in order to improve storm water management and groundwater recharge.

2.7.5 Challenges and Opportunities of urban green infrastructures in Addis Ababa

The Ethiopian constitution Article 44(the right to live in clean environment)and article 92(development should not damage environment),the 1997 forest policy, forest law 542/2007,the climate resilient green economy, and carbon trade are good opportunities to developing and managing green infrastructures in Ethiopia and Addis Ababa.

The revised 2002 master plan was the main opportunity as it allocates 41% of Addis Ababa for green infrastructure. But Addis Ababa has poor green infrastructure and hence it is faced with enormous environmental, social, and economic problems associated with the poor development and management of the green infrastructure. For example, the urban forest in Addis Ababa has been transformed from once dense indigenous forest to eucalyptus plantations (Horst, 2006). Meanwhile Addis Ababa is facing tremendous environmental and social problems associated with lack of appropriate green infrastructure development and management.

Dubbale *et al.* (2010) reveals that people dispose waste along roads, rivers, open spaces, and other sites, the regulation is continuously violated by the people due to lack of alternative means for disposal; even though the hygiene and environmental sanitation regulation issued by the Addis Ababa city administration (Pro. No.1, 1994) prohibits.

CHAPTER 3: DESCRIPTION OF THE STUDY AREAS AND RESEARCH METHODOLOGY

3.1 Description of the Study Areas

The study areas are located in two inner sub cities of Addis Ababa which are LIDETA sub city and Kirkos Sub City spatially they are referenced with the main east west axis of Addis Ababa.

Lideta and Kirkos sub cities are located at the inner part of Addis Ababa city with an area of 9.18 km² and 14.62 km² respectively (wikipedia.org, May 2017 at 9 am). According to CSA Projected Population of Addis Ababa, 2004 E.C, they have total population of 224,471 and 246,194 respectively. These two sub cities shared large common boundary at the west and north western part of Kirkos sub City for Lideta sub city. National Theatre to Mexico Roundabout and Mexico roundabout to Africa union round about is the boundary of the two Sub cities.

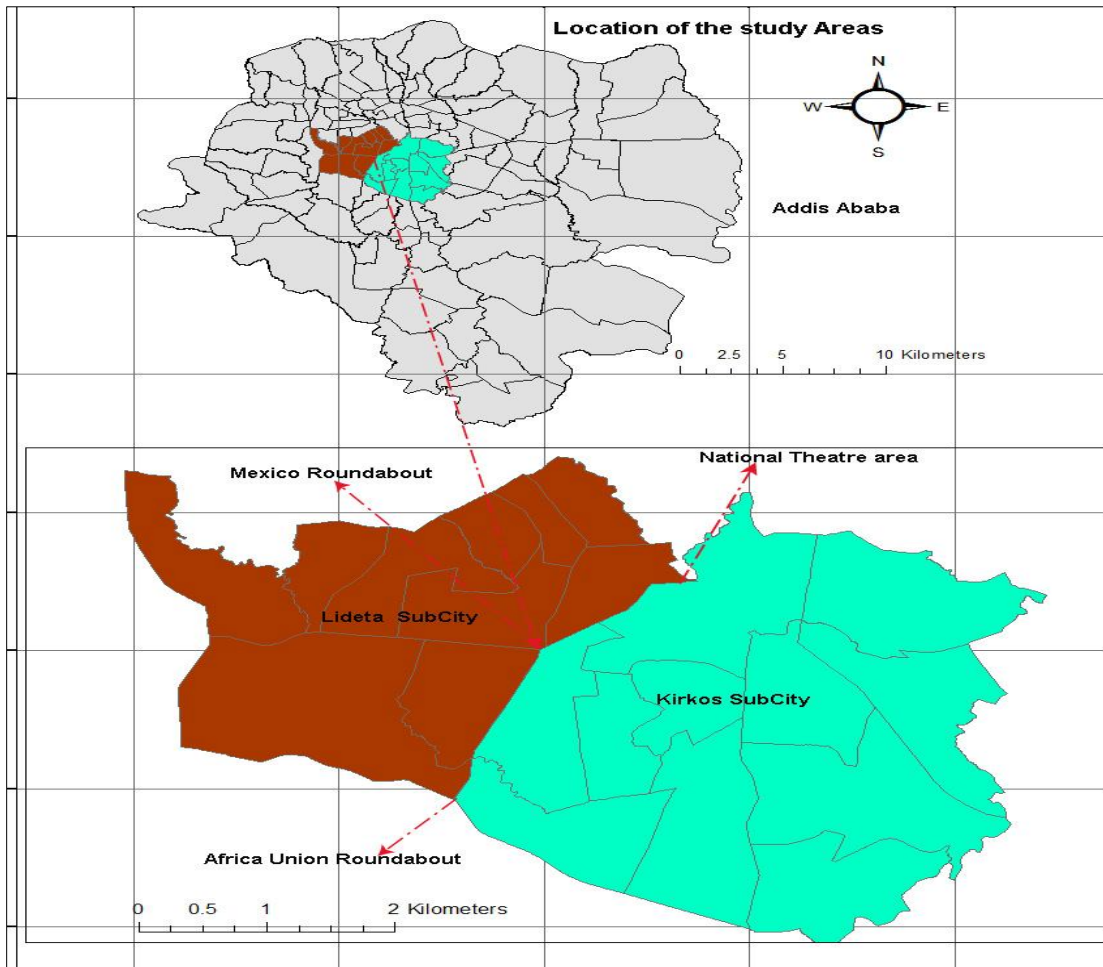


Figure: 3. 5: location of the study Areas
Source: Addis Ababa Urban Planning Institute, 2017

In order to assess the situation deeply the researcher takes one case from each selected sub cities. Initially two sub cities are selected by site selection criteria and then different thematic cases are selected in the selected sub cities.

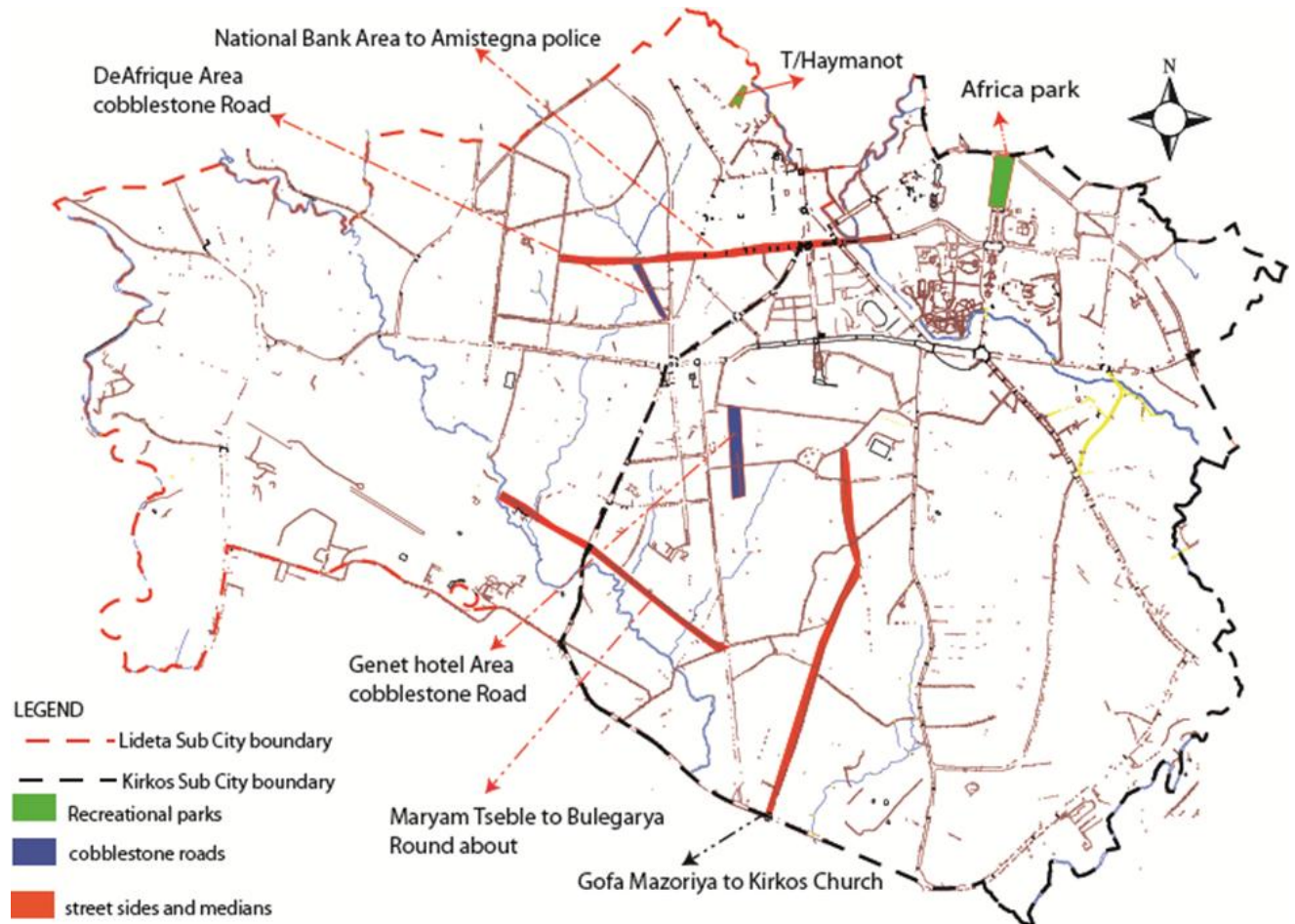


Figure: 3. 6: Location of thematic cases
Source: computed by the researcher, 2017

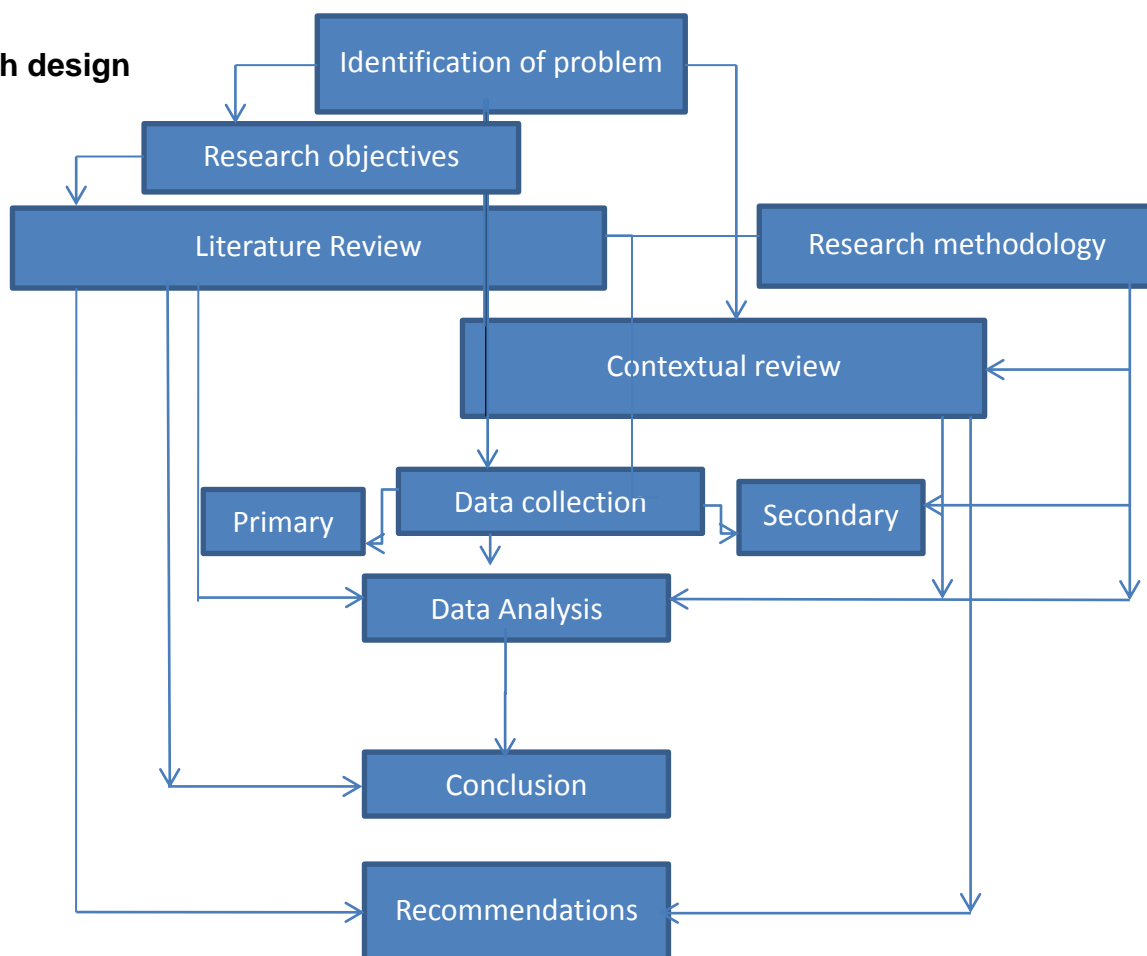
To assess the challenges and opportunities of urban green infrastructures particularly recreational parks in Inner Sub Cities of Addis Ababa; one park is studied from each selected Sub City. Tekele Hymanot Park in Lideta Sub City and Africa Park from Kirkos Sub City are studied. For the assessment of physical environmental challenges of Street sides and medians trees; one street is selected from each Sub City. The street from National bank area to Amistegna Police Station and Maryam Tseble to Bulgaria Roundabout are studied from Lideta Sub City and from Gofa mazoriya to Kirkos Church is studied from Kirkos Sub City. Like this Cobblestone roads are selected from each selected sub cities for assessment of the challenges and opportunities of permeable pavements particularly Cobblestone roads in Inner Sub Cities of

Addis Ababa. Deafricqe Area in Lideta Sub City (Woreda 8) and Woreda 6(Genet hotel Area) up to Keker building in Kirkos Sub City are studied.

3.2 General Research Methodology

The Research is based on qualitative and quantitative Approaches of research with case study methodology and it is both a descriptive and exploratory research type, because descriptive research is more appropriate to describe some aspects of phenomenon and therefore help to understand a topic and lead to causal analysis. Exploratory research is more appropriate to explore existing situations. The case study places more emphasis on the full analysis of a limited number of cases. It is holistic and a more comprehensive explanation of a phenomenon.

3.3 Research design



3.4 Case study selection criteria

Urban green infrastructures are under extreme pressures due to many factors in all Inner Sub Cities of Addis Ababa including ADDIS KETEMA, LIDETA, KIRKOS, and ARADA Sub Cities. These sub cities are characterized by high pollution, overcrowded settlements, and high commercial activities. Among these Inner Sub Cities, **LIDETA, and KIRKOS Sub Cities** are selected based on the following criteria.

- The green infrastructures availability especially more recreational parks.
- Availability of different proposed renewal designs which are not implemented. Therefore there are chances to develop other options which include the UGI.
- Main city center of Addis Ababa, National Theater Area, is located at the boundary of LIDETA and KIRKOS Sub City. Since it is an important and strategic location for the social & economic activities of the city mainly through its direct physical linkages to the rest of the city. The area also offers diverse use, which include residential, offices leisure sport, commercial activities, schools, hospitals, and religious establishment and sport facilities.

3.5 Types and Sources of Data

In this study, both primary and secondary data are utilized. For assessing the challenges of urban green infrastructures the researcher has used both primary and secondary data. Primary data are collected from Questioners, interview and field observation of the study Areas. Secondary data were collected by reviewing documents. The sources of primary data were Addis Ababa urban planning institute, Addis Ababa city environmental protection agency, LIDETA and KIRKOS Sub City municipal office, Addis Ababa city road authority, Addis Ababa water and sewerage authority, Addis Ababa and LIDETA Sub City SBPDA and KIRKOS Sub City sanitation, beautification, and park development Agency . On the other hand for the assessment of opportunities of urban green infrastructures primary data are collected from interview of professionals from the above organizations.

3.6 Data collection methods

For gathering primary data the researcher has employed questionnaires, interviews and field observations, and Discussing and consulting with professionals, and reading books and literature Review for secondary data.

Questionnaire: Majorly close ended Questionnaire method was used in this study because it was important to collect data about the challenges of urban green infrastructures from the residents specifically for recreational parks and Cobblestone roads.

Interview: In this study, the researcher has used majorly semi structured close ended interview because it helps to extract depth information about the challenges and opportunities; and the researcher and participant/s / set some broad parameters to a discussion.

Observation: It has been used to identify the challenges of urban green infrastructures particularly recreational parks and Cobblestone pavements in the study Area.

3.7 Data Analysis methods

Since the study has been both qualitative and quantitative: description, classification, and data analysis started before having a full set of data for qualitative data. This helped to make sense of the data was being gathered and also guide further data generation. Different soft wares such as SPSS (statistical package for social science), Arc GIS (geographic information system), and Excel were used as tools to analyze the data in the form of percentages, graphical, charts and tabular analysis. Cross checking of different materials has been made to ensure the accuracy and relevance of secondary source. **Triangulation** is a technique used for cross checking of the result of the analysis so that the researcher comparatively analyzed the questionnaire results ,observation results, interview results, and documents data in order to arrive at conclusion.

3.8 Sampling Method

One Sub City level recreational park, one Arterial Street, and one collector Cobblestone Road were selected from each selected sub cities by purposive sampling technique.

For data collection from residents Nonprobability convenient sampling and probability Stratified random sampling were used as follows:

Nonprobability convenient sampling was employed for collecting data about challenges of recreational parks through questionnaires from users. First the anticipated numbers of users in park with a week have been taken from the cashier then conveniently samples were taken. In the case of Tekele Haymanot Park around 700 users enter per week. 70%(500) of the users enter in the park for the purpose of meeting in the form of Idir, Ikub ,etc; the rest 200 users come for recreation; so that conveniently 20 % (40) of the users were taken. Africa Park around

200 users come per week, so that conveniently 20 % (40) of users were taken. For this case questionnaires were distributed for 5 days in working hours of the recreational parks especially by weekend in each selected park. In addition interview were employed from each organization which is Addis Ababa city road authority, AACGSBPDA (Addis Ababa city government sanitation, beautification, and park development agency), AAEPA (Addis Ababa environmental protection agency), AAUPI (Addis Ababa urban planning institute), and LIDETA and KIRKOS Sub City SBPDA (sanitation, beautification, and park development Agency).

Conveniently officials were selected from each institution; Addis Ababa city road authority, Addis Ababa environmental protection agency, Addis Ababa city government sanitation, beautification, and park development agency, LIDETA and KIRKOS Sub City sanitation, beautification, and park development Agency, Addis Ababa water and sewerage authority and Addis Ababa urban planning institute for collection of data about physic- environmental challenges of Street sides and medians trees.

stratified random sampling technique were used for collection of data about permeable pavements particularly Cobblestone Roads, First the households near or with in the planning distance were clustered in three categories which are 5m, 10m, 15m from the Cobblestone roads then respondents are randomly selected and totally 150 samples are taken. Beside this interview are employed for Addis Ababa city road authority, Addis Ababa environmental protection agency, Addis Ababa city government sanitation, beautification, and park development agency, LIDETA and KIRKOS Sub City sanitation, beautification, and park development Agency, Addis Ababa water and sewerage authority and Addis Ababa urban planning institute.

To get data about opportunities of urban green infrastructures in inner Sub Cities of Addis Ababa different documents were studied and one interview was held for each organization from Addis Ababa city road authority, Addis Ababa city government sanitation, beautification, and park development agency, LIDETA and KIRKOS Sub City sanitation, beautification, and park development Agency, Addis Ababa environmental protection agency ,Addis Ababa water and sewerage authority and Addis Ababa urban planning institute.

Table: 3. 5: Summary of data collection and analysis methods

N O	PURPOSE	DATA USED	DATA COLLECTION METHODS	DATA SOURCE	METHODS OF DATA ANALYSIS	DATA INTERPRETATIO N AND PRESENTATION METHODS
1	To show spatial distribution, and connectivity of urban green infrastructures	Nortech map, existing land use map, different proclamations and standards	Documents Nortech	Lideta and Kirkos sub-city municipality office, AAEP, AASPDA	Mapping, referencing, narration	GIS, AUTOCAD
2	To assess the challenges of recreational parks	Existing land use Images Results from questionnaires', and interview Recreational parks Standard	Observation Questionnaire Interview	Lideta and Kirkos sub-city municipality office Residents AAEP, AASPDA, AAWSA	Description Mapping tabulating referencing triangulating	GIS SPSS EXEL
3	Physical- environmental challenges of Street sides and medians trees	Results from interview Images	Observation Interview	Residents, AACRA, AAEP, AASPDA, AAWSA	Description Triangulating	
4	To assess the challenges of permeable pavements particularly Cobblestone	Results from questionnaires', and interview Images	Observation Questionnaire Interview	Residents LIDETA and KIRKOS Sub City Cobblestone project office, AACRA, AAEP, AAWSA	Description narration tabulating referencing triangulating	SPSS EXEL
5	To Identify opportunities of urban green infrastructures	Different documents Results of interview from officials	Reading Interview	Internet AACRA, AACGSBPDA, LIDETA and KIRKOS Sub City SBPDA, AAEP, AAWSA and AAUPI	Narration Referencing	

CHAPTER 4: RESULTS AND DISCUSSION

This is the main part of the research to answer research questions and objectives which are mentioned in the first chapter in line with challenges and opportunities of Urban Green infrastructures particularly recreational parks, Street sides and medians trees, and Cobblestone roads in Lideta and Kirkos sub cities of Addis Ababa.

4.1 Respondents' Information in the Study areas

The occupation of users has direct and indirect implications for the challenges and opportunities of urban green infrastructures particularly to recreational parks in terms of facilities that should be provided and enhanced. Example students need calm area (space) for reading. It is shown in the table 4.6 in Tekle Hyamont Park 57.5 % is government, 35 % private and 7.5% of them are students. Similarly in Africa Park 67.5 % is private, 30% are government, and the rest 2.5 % are students. However 95 % of the respondents (35 out of 40) in Africa Park come with their children. The variety services given by the park and occurrence of different occupation of park users have direct relationship.

Table: 4. 6: *Respondents' information in the Study Areas*

Africa park	Frequency	Percentage	Tekele haymanot park	Frequency	Percentage
Government	23	57.5	Government	12	30.0
private	14	35.0	private	27	67.5
student	3	7.5	student	1	2.5
Total	40	100.0	Total	40	100.0

Source: computed by the researcher, 2017

Age structures of the Respondents have many implications and interpretation for recreational parks. For example Children need more play grounds than adults and elders. On the other hand adults need sport fields however they use the space for illegal activities rather than the intended value of the park.

Table: 4. 7: *Age of Respondents in the park*

Africa park	Frequency	Percent	Tekele haymanot park	Frequency	Percentage
<18	4	10.0	<18	2	5.0
18- 30	13	32.5	18- 30	17	42.5
30-40	15	37.5	30-40	10	25.0
>40	8	20.0	>40	11	27.5
Total	40	100.0	Total	40	100.0

Source: computed by the researcher, 2017

As we can see in table 4.7, 57.5 % of respondents in Africa park are above 30 years old ,32.5 % are in between 18-30 but as described in above paragraph, park manager of Africa park asserts that nearly 95 % of them come with their under 10 children. On the other hand in Tekele Hymanot Park 42.5% of respondents are old, 42.5 % are in between 18-30 years old and 5 % of them are below 18 years old. All Respondents in Tekle Hymanot Park come to the park to recreate themselves and about 95 % of them are above 18 on the other hand nearly 95 % of the park users are in Africa Park are children.

4.2 Urban Green Infrastructures in the Study areas

As discussed by Anna (2016) and Asmelash (2013) Urban green infrastructures are open Areas such as urban forests, large public parks, gardens, playing fields, rights-of-way along streams and roads, and constructed features such as green roofs, permeable vegetated surfaces, swales, rain gardens, and “green streets” In the same way; Ethiopian green infrastructure manual (2015) categorized UGI into 17 types. However Cobblestones are not categorized under urban green infrastructures, but they are important for infiltration and cleaning of wastes so that it is environmentally friendly and permeable surfaces thus they can be categorized as urban green infrastructures since many scholars including Benedict & McMahon (2002) included preambles pavements under UGI. In addition to this Cobblestone decreases the pollutants that are generated from vehicles for excavating, dumping, rolling, etc so that the researcher concluded that it is pollutant free which is one of the reasons to be urban green infrastructure.

In Lideta and Kirkos Sub Cities, there are different types of urban green infrastructures such as recreational parks, street medians and side greens, Cobblestone pavements, urban agriculture, cemeteries like in Kirkos church, and church’s green areas like Kirkos and Lideta churches, Roundabouts, street islands, rivers and rivers sides are found but they are not enough as it is compared with the standard and as the study areas are featured with high population density and dense settlements. Each of the above urban green infrastructures has their own challenges and problems in Lideta and Kirkos Sub Cities.

As cited in Tsige (2015) Rouse and Bunster (2013) put six principles should be fulfilled in the planning and design of green infrastructures .Thus include multi functionality, connectivity, habitability, resilience, identity and return on investment . However the study tried to assess only connectivity and Distribution of urban green spaces; as shown in the figure 4.8 and 4.9, green

spaces have no connectivity; sub city recreational parks are located at one side of the sub cities which decreases the accessibility of the park shown in figure 4.10.

According to the standard of Addis Ababa development plan project office (2017); 30% of the city should be planned for urban green spaces however the green space coverage for the two sub cities is about 13 % which is still below the standard (considering the study areas as city) due to the increase in impervious surfaces. This resulted less evapotranspiration and finally causes urban heat island, pollution, climate change and other environmental issues.

Inner cities of developing countries urban green infrastructures do not give the intended purpose and do not fulfil the need of people (CLUVA, 2013). A multi-functionality assessment of urban green infrastructures, using the urban morphology types (UMTs) as its basis, was held to start assessment of the provision and need of different ecosystem services in Addis Ababa and dar es salaam. Lideta and Kirkos sub cities are being in inner part of the city the provision of the urban green infrastructures were low and high need of different ecosystem services in 2011 as shown in the figure 4.7 below.

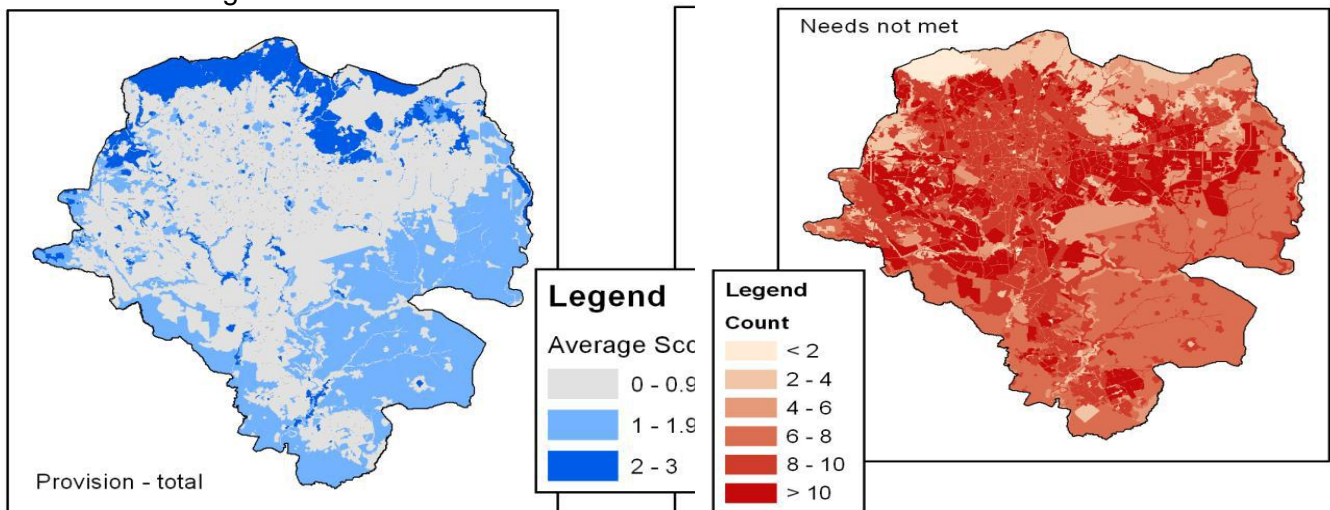


Figure: 4. 7 ecosystem services provision and need assessment respectively in Addis Ababa 2011
Source: CLUVA, 2013

Availability, Distribution, and Connectivity of Urban Green Infrastructures in Lideta and Kirkos Sub Cities in 2002 and in 2012

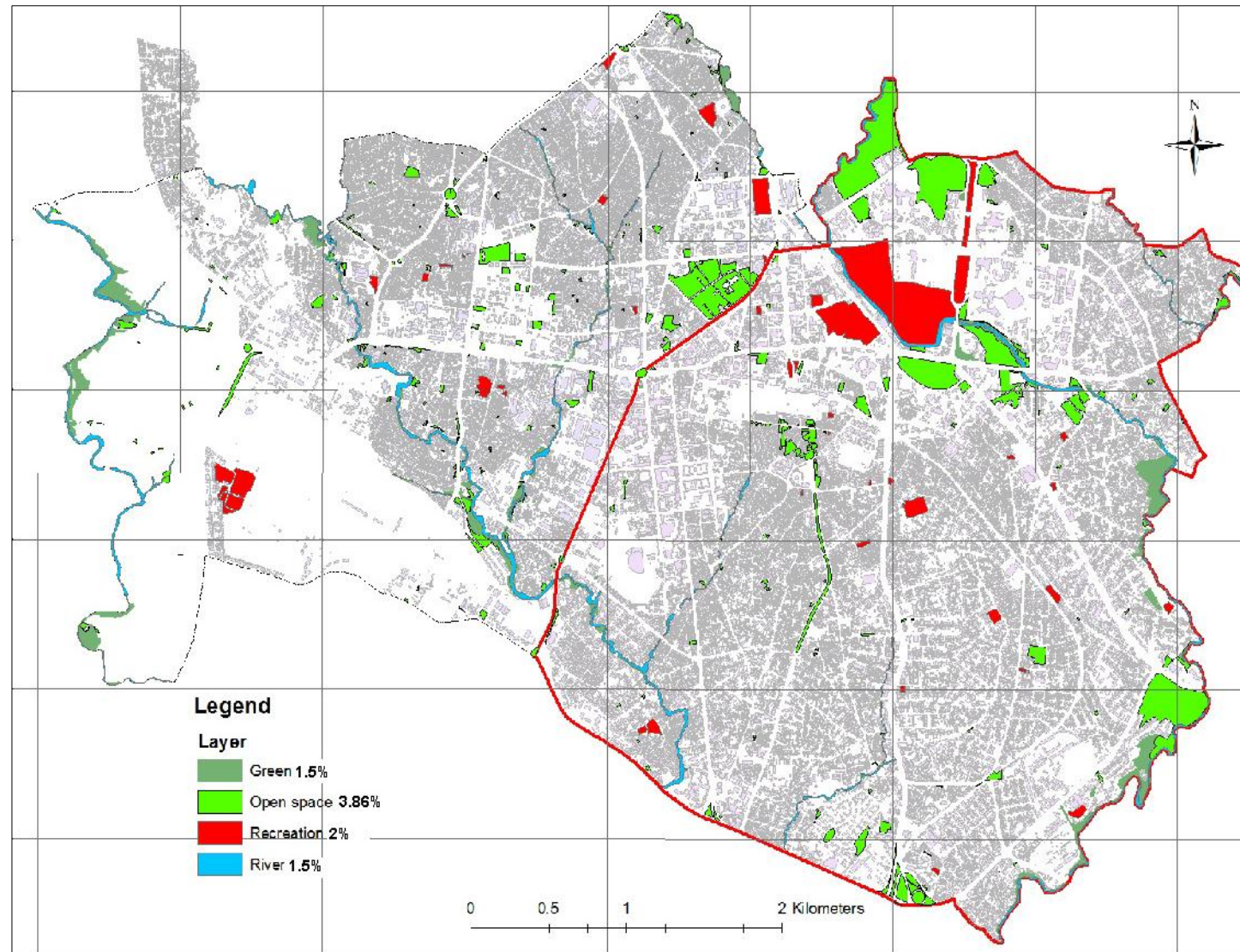


Figure: 4. 9: Availability, distribution, and connectivity of Urban Green Infrastructures in Lideta and kirkos Sub Cities in 2002
 Source: AAUPI, 2017

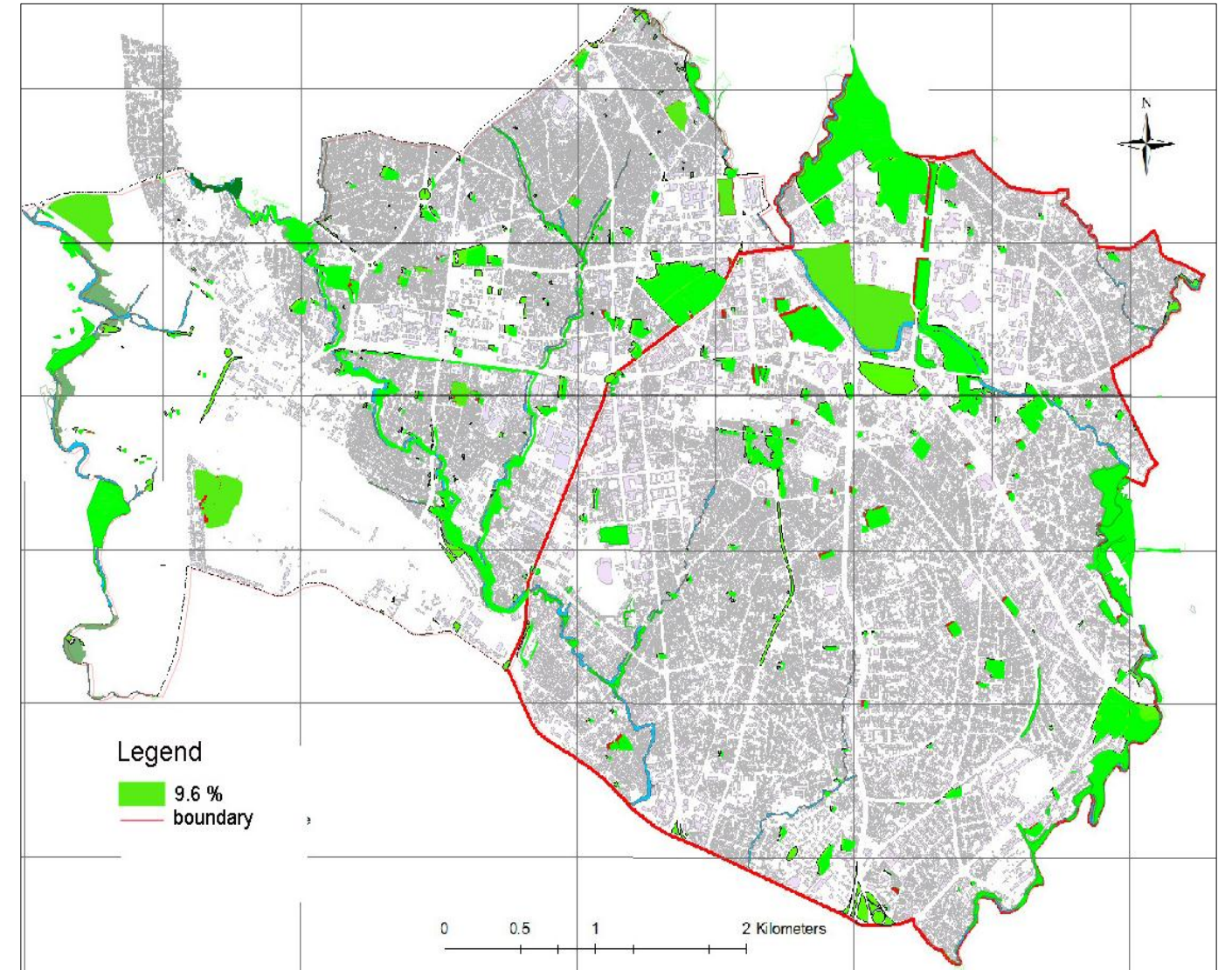


Figure: 4. 8 : Availability, distribution, and connectivity of Urban Green Infrastructures in Lideta and kirkos Sub Cities in 2012
 Source: AASPPO existing survey, 2012

As shown in the figure 4.9 above, in 2002 the urban green infrastructure coverage in Lideta and Kirkos sub cities were 8.6 % of the total area and 9.6 % in 2012 as shown in figure 4.8. Connectivity is one of the principles that must fulfilled in the planning and design of green infrastructures .how ever green spaces are fragmented in Lideta and Kirkos sub cities as shown in the figure 4.8 and 4.9. Distribution is also another principle that must be fulfilled which basically focuses on the scattering of urban green spaces at different places sufficiently and equally, but they are fragmented and concentrated arbitrary.

According to the officials from the development plan project office and AASBPDA there are no significant development of green spaces that have significant changes. Figure 4.9 implies the availability of urban green infrastructures in inner sub cities are still low. MoUDHC manual ,2014 classify green infrastructures into 17 types, but according to the analysis made in this study the following urban green infrastructures available in the study areas shown with their percentages with comparing the plan of 2002 and development plan of 2017.In 2002, green space coverage was (1.5 %), open spaces (3.86%), recreational areas (2 %), and rivers buffers(1.5 %).according to development plan of 2017 urban green infrastructures that are proposed and AASBPDA 2008 report in the study areas are as follows

Table: 4. 8 urban green infrastructures in Kirkos and Lideta sub cities

UGI type	NO	Area	%age	REMARK
City level park	7	117.7 ha	4.9 %	Including Proposed
street sides and Medians	70	8 ha	0.34 %	existing
Roundabouts	16	5.4 ha	0.23%	existing
Street islands	8	0.4 ha	0.02%	existing
City level stadium	1	8.16 ha	0.34%	existing
River buffer	37	106ha	4.45%	Including proposed
Sub city level park	8	20ha	0.84 %	>>
Sub city level stadium	1	3.9ha	0.16%	>>
Urban agriculture	3	1.2 ha	0.05%	>>
Woreda level play ground	12	8.2 ha	0.34%	>>
Woreda level park	38	29.9 ha	1.25%	>>
Total		309.26 ha	12.92%	

Source: AADPPO, 2017(written in black) and AASBPDA 2008(written in red) report

Without incorporating others, 12.92 % of the study areas are covered with the urban green infrastructures shown in table 4.8 above which shows the increment of green spaces coverage in the study areas. Especially the coverage of recreational parks reached 7.83 % which has shown 5.83 % increment.

Accodrding to the Urban Upgrading and Renewal Manual(2006) of Addis ababa neghibourhood open spaces and children playing areas must be provided how ever based on the 75% respondents of africa and tekkel hyamanot park, they lack such facilites at their negibourhood.

Distribution of Proposed Urban Green Infrastructures in Kirkos and Lideta sub cities in Development plan of 2017

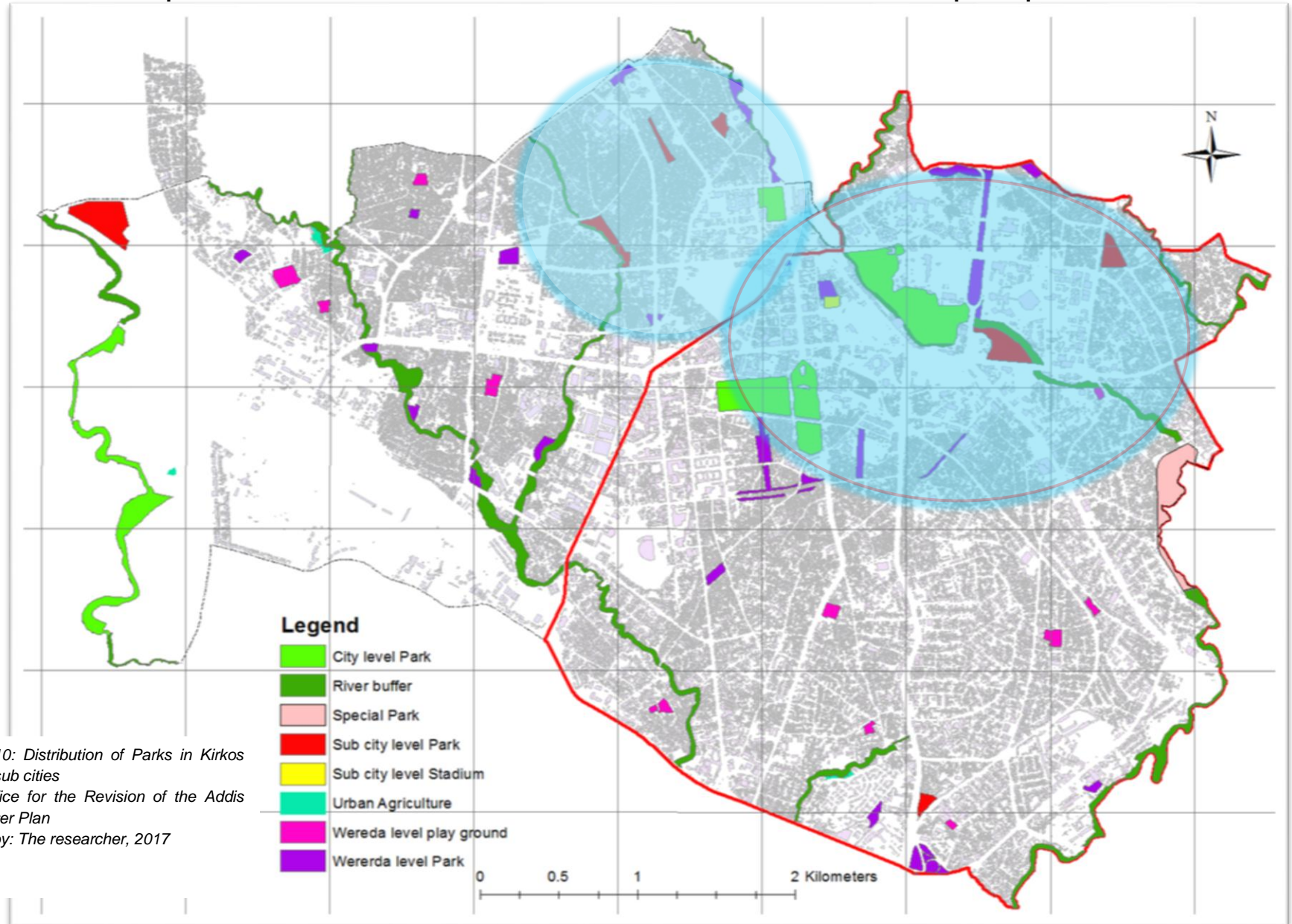


Figure: 4. 10: Distribution of Parks in Kirkos and Lideta sub cities
 Source: Office for the Revision of the Addis Ababa Master Plan
 Computed by: The researcher, 2017

4.2.1 Recreational parks in Lideta and Kirkos sub cities

4.2.1.1 Lideta Sub City

MoUDH(2015) standard states that Sub-city / City Park Shall have mostly open Areas, i.e. lawn, for passive recreational use and informal active recreational use (e.g. informal ball games); shall have more than 40 trees per ha, i.e. approx. 200 to 400 in a park of 5 to 10 ha, providing a good amount of natural shady Areas; should have ornamental shrubs and flower beds; shall have a playground for children in the age group 2-10 years; should have additional playground facilities like an adventure playground; shall have formal sport facilities ;shall have adequate lighting; shall have adequate number of toilets; shall have on-street as well as off-street parking space; should have storage facilities and service buildings; may have sculptures; should have food corners and small retail shops; should have first aid services; should include some urban agriculture; should have composting facilities; may have an internet café; may have a bank or ATM machine; may have a swimming pool.

Tekele Haymanot Park: the area of the park is 3632m²; In this park there is one cafeteria that serves the users food and non-alcoholic drinks without entrance fee and administered by one private shared company with 5 years extended agreement from now. Initially it was hired with 118,124 birr per month from 14/08/04 E.C to 14/08/04 E.C by the same company. However, based on the observation and the interviews from the officials and guardians in the park, there are alcoholic drinks and forbidden activities in the park.



*Figure: 4. 11 : partial view of Tekle Haymanot Park
Source: field observation photo taken by the researcher march, 2017*

The park lacks the above mentioned facilities at Sub City level; about (50%) satisfied with green components of the park since they are in good conditions (not dried, not damaged and etc), but there are challenges and problems observed in the park and park users complain about. The park has no enough shelter, no enough toilets (only1) and lacks hygiene, no enough shower

rooms (completely closed), scarcity of water, most of the benches are broken, the fences are weak, smell exist from dumping wastes in the area and etc. construction of huge store house that does not balance with the area of the park consumes the green area.

Figure 4.10 depicts that ornamental plant species are dominated and kept well. Referencing official's in the park, most of the time the park spaces are used in groups ranging from 20-30 people.

Gola Park: According to SBPDA the park has an area of 9625 m² and it needs 16 employs but currently it has 22 employs who work both in Lideta Park and Tekele Haymanot Park.



Figure: 4. 12 partial view of Gola Park
Source: captured by the researcher, 2017

Green components of the park are good but islands and fences for islands are damaged, they need to be repaired. There is national selection committee board office inside the park. The cafeteria in the park is outsourced to private firms like Diasporas from Saudi. A residential building that was initially owned by Armenian exists in the park which leads to conflict in the rights of the property with the SBPDA and the land holders.

Lideta Park: This Park has an area of 12192m², is developed recently, and does not start work officially now. This park was given to private developer with bid at the cost of 65,000 birr and it had 70 workers but now it is on the way of procurement to develop and manage the park

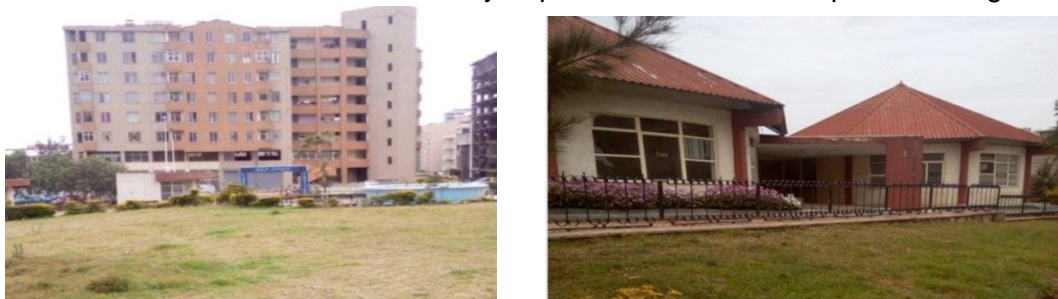


Figure: 4. 13: partial view of Lideta Park
Source: field observation photo taken by the researcher march, 2017

Figure 4.12 paints as there is open spaces that are not planted which indicates that different trees and shrubs should be planted soon. Beyond this the species type planted are not diversified. The fences used are iron bars and black color which are against the proclamations of (MoUDHC, 2015) that states construction materials of fences should be local and the color of the fences should be harmonized with the surrounding building color.

Ethio Cuba Park: This Park has an area of 29803m² and located next to black lion hospital. According to the reports of (AASBPDA, 2008) and officials interview from SBPDA reports the park need 23 people but it was 17 workers and the problem still goes on. The construction of the park is given to ETITE Construction Company, currently the work is completed and starts work without entrance fee.



Figure: 4. 14 view of Ethio Cuba Park

Source: Google earth 2017 and (Addis Ababa main city center urban design guideline, 2015)

Based on Addis Ababa main city center urban design guideline(2015) it is intended to accommodate passive and active recreational activated ranging from reading & therapeutic activities for patients from the immediate Black Lion Hospital to children play such as skating area and occasional live performances.

4.2.1.2 Kirkos Sub city

Africa Park: In Kirkos sub city, there are 2 parks that are already developed but they are not administrated by the sub city sanitation, beautification cemetery, and park development agency. According to the officials interview from AASBPDA and workers interview in the park; The Park has designed and developed with 3 parts with the name of Addis Ababa Park, Ethiopia Park, and Africa Union Park with total area of 45707m². It is administered by MEDROC Ethiopia, with an entrance fee of 20 birr for children under 12 years; 30 birr for adults above 12 years and 60 birr for camera use.



Figure: 4. 15 partial view of Africa Park
 Source: field observation photo taken by the researcher, March 2017

Based on researcher's observation and interview of the park manager, The Park has developed in good standard and quality materials relatively to other parks in Addis Ababa in children playing equipment's especially in outdoor games; but it lacks parking area. Currently only Africa Park gives services but Addis Ababa Park and Ethiopia Park are closed due to security reasons.

Olympia Park: It has an area of 647m², is developed in good way, and starts work recently. Half of the park is developed by private developer and has good quality of green but it lacks benches.

ECA Park : General Manager of AASBPDA (W/O Almaz) has discussed that the area of the park is 167,900 m² and it contains many facilities that could make the park better than the rest of parks in terms of quality, inclusivity, accessibility, and etc. however there facilities that cannot be feasible to the users for example the climbing mountains and the caves constructed are not big enough. The construction of the park is not completed yet it is because of some improvements.

4.2.2 Availability and Distribution of Street sides and medians trees

According to AASBPDA reports of 2016 reports shown in annex II Table 9, there are 21 street sides with total area of 21425m² in kirkos sub city and 7 with total area of 8400m² in Lideta sub city. Most of them are developed by the government and the rests are developed by private developers.



Figure: 4. 16: sample pictures on streets from Gofa Mazoriya to Kirkos church and National area to Amestigna
 Source: computed by the researcher, 2017

Gofa mazoriya to Kirkos church and Bulgaria to Africa union along Michael church are studied from Kirkos and National Bank Area to Amistegna police station from Lideta sub city.as described in AASBPDA reports of 2008 E.C; there are 22(13600m2) street medians in Kirkos and 8 (7420 m2) in Lideta with the total area of 21020 m2.around 55 % of street medians are developed by the government, 30 % of it was undeveloped.

4.2.3 Availability of Cobblestone Roads in Kirkos and Lideta sub cities

According to Lideta community development and participation office reports of 2009 the Cobblestone coverage in the sub city starting from initial work up to now is 22,221 km. on the other hand according to Kirkos community development and participation office reports of 2009 26,268 km of the streets in the sub city are covered by Cobblestone. On the other hand according to AACRA 2017 reports there are 20,740 km and 29,666 KM Cobblestone roads coverage in Lideta and Kirkos Sub Cities respectively.

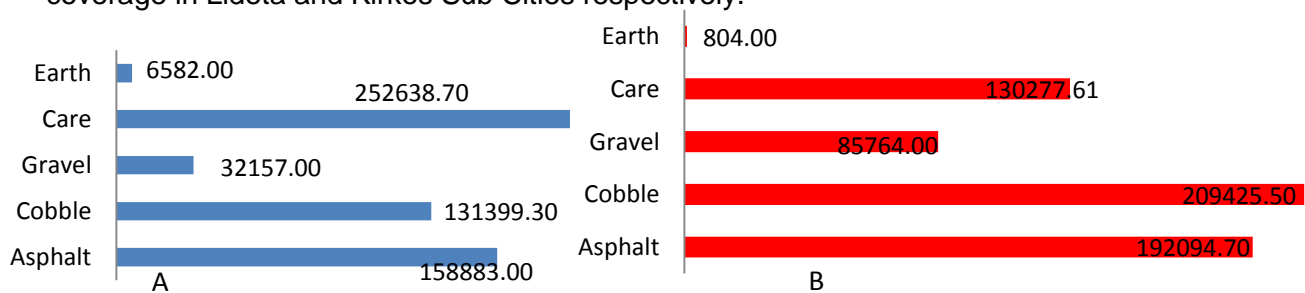


Figure: 4. 17 A and B: Area coverage of road surface types in KM² in Lideta and Kirkos Sub Cities respectively

Source: AACRA, 2017

4.3 Challenges of Recreational Parks in the Study areas

Generally, as stated by Sara et al. (2015), urban green infrastructures have challenges like lack of collaboration and communication; lack of knowledge regarding green spaces and qualities; and the inefficient use of Environmental impact assessment tools. Specifically parks have challenges of inadequate investment in landscaping, playscapes, ball fields, walking and biking trails, recreation centers, and other community facilities in large cities (Association, 2011). However for the purpose of this study the challenges of recreational parks have been categorized as social, economic, Environmental, physical ,capacity building, etc which are discussed as follow. Thus the following discussions were made with respect to these categories for the study areas.

4.3.1 Social challenges

Parks can foster appreciation of different cultures and lifestyles (Gobster, 1998). However as stated in (Hutchinson, 1987, Loukaitou-Sideris, 1995) different ethnic groups want to use park space in different ways. It has been recorded as a challenge for park developers and park users to bring socially Inclusive Park. On the other hand Limited and inadequate public spaces and recreation facilities and Service delivery problems are mentioned as the social challenges of recreational parks (Johannesburg Development Agency, 2001). Besides these other social challenges are revealed in this study particularly in Africa Park and Tekele Hymanot Park.

4.3.1.1 Unfair distribution and inaccessibility of recreational parks

The major social factor in the provision of recreational parks is to ensure their availability and accessibility with in predefined catchment. However, one of the social challenges that are revealed in this study is unfair distribution and lack of accessibility of recreational parks.

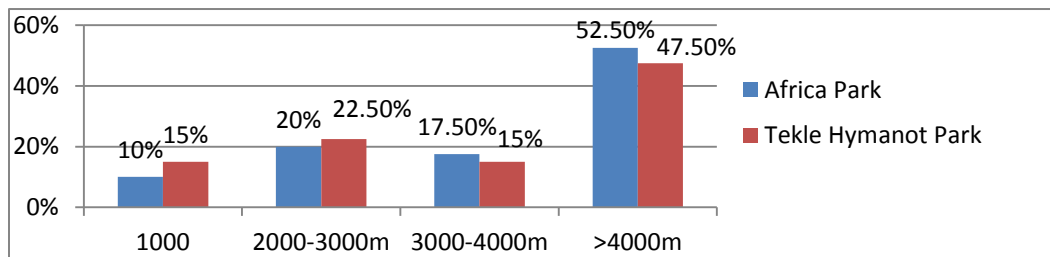


Figure: 4. 18: Park users response in Africa and Tekle Hymanot Park about Distance from near park
Source: computed by the researcher, 2017

According to MoUDH (2015), Accessibility standard should override the quantity standard and Public green open spaces shall be evenly distributed within the city to keep the distances people have to travel to a green open space low. 85 % of park users in Tekele Hymanot go greater than 2000m to get park.90 % of the park users in Africa park said that they go more than 2000 m to get park and 52.5 % of them go more than 4000m as shown in the figure 4.17. Parks should be located within maximum distance of: 1,000 m to 1,500 m a Woreda park (or a bigger park); and 4,000 m a Sub-city park (or a bigger park) so that every can reach from his/her home.

As shown in the figure 4.19, about 65 % of the respondents said that, it took them 20 minutes and more to reach the nearest Sub City or Woreda Park. Even if people should get parks not more than 15 minutes walking distance.

Time taken to reach near park at Respondents local area

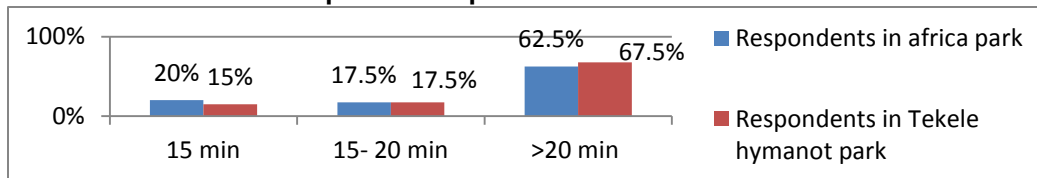


Figure: 4. 19 Park users Response in Africa and Tekle Hymanot Park about Time taken to reach near park
Source: computed by the researcher, 2017

17.5 % of respondents indicated that they need to travel 15 minutes to reach the nearest park to relax or spend their leisure time. However the significant number (81.5 %) of respondents replied that they shall travel more than 15 minutes to access the nearest park. These respondents attested that they are not in a good position to find parks near their area of residence. The study testified that the distributions of recreational parks in Addis Ababa do not consider the population and accessibility. The level of satisfaction of the respondents due to mere distribution of recreational parks is shown in figure 4.19.

Satisfaction of Respondents in distribution of sub city parks

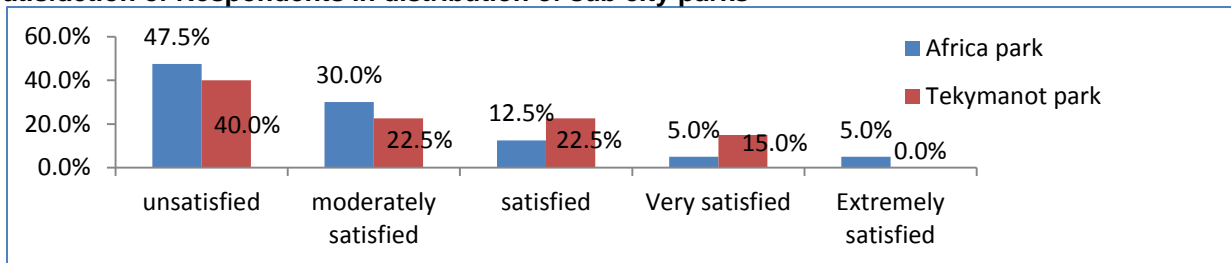


Figure: 4. 20 level of Satisfaction of Park users in the distribution of sub city parks
Source: computed by the researcher, 2017

Figure 4.20 above depicts that about 78 % of the respondents drawn from Africa Park and 63 % from Tekele Hymanot park testified that they are not satisfied with the distribution of sub city parks .Only about 30 % of them replied that they are satisfied with the distribution of sub city parks which indicates that there is problem of planning in the supply and demand of the park in inner sub cities of Addis Ababa as it is also discussed by the W/ro Almaz Mekonnen AASBPDA manager.

Satisfaction of sub cities park accessibility

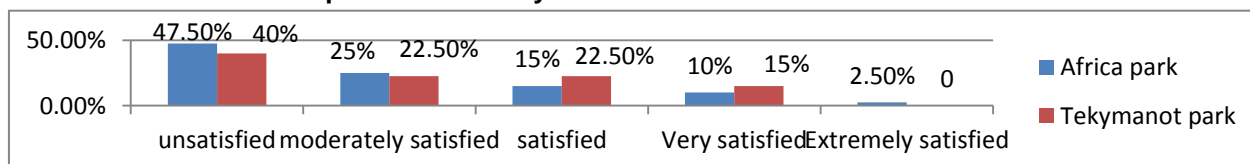


Figure: 4.21 Satisfaction sub city park accessibility
Source: computed by the researcher, 2017

The study tried to reveal the satisfaction level of sub cities park accessibility in terms of park location, number in the sub city, facilities provided, etc. about 70% of respondents testified that they are not satisfied with accessibility of them. Based on the officials' interview from Sub cities municipality, Addis Ababa urban planning Institute, Addis and Addis Ababa sanitation beautification and park development agency supply and demand of the parks are not equal. 80% of interviewed officials recommended that inner cities recreational parks should be given more privileges in size and in number than outer because there is high mobility and urban heat island effects in inner parts of the city.

4.3.1.2 Low services delivery and satisfaction of users

Cecil *et al.* (2013) point out that Parks are designed and developed to give maximum satisfaction of residents by giving recreational ecosystem services either directly (for example by making us more physically active) or indirectly (by their high biodiversity enhancing opportunities for nature experience and recreation). However, Respondents attest those parks that are found in inner sub cities of Addis Ababa are not giving the right services efficiently and effectively. Due to this, most of the park users are not satisfied by the services provided which implies parks in inner sub cities are inaccessible in terms of facilities provided.

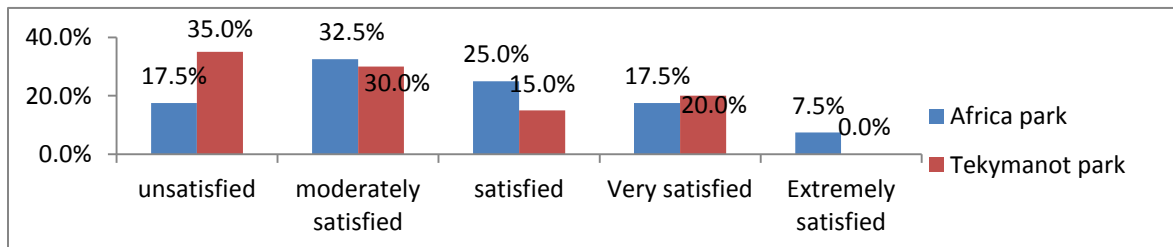


Figure: 4. 22 : Total satisfaction of Park users about the sub city parks
Source: computed by the researcher, 2017

Based on the data drawn 56.5 % of park users in Africa Park and 67.5 % in Tekle Hymanot Park are not satisfied in the quality of the park and the services they get. The qualities that are mentioned as parameters by the respondents are number of facilities provided, comfort of facilities, calmness of the area, presence of water features availability of green spaces and trees.

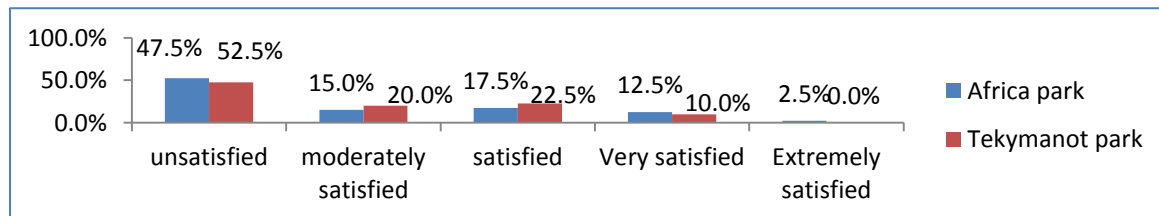


Figure: 4. 23: Satisfaction of respondents in quality of the parks
Source: computed by the researcher, 2017

4.3.1.3 Non inclusive recreational parks for elderly and children

McGee (2017) define "Inclusive recreation" is the integration of all people, regardless of age and regardless of functional ability, in leisure and recreational activities that are developed for the general community population. Involvement in meaningful recreation and leisure activities is essential for every individual's physical, psychological, and emotional well-being. According to MoUDH (2015) all parks should be designed in a way that considers equal access for all people – people with and without disabilities, people of all age groups, and people of all socio economic statuses. However, based on the observation of functions and data drawn from respondents in Africa and Tekele Hymanot park; Recreational parks especially the sub city parks in Inner Sub Cities of Addis Ababa do not consider All age categories such as children, teenage, adults and elders, So all must be incorporated. Based on the results drawn from observation of the researcher, interviews of the officials and park users Respondents, there is no recreational park that could satisfy all ages at the same place in inner sub cities of Addis Ababa.

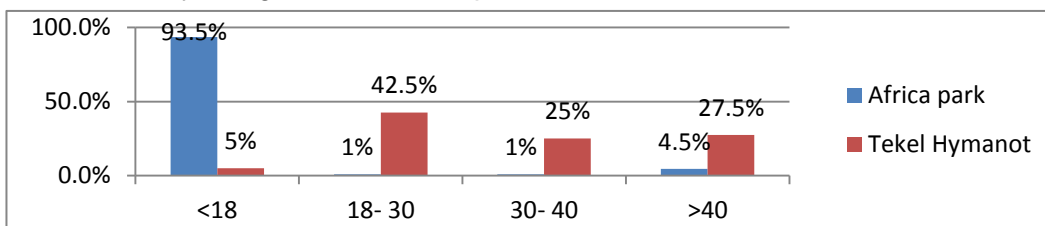


Figure: 4. 24: Park users' age in Africa and Tekele Hymanot Park
Source: computed by the researcher, 2017

The data drawn from respondents and officials indicate nearly all of park users in Africa Park are children's and on the other hand nearly the entire park users in Tekele Hymanot Park are adults this is because of the fact that they are directly related with the facilities provided.



Figure: 4. 25 Park users in Africa and Tekele Hymanot Park
Source: photo taken by the researcher, 2017

Figure 4.25 'A' and 'B' are in Africa park paint facilities that are planned for children and show dominance of children whereas picture 4.25 'C' shows facilities that encourage adults and elders.

Lack of facilities for elder people

In Africa Park 4.5 % Adult park users only come and entertain. Based on the data drawn from officials of the park and park users in addition to the inaccessibility of the park, they testified that facilities provided are not for elders. It was designed for children's only, no games for Elders. On the other hand in Tekele Hymnot Park 42.5% of Park users are adults, 52.5 % are elders and 5 % of them are below 18 years old. This is due to the absence of enough and functional facilities that encourage children to use the park.



Figure: 4. 26 Absence of facilities for elders in Africa Park
Source: computed by the researcher, 2017

Inadequate and less comfortable children play ground

The possible constitutes of recreational parks and functions expected to be found are declared by (MoUDH, 2015) which includes Playgrounds should have at least 5 types of play equipment, shall have adequate space around the equipment's, Pavements on playgrounds should have protective surfacing; may include seating area for parents around the play equipment's.

Based on the researcher observation and more than 60 % respondents attested that there is not enough children play grounds in the Lideta and kirkos sub cities. Both of the parks lack adequate and effective children play grounds.

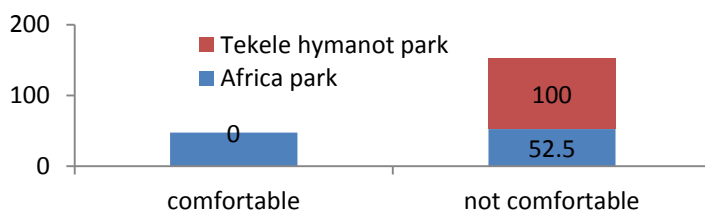


Figure: 4.27: Park users satisfaction in children's playground Africa and Tekele Hymanot Park
Source: computed by the researcher, 2017

All of park user respondents are not satisfied with the children’s playground in Tekele Hymanot Park. In the same way 52.5 % of park users in Africa Park are not comfortable with the children play grounds exist even if it is has good facilities of children play grounds relatively with Tekele Hymanot Park.

4.3.1.4 Crime

According to LeVario (2011), crime is one of the challenges that urban parks face and some of the crimes that are happened regularly in parks are Murder, Arson, Rape, Theft, Assault, Robbery, Vehicle, and Burglary.

Similarly, Based on the interview made to the guardians and officials’, crimes are happened and become challenges for inner sub cities Parks of Addis Ababa. Such as Theft, Murder, Assault, and Robbery are some crime challenges to recreational parks in inner sub cites of Addis Ababa especially in Tekele Hymanot Park. From the interview results of the officials, in Africa and Tekel Hymanot Park, the researcher reveals that there are no implementing programs which provide more specific public information regarding crime records for park locations, safety measures, and perceptions regarding the inner sub cities park.

4.3.1.5 Occurrence of forbidden activities in the park

Results drawn from respondents of Africa and Tekele Hyamanot Park indicated that 10% and 60 % of respondents respectively give evidence that forbidden activities like smoking and chewing chat are the challenges for the park users since users do not fill comfortable. In line with this officials reveals smoking, chewing chat, and fecing in restricted spaces of the park are some of the forbidden activities occurred in the park.

Table: 4. 10 : Park users Response on forbidden activities in the park

Africa park	Frequency	Percent	Tekele Hymanot park	Frequency	Percent
Yes	4	10.0	Yes	24	60.0
No	36	90.0	No	16	40.0
Total	40	100.0	Total	40	100.0

Source: computed by the researcher, 2017

Table 4.10 depicts that 60% of the respondents in Tekele Hymanot Park attested that as they have observed Occurrence of forbidden activities including chewing chat, smoking, and fecing

and 10% of respondents in Africa Park have observed too. More than 30% of Park users notifies as they are disturbed while they are recreating due to the pollution created by the activities.

4.3.1.6 Land use change and incompatibility

The results obtained from observation, sub city SBPDA officials, and more than 50% respondents of Tekele Hyamanot Park reveal that; Due to lack of monitoring and follow up of private developers; some recreational parks in inner sub cities of Addis Ababa changed the function of the park in to another. For example Ambassador Park was changed to pure hotel and It is now closed (observation and interview of W/ro Almaz Mekonnen Manager of AASBPDA). Based on the officials interview and observation in Tekele Hyamnot park, there are activities and services that are not allowed in the park which partially changed the park to commercial. It is due to the alcoholic drinks and other gambling games undertaken at the park.



*Figure: 4. 28 alcohol drinks area(A) and gambling houses(B) in Tekel Hymanot Park
Source: photo taken by the researcher*

The figures shown above are in Tekel Hyamnot Park .Picture 4.27 'A' and 'B' are a cafeteria and pool houses that are administrated by private developers which functions against the intended purpose like Alcoholic drinks and gambling. Everybody could enter to this part without fee because it is not part of the park. Which shows that the stated function of recreational parks are changed to another function which is caused by lack of strong institutional set up and capacity as stated in the institutional challenges of recreational parks.

The planning of spatial developments must be sensitive to four environmental issues including compatibility, suitability, sustainability and limitations and constraints of the site. However

recreational parks in inner sub cities of Addis Ababa have problems of compatibility. Tekele Hymanot Park has compatibility problem because Tekele Hymanot church is located near to the park and causes sound pollution to the people especially in holidays as about 25% of respondents complain about it.

4.3.1.7 Security issues

According to the officials interview from AASBPDA and workers interview in the park; The Park has designed and developed with 3 parts with the name of Addis Ababa Park, Ethiopia Park, and Africa Union Park with total area of 45707m². Currently only Africa Park gives services but Addis Ababa Park and Ethiopia Park are closed due to security issues. (MoUDH, 2015) do not proclaim anything about security issues however interviewed officials from AASBPDA ,the managers of Africa park and significant number of respondents stated that public area and highly secured offices should be separated unless absolute democracy is prevailed in Ethiopia.



Figure: 4. 29 security issues in Africa Park
Source: photo taken by the researcher, 2017

Africa Park is near the palace, the foreign affairs offices and near economic commission of Africa. As a result the park will be less attractive to the users. As shown in figure 4.28 'A' the federal police are inside the park which makes the park users discomfort as the park manager and nearly all of the respondents testified.

4.3.2 Economic challenges

4.3.2.1 Low considerations of urban poor

According to Association (2011), access to urban recreational parks and recreation programs should have no fee. Similarly MoUDH (2015) states competent authorities may require members of the public to pay an entry fee to use public green open spaces. However, authorities should allow free entry for people, who have no other free access to green spaces where they live, do not have gardens, do not have cars and might not be able to afford entry fees. But based on the observation and interview made with the official's AASBPDA; there is no rule or systems that can identify who can afford and who cannot.

Table: 4. 11 Respondent's affordability in Africa Park and Tekele Hyamont Park

Africa park	Frequency	Percent	Tekele hyamont park	Frequency	Percent
yes	13	32.5	yes	16	40.0
no	27	67.5	no	24	60.0
Total	40	100.0	Total	40	100.0

Source: computed by the researcher, 2017

Based on the results drawn from respondents of Africa and Tekele Hymanot Park 67.5 % of respondents in Africa Park and 60 % in Tekele Haymanot testified that entry price of the parks could not affordable. As they also testified the costly entrance fee makes them in order not to come to the park frequently. According to the results drawn from 4 guardians' interview in Tekel Hymanot Park, there are people who refuse to pay 2 birr and leads to assault and violence to them. They recommended that the government should make recreational parks entry free.



Figure: 4. 30: entry prices of Africa Park and Tekele Hyamont Park
Source: captured by the researcher march, 2017

Entry prices in Africa Park are 20 birr for children and 30 birr for adults that cannot be affordable for many people as 67.5% of Park users mentioned. Africa park manager justifies that the entry

price is not affordable to many people, which causes limited park users that finally leads to low return of their organization and poor services. The official also added that the income that is collected from the park users does not cover even the salary of the employees so that government should subsidize and release sufficient fund to recreational parks thus people can enter to the park with optimum price that they could afford and get efficient services.

4.3.2.2 High Land value

The demand on outdoor recreation areas of every kind has been increasing faster than the supply of lands and facilities can accommodate (Wheeler, 2011). According to Johannesburg Development Agency (2001) a number of factors contributed to high land values and rentals in inner city like, congestion, lack of parking, and a restructuring in the office market that saw demand for office parks grow, and the subsequent development of suburban shopping malls.

Interviewed Officials' discuss scarcity of Land resource is one of the main challenges of recreational parks in inner sub cities of Addis Ababa. They also mark as the land value in inner city of Addis Ababa is high; so opens spaces and green areas are changed to another land use and sold to investors for high rise buildings against the structural and local development plans. Poor management, corruption, and others are stated as challenges; but they emphasizes on high land value that highly contribute to Recreational parks insufficiency and narrowness in inner sub cities of Addis Ababa.

4.3.2.3 Low Budget

Budgets are perennially inadequate, and recreation land acquisition probably could not feasibly support all user demands or perceived "needs." As cited in mensah (2014) ,(Mpofu, 2013) indicates due to Lack of political will - Beautification projects halted in Addis Ababa Institutional inefficiencies (financial constraints, low staff strength, lack of logistics, bureaucracies, corruption, political interference, and embezzlement of funds) are another challenges mentioned.`

Similarly, in this study interviewed officials reveals Lack of enough budgets for urban green infrastructures is another finical challenge which influences the services and functionality of recreational parks directly or indirectly.

4.3.3 Poor Capacity Building

4.3.3.1 Absence of participatory planning Approach

The limited role of the wider community in the development and management of urban recreational parks; the highly limited opportunity by the wider community to access these facilities; and the very traditional approach towards development of urban centers have had contributed to the complex problems that halted the progress of recreation parks and other green spaces in the centers (AASBPDA, 2015).

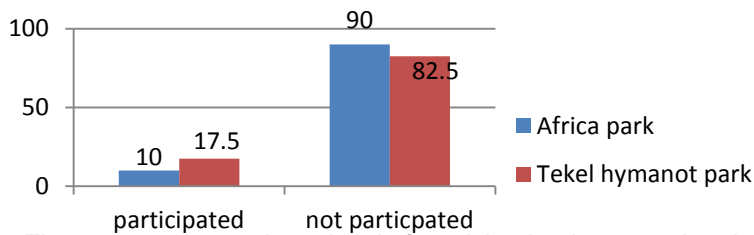


Figure: 4.31 respondents level of participation in recreational parks development

Source: computed by the researcher

Based on the data drawn from respondents of Africa and Tekele Hyamanot park about 85 % of respondents testified that there is Low level of community participation. Similarly based on the interview held to officials of the concerned body whether they have participatory planning for recreational parks or not; 90 % of the interviewers are answered as they do not have participatory planning.

4.3.3.2 Poor management

International Bank for Reconstruction and Development (1996) defines Management is a cyclical process involving the formulation of goals; planning and programming; implementation; operation and maintenance; monitoring and evaluation; and application of information derived from monitoring to planning and operational functions. Based on the interview made with officials' 75 % responded as they have no clear hierarchy of recreational parks management and clear parameters to be managed by the AASBPDA, sub city SBPDA, Woreda, private. AASBPDA have the power and duty of Develop or give contract agreement second-party of private, NGO or volunteers developers to work on Closed Park and manage and monitor in accordance with the agreement for the proper service delivery for the public or community. Africa Park is administrated by private investor. Based on the manager of Africa Park, there is no agreement with AASBPDA so the park does for the priority of the organization. Since the park is responsible to AASBPDA, they face difficulties to monitor.

4.3.3.3 Lack of follow up and monitoring

Officials attested that SBPDA are primarily responsible to recreational parks management and follow up. However as they stated there is no proper follow up and monitoring to take measures to illegal activities in recreational parks. About 30 % of the respondents in Africa and Tekele Hymanot Park also indicated that government is not taking measures to illegal activities in the park. Based on the observation made in the park, there are different facilities that are restricted from the park like alcoholic drinks, facilities for gambling like kerbola and Pool which shows that there is low monitoring.

4.3.3.4 Lack of integration and collaboration of different organizations

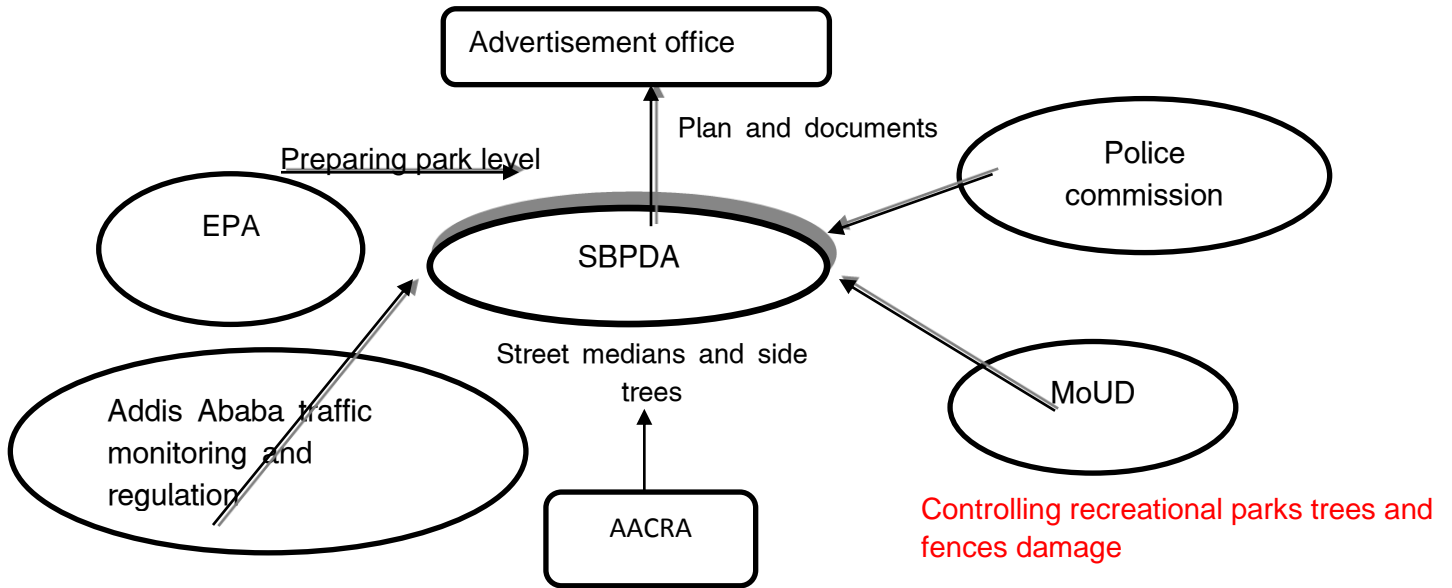
According to Sara *et al.* (2015) the importance of communication and collaboration is elimination of professional barriers in order to incorporate green qualities and bring effective and efficient development in the densification plans and projects. However based on the interview made organizations have their own roles but they do not integrate each other. According to the Kirkos sub city SBPDA manager in principle recreational parks have internal and external integration as shown in the figure 4.32, but practically those organizations do by themselves.

External relationship is the integration of organizations for the same issues but has low stake than those which have internal relationship of organizations that integrate for the common interest for developing and sustaining the projects.

According to Ato Eshetu, park design and development team leader in AASBPDA, the challenges of the organization is lack of integration, unclear and non-participatory, absence of organized data, etc are stated as challenges. The official also put the roles of the different stakeholders and their problems.

Land management authority has a mandate to provide permission for the proposed development and give the rights of ownership for the intended purpose but it lacks integration with AASBPDA since plans that are proposed for the green areas are changed to another development. AA urban planning institute and offices of the structural plan preparation have a role of follow up the implementation of recreational parks according to the plan or not and prepare plans and documents. The good sides of the these organizations as mentioned by Ato Ephrem in AADPO they prepare sufficient recreational and green spaces but failed to follow up the implementations due to lacks of integration too.

External relations



Internal relations

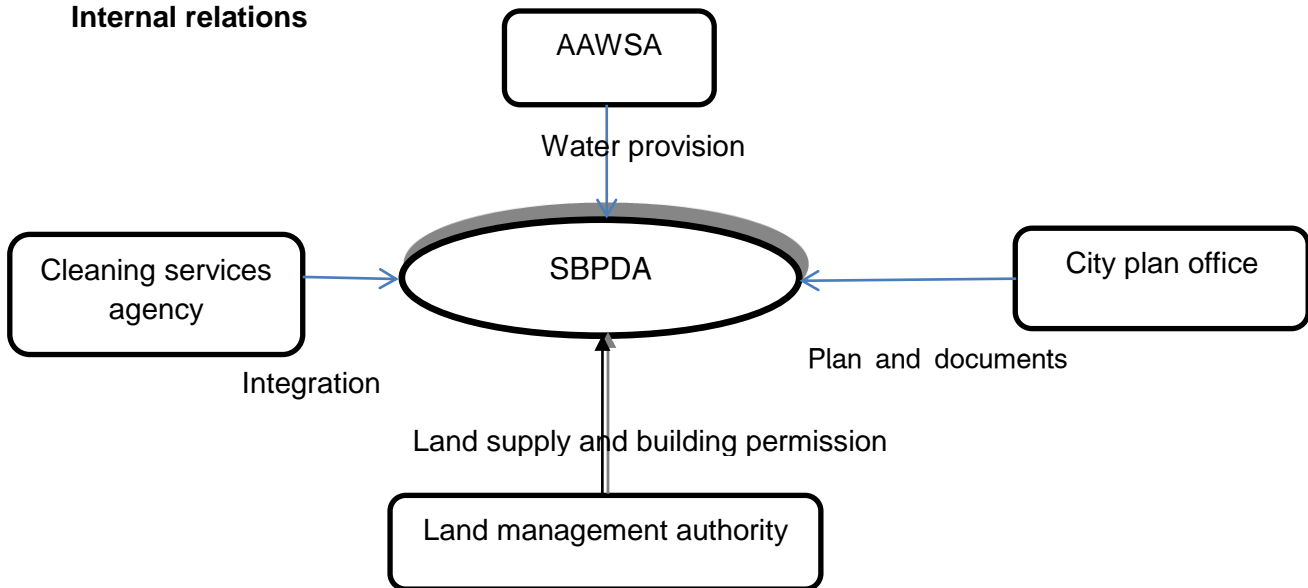


Figure: 4. 32: External and internal relation of concerned organizations to recreational park
 Source: AASBPDA, 2016

AAWSA has role of providing water to the services but the organization do not address water services adequately to recreational parks. For instance the plants in Lideta Park are watered with vehicles that bring from another area which shows that lack of integration.

Addis Ababa capacity building offices has primary role of flourishing qualified and experienced professionals in park management, park design ,planning ,etc ; however as stated by W/ro Almaz Mekonnen (the manager of the AASBPDA) lack of experienced professionals are the challenges of the organization due to lack of integration.

Officials in AAEPDA discuss that the organization need to increase the green cover of the city through keeping the implementation of green infrastructures according to the plans, control the sound pollution level, controls the species types planted in the parks, etc . Also they have prepared manuals and guide lines about recreational parks tree species type and pollution tolerance scale. However due to AASBPDA as well as AADPO do not use the manuals prepared as witnessed by the officials, due to this some plants in the park are against the standard.

Cleaning services agency are those that provide cleaners for the park but according to the manager of Lideta sub city SBPDA, cleaners who are employed by Agencies lacks skills and experiences in the park cleaning; it is also challenges for the guardians.

Addis Ababa Advertisement offices has role of giving information about the park including its location, services given by the park, safety measures taken ,etc but it lacks integration with AASBPDA which brings problem. For example Africa Park is situated in center of the city but many park users are not come to the park due to absence of promotion as stated by more than 65% park users in Africa Park and the park manager.

Governmental and non-governmental organizations have relationships with the SBPDA including NGOs and private firms for developing the parks, street sides, etc which have hopeful start for the future. To sum up as stated in the first paragraph of this topic even if different organizations that have relations with AASBPDA have plans or aims to do, it lacks integration and collaboration.

4.3.3.5 Human resources

Human resources are one of the challenges to recreational parks. Abuse of power and corruption are issues that affect institutional capacity in the area. Based on the manager of SBPDA (W/O Almaz) implementing bodies of UGI, contractors, landscape designers and planners lack experience and knowledge on recreational park management and development. For instance as stated by the park manager of Africa Park, the water access provided in Africa park stops working due to lack of experienced professionals aided with the low cost benefit return of it. On the other hand Ato Eshestu official in AASBPDA discusses about the planters and other workers could not work in modern way due to they are too old.

4.3.4 Technical challenges

4.3.4.1 Poor Plant diversity and selection

According to MoUDH(2015) within a park, at least 50 % of trees should be fruit trees to support food security. A diversity of plant species (ornamental trees, fruit trees, shrubs, vines, groundcovers, grasses, and herbaceous plants) should be assured in order to guarantee the biodiversity of parks. However based on observation and interview of officials in both parks studied, there are no fruit trees to support food security expect the presence of two avocado trees in Tekele Hymanot Park.



*Figure: 4. 33 ornamental trees in Tekle Hymanot Park and no ornamental trees in Africa Park
Source: captured by the researcher, 2017*

Based on the observation made by the researcher, Tekle Hymanot Park has (ornamental trees, fruit trees, shrubs, groundcovers, and grasses) plant species types however Africa Park lacks fruit trees, enough ornamental trees, and grasses.

4.3.4.2 Poor material selection for fences and poor design

According to (MoUDH, 2015) standard the Park fences and walls should be made of durable materials and as much as possible out of locally available materials and 50% of it should be open and clear. However some parks like Tekele Hymanot Park has dead and closed fences at all parts except the entrance side and the it is not environmentally friendly as shown in the left figures below.



*Figure: 4. 34 : fencing materials in Tekele Hymanot and Africa Park
Source: photo taken by the researcher, 2017*

As shown in the figure 4.34, the construction material of the fences is iron bar and it is not environmental friendly in both parks. Recreational parks are important and considered as environmental regulators by giving regulating ecosystem services but they become sources of pollution. The park managers in Tekele haymanot and Africa park as well W/ro Almaz Mekonnen the manager of SBPDA said that fences are in iron bar and sheet, thus they are easily rusted and polluted the environment. Significant number of respondents in Africa and Tekele Hymanot park said fences are not well coming they added the reason that they want to see local, cultural and naturalistic features in the park. Nearly 90% of the respondents in Tekele Hymanot Park are not comfort able with fences because it covers the view of them towards the surrounding. For the sake of safety from injuries (MoUDH, 2015) declares, Fences of parks shall not contain pointed finials and sharp edges. However as shown in pictures above the fences have pointed finials.

4.3.4.3 Absence of necessary facilities

Recreational parks must have many facilities to function efficiently and effectively. All necessary facilities of the recreational park should be provided by the competent authorities however sub city recreational parks lack basic facilities. sub city parks shall have a playground for children in the age group 2-10 years; should have additional playground facilities like an adventure playground; shall have formal sport facilities (e.g. hard surface basketball court, volleyball court, football field, table tennis) of which some should be lighted for night use; shall have seating and tables; shall have litter bins; shall have adequate lighting; shall have adequate number of toilets; shall have on-street as well as off-street parking space; should have storage facilities and service buildings; should integrate some storm water management practices; may have sculptures; should have food corners and small retail shops; should have first aid services; should include some urban agriculture; should have composting facilities; may have an internet café; may have a bank or ATM machine; may have a swimming pool (MoUDH, 2015).however the researcher concluded from observation, interview and respondent that as many facilities lacks in inner sub cities parks

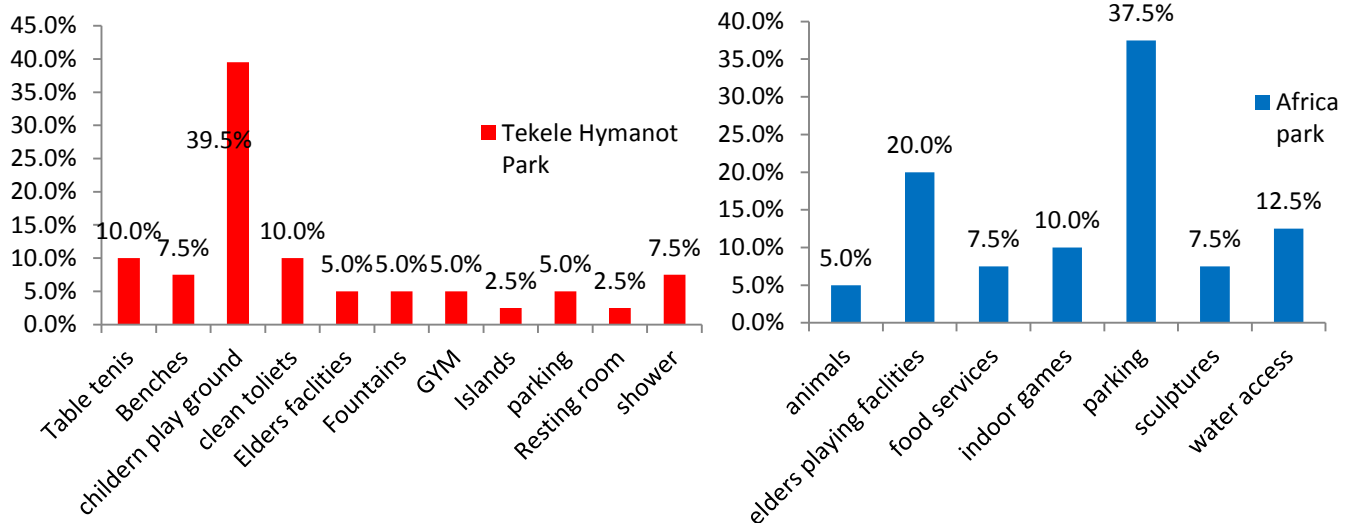


Figure: 4. 35 Facilities mentioned by Park users to be added in Tekele Hymanot and Africa Park
Source: computed by the researcher, 2017

Based on the data drawn from respondents in Africa and Tekele Hyamnot Park, the following share of respondents mentioned facilities to be added in the parks. parking (37.5% in Africa park), benches (7.5% in Tekele Hymanot park), elder's play facilities (20%), animals (5%), children paly grounds (39.5% in Tekele Hymanot park), water access (12.5%), Varity of food services (7.5%), Restrooms and sport facilities are some of the facilities that are mentioned by the officials and respondents to be added.

4.3.5 Environmental challenges

The study viewed environmental challenges of recreational parks with respect to noise and air pollution. As many literatures discussed recreational park needs a calm area that is important to engage to the nature. However in the Africa and Tekele Hymanot Parks sound pollution is one of the challenges for park users that are caused by vehicular and people's noisy.

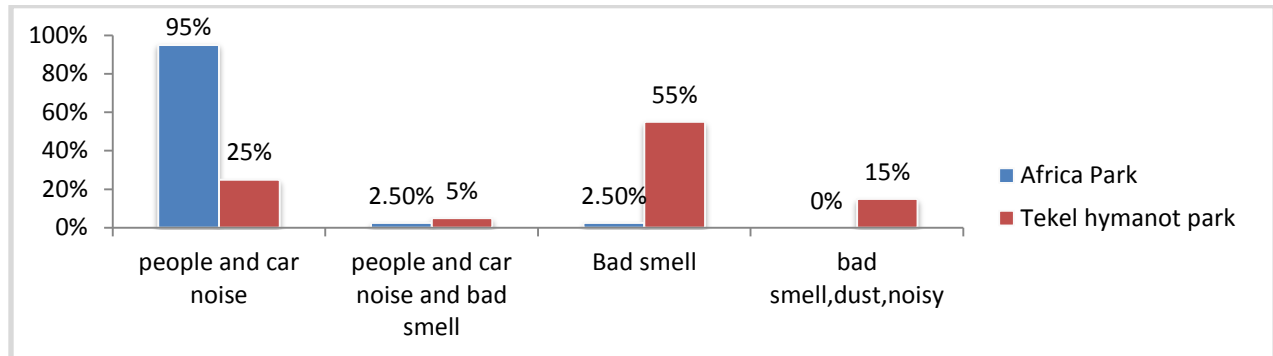


Figure: 4. 36 : park user's response to disturbance types
Source: questionnaires'

60% of respondents attested that they have problems of noise in the park. Every land use has its own standard how much it should be far from high sound emitting land uses and the maximum permitted emission of it in order to create social wellbeing and healthy society. But according to the official's interview from AASBPDA, AAUPI and AAEPa such sound compatibility are not considered when they are planned and designed.

About 25 % of Respondents in Tekele Hymanot Park indicate that Tekele Hymanot Park has compatibility problem because Tekele Hymanot church is located near to the park and causes sound pollution to the people especially in holidays.



Figure: 4. 37 : waste dumping adjacent to Tekele Hymanot Park
Source: photo taken by the researcher, 2017

95 % of park users in Africa Park complain about the vehicular noise emitted and majority of respondents on the other hand (55%) in Tekele Hymanot Park complain about the bad smell they feel. Officials in TekeleHymanot park indicate that the causes of air pollution are due to lack of integration of AASBPDA and AASWRPO, lack of follow up, lack of public awareness and poor waste management in the parks.

Poor waste management and aesthetically unpleasant environment at Tekele Hymanot park

The improper disposal of waste results in the, pollution” of man’s environment (Danquah, 2010). Enyew (2013) indicates as urban waste management has been a challenge for municipalities and urban governments in the developing world, largely due to poor infrastructure, bureaucratic competence, and limited institutional capacity of the municipalities.



*Figure: 4.38: Aesthetically unpleasant area in the Tekele Hymanot Park
Source: photo taken by the researcher*

Figure 4.38 (A) shows **kitchen grey wastes** drain to the walkway that is due to lack of follow up and sense of ownership for the park. Officials in the park said that different solid wastes like plastic bottles disposed there by park users and passersby’s who throw in as shown picture B. based on the results drawn from respondents of Africa and Tekele Hymanot park about 90% of them justified as they are not comfortable the services and recommended that facilities should be repaired.

4.3.6 Physical challenges

This study identifies deterioration of facilities, lack of comfort and convince, and size of parks are physical challenges which are discussed as follows:

4.3.6.1 Lack of maintenance and deterioration of facilities

Based on the observation and interviews made to the officials specifically to SBPDA; recreational parks are not maintained timely which resulted reckless accidents to the users and environmental degradation featured with soil pollution, air pollution ,etc. The deterioration is due to low attention to parks and poor management as stated in institutional challenges of recreational parks. Chairs in the park, fences, toilets, and other facilities need maintenance in inner sub Cities Park.

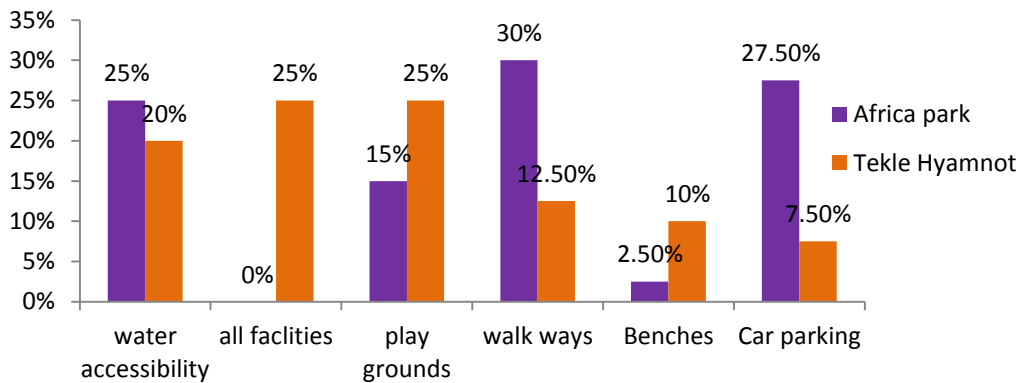


Figure: 4. 39 : Responses of park users on improvements of facilities in Africa and Tekel Hyamnot Park
Source: computed by the researcher, 2017

4.3.6.2 Size of parks

According to the MoUDH(2015) , A Sub-city Park should be around 8 ha (sub-city)of land , can serve up to 160,000 people in a radius of 4,000 m, with a carrying capacity of 0.05 ha/1,000 population. But in inner sub cities all sub city level area of recreational parks are below the standard as shown in annex II 68Table 15. Example Tekele Hymanot park is 0.4 ha which lacks 7.4 ha of land to meet the standards of sub city parks. The Cashier and one Guardian in Tekele Hymanot Park stated that due to the park has small area, in the weekend the maximum capacity of the park reached which caused discomfort to privacy of individuals. Significant number of respondents in the park also stated that they lack privacy and many facilities that are caused by small size of the park.

4.3.6.3 Lack of Comfort and Convenience

MoUDH(2015) declares all facilities like Playgrounds should be in safe condition at all times; Pavements on playgrounds should have protective surfacing. On the same source it is stated that Children's playground should have protective surfacing in order to prevent them from injury and to increase convenience. However based on the data drawn from respondents of Africa and Tekele hymanot park 52.5 % of respondents' from Africa and All from Tekele Hyamanot testified that pavements, facilities, play grounds, etc are not comfortable. As they also mentioned; other facilities like access roads and Trails are not convenient because it causes children unsafe.



Figure: 4. 40: lack of comfort and convenience of play grounds and other facilities in Africa and Tekele Hymanot Park

Source: photo taken by the researcher, 2017

As shown in the figure 4.40 above play grounds have no protective covers, trails, water lines and access roads are not convenient and not feel comfortable. In addition some picnic areas in inner sub cities park are not comfortable due to deterioration, incompatible land use and poor design.

4.4 Challenges of Street sides and medians trees in the study areas

4.4.1 Physical challenges

Eyob(2010) discusses Infrastructure development including trenching work for telecommunication, sewers, and water is physical challenges of street trees In Addis Ababa. Most of the underground utility was not undertaken in a coordinated manner so that Damage to tree roots occurred during the installation and maintenance of service utilities. However besides it, this study reveals other physical challenges including land use change, human intervention like street vendors and street persons discussed as follows:

4.4.1.1 Damage of trees

Based on the observation and interview results of officials from AACRA and AASBPDA, street trees are damaged due to vehicular, lack of follow up, improper site management, illegal activities of people arise from lack of awareness, etc. on the other hand they are a challenge by themselves as discussed in technical challenges of Street sides and medians trees since wrong plant selection causes infrastructure degradation.



Figure: 4.41 :damaged plants in the study areas
source; captured by the researcher,2017

Figure 4.41 'A' depicts that the trees are planted without protective cover that exposed to damage. On the other hand picture 'B' shows that dried tree in the median that could be mitigated or completely eradicated with proper keeping of plants at initial stage and proper follow up and monitoring after planting them as discussed in institutional challenges of Street sides and medians trees.

4.4.1.2 Land use change of Road medians

Street medians are intended to give environmental and other ecosystem services but in inner sub cities of Addis Ababa street medians are changed into market area, parking area, and

waste dumping area; due to poor institutional set up and management. AACRA Road Design Team Manager asserts that; Functions away from intended purpose bring other challenges like environmental degradation and traffic accident and finally risks to human wellbeing's.



Figure: 4. 42: Road medians for parking and marketing area on street from Gofa Mazoriya to Kirkos Church

Source; captured by the researcher, 2017

As shown in Figure 4.42 'A' cars are parked in wide street medians; the researcher interviewed significant number of passersby and concluded that, car accident, close the pedestrian crossings, decrease imperviousness of the area, etc are some of the impacts followed the change. Figure 4.42 'B' shows Street marketing on street medians which impose challenge on green spaces and street trees. Generally as the researcher concluded that the environmental challenges would be imposed if the intended purpose of street medians are changed since it decreases the green spaces.

4.4.1.3 Street persons

Street persons are homeless people staying the night and day in the street. Based on the officials' interview of AASBPDA, AACRA, Lideta and Kirkos Sub cities SBPDA ;They mention street persons as the challenges of street trees since they live there the whole night and day; they damage the plants deliberately for the purpose of sleeping. As the officials stated, they cut trees for sleeping purpose too.



Figure: 4. 43: houses supported by street trees

Source: captures by the researcher, 2017

Based on the researcher observation in the study streets, street persons do their houses there by making street trees one side for supporting their houses which impose challenges to trees as shown in the figure above.

4.4.1.4 Street vendors

Street vendors are who use streets as a market area. during site observation for this study; The researcher Observation that Street vendors are other challenges for street side trees especially at the initial stage of the plantation and for those which have no protecting cover as shown in the figure 4.44 below. The officials said that; this is caused by lack of proper follow up and monitoring besides lack of public awareness towards street trees.



figure 4.44: street vendors intervention to street trees
source: computed by the researcher,2017

as shown in the figure 4.43 street vendors put their staffs on street trees which casuses physical damage on it. In addition to this street vendors damage street trees by themselves while they sell their staffs especially to young trees. the researcher revealed that it is high challenges of street trees in road from Africa union Round about to Bulgaria Round about specifically around Michael church.This is aproblem of all inner subcities street side trees especially in those areas that many moblitiies are for instance on streets from Gofa Mazoriya to Kirkos Church and Africa union Round about to Bulgaria Round about.

4.4.2 Planning and design challenges

According to Christopher *et al.* (2011) appropriate tree species selection and location and design of the planting site will ensure the healthy growth and longevity of trees, enhance streetscape character, and maximize the City's investment. Finally it enhances property values in residential neighborhoods and commercial Areas. However in inner sub cities of Addis

Ababa; appropriate tree species selection, location, and design are not practiced. Some of planning and design challenges are stated as follows:

4.4.2.1 Low diversity of street trees (LDST)

Planting a diverse urban forest with the right tree in the right place can enhance a city streetscape and reduce the long-term cost of tree replacement and maintenance (Farley, 2013). According to MoUDH (2015) there should be diverse plant selection to improve the social, economic, and environmental value of a particular space. But based on the observation plants that are planted in street medians and sides are low and sometimes monotonous; in inner sub cities of Addis Ababa. This means street trees are not in the right plant composition that leads poor streetscape which finally reduces the value of the area.



Figure: 4.45 Gravilla along street medians and side in Africa union Round about to Bulgaria Round about
Source; computed by the researcher, 2017

On the street from Maryam Tseble to Bulgaria Roundabout along Africa union in Lideta sub city and Kirkos sub city, the median and street side trees are dominated by *Gravilla* As shown in the figure 4.45.



Figure: 4.46: *phoenix recilenta* along street side and medians on Gofa Mazoriya to Kirkos Church
Source: computed by the researcher, 2017

Similarly on the street from Gofa Mazoriya to Kirkos Church the dominant street side trees are *phoenix recilnta* (*zenbaba*) as shown in figure 4.46 which are monotonous. As stated in David et al. (2004) Planning for species diversity, establishing native trees and avoiding or reducing conflicts with utilities, views, and other urban constraints street tree guide lines are among others. No one genus (e.g., *Prunus*) should represent more than 30% of the total street tree populations. However based on researcher estimation 95% of the trees is *Garvilla* on street from Maryam Tseble to Bulgaria Roundabout shows failure in variety and native trees.

4.4.2.2. Inappropriate plant species selections

Street tree plantation in Addis Ababa is based on aesthetic values (beautification) (Kumelachew, 2015). but Appropriate tree species selection should consider: form, mature size, color, and texture to reflect the urban design goals of a street; the mature tree canopy with respect to how it may affect street and pedestrian lighting or views of signage and building fronts (Christopher *et al*, 2011).however based on data drawn from officials from AACRA, AAEPa and AASBPDA; in Addis Ababa trees are not planted according to the standard due to lack of integration and experienced professionals. They also added that when selecting trees for placement on streets, we should consider the exact use of the plants (shade, fruit, seasonal color, beautification, wind break, or screen etc).

4.4.2.2.1 Median tree: shape and Trunk diameter

Matching tree characteristics to nearby architectural styles, community, or historical identity, surrounding trees and other contextual aspects add to the visual unity and continuity of a street or neighborhood (urban forest guideline for Addis Ababa city).

A, shape

When selecting a tree to plant in a green space 'form 'follows function. Selecting the right shape to complement the desired function can increase the maintenance cost and the value of the tree in the land scape. however in streets of the study areas ,trees are not planted by such guide lines because spreading and up right plants exist in the places where columnar plants are more important(suitable) and vice versa.



Figure: 4. 47: columnar shape plants on the street from Gofa Mazoriya to Kirkos Church and spreading plants on the National Bank Area to Amistegna police station respectively
Source: captured by the researcher, 2017

Picture 4.47 'A' shows street from North to south that need spreading canopy to protect cars from afternoon harsh sun where as in picture B spreading plants is not significant since it is east to west road. According to the (urban forest guideline for Addis Ababa city) roads oriented from east to west, trees with tall bole and conical shape can be used; and for roads oriented from north to south with short bole and broad crown can be planted to maximize shade cast on the pedestrian walk way. However as expressed before in the study areas on the street from Gofa Mazoriya to Kirkos Church (roads orient north to south) lacks spreading plants species; rather they are more of columnar and upright plants dominated by phoenix Recilnta. On the other hand plants on streets that orient from east to west like Maryam Tseble to Bulgaria and National Bank Area to Amistegna police station are spreading rather than columnar which are against the standard as shown in figure 4.47 'B'.

B, Trunk diameter

As stated in Christopher *et al.* (2011) tree species selected for planting on median strips that are 1.3 m to 2 m wide should be expected to grow to trunk diameters no greater than 30cm and on median strips greater than 2 m wide, trees obtaining larger diameters may be used. However such guide lines regarding trunk diameter and median size relationships are not stated in urban forest guideline for Addis Ababa city. So that absence of proper guide lines that addresses all characteristics or requirements is challenge for inner sub cities of Addis Ababa. Due to this there are plants of which trunk diameters are greater than 30 cm in median strips less than 2 m wide which final leads infrastructure damage, traffic accident, aesthetically unpleasant and etc as shown in the figures below.



Figure: 4.48: trunk diameters greater than 30 cm on streets from Maryam Tseble to Bulgaria Round about and National Bank Area to Amistegna police station respectively
Source: captured by the researcher

The same problems happen on the street from Gofa Mazoriya to Kirkos Church and to other inner sub cities street medians.

4.4.2.2 Height of shrubs in the medians

Trees located in medians should have a vertical clearance of the lowest branch of 8 feet (3.2 m) in height over the median, and 14 feet (4 m) in height for any portion of the tree that overhangs the roadway. Shrubs located in the median should not exceed 3 feet (1m) above the roadway.



Figure: 4.49: shrubs with height greater than 1 m on street from National Bank Area to Amistegna police station

Source: captured by the researcher

Tree branches that extend into the path of travel must maintain 80 inches (2m) of vertical clearance. However there are street side plants which have no 2 m vertical clearance from the pedestrian walk ways. This is highly depends on the species selected for placement especially in street sides which mobility is high since it does not bring comfort. For example on the street from Gofa Mazoriya to Kirkos Church this problem happens.

4.4.2.3 In appropriate location and spacing

4.4 .2.3.1 in appropriate location of trees

The standard of spacing side trees should be on 1/3 of the width of the side walk at the side of street. The location of plants should not create visual and physical obstacle (even at maturity). However Street side trees are planted wrongly at the center of the side walk or at the corner of the side walk without considering the dimensions of the sidewalks in the study areas as shown in the figure below. All plants shown in the pictures below are planted in half/middle distance of the side walk that make the pedestrians discomfort it is because it makes the space small and to covers sight which leads pedestrians collision. The branches and trunk of phoenix Reclinta shown in picture 'A' covers the whole side walk which makes it inaccessible.



Figure: 4. 50: in appropriate location of street side trees
 Source: captured by the researcher

4.4.2.3. 2 Street Trees clearance from Street Amenities and Utilities

A, Traffic signs

There are many street scape elements but elements considered in this study include Traffic signs, man holes, utility poles, and fences.

According to MoUDH (2015) the minimum distance between tree stem and a stop sign shall be 5 m and other traffic signs shall be 1.5 m. However officials from AACRA and AASBPDA reveal, due to lack of integration between Addis Ababa traffic monitoring and regulation, Addis Ababa sanitation beautification park development agency and other related organizations, traffic signs are located near street trees against the standard in the inner sub cities of Addis Ababa Street.as well the researcher has testified this during site observation as they are against.



Figure: 4. 51: Traffic signs located against the standard on the street from Maryam Tseble to Bulgaria Round about and National Bank Area to Amistegna police station
 Source: captured by the researcher, 2017

The minimum distance between tree stem and a traffic control device shall be 7 m. But as shown in figure 4.51 'C', the distance between traffic control device and stem of the tree is less than 1 m. which is the problems of many traffic control devices in inner sub cities of Addis

Ababa Street sides and medians trees .As AACRA road design team manager states such kind of problems causes the driver to take misleading actions since the plants cover the device.

B, Manholes

According to (Christopher *et al*, 2011) manholes should be far from street trees with 3 feet (0.9m). (The minimum horizontal distance between tree stem and a utility manhole shall be 1.5 m MoUDH (2015). However in the study streets some trees are planted next to utility boxes without any gap as shown in the pictures below.



Figure: 4.52: in appropriate location of street side trees and utility manholes
Source: captured by the researcher, 2017

Utility Manholes are the void spaces under the streets left for the purpose of maintenance of utilities. So that if trees planted in the way shown in pictures above roots of trees would be damaged during operation phase of the maintenance and construction phase of the manholes incase trees are planted before the excavation of the manholes. The researcher concluded that if street trees be far from manholes it will not be damaged even in underground infrastructure development against to (Eyob, 2010).

C. Electric and Tele poles

As stated in Christopher *et al*. (2011) street trees should be 1.5 m far from the utility poles especially from the electrical poles. However in Ethiopian national urban green infrastructure standard, the minimum horizontal distance between tree stem and overhead electrical distribution / power lines shall be 3 m. Only small trees (not reaching the height of the utility line) may be planted closer to overhead electrical distribution / power lines. But their mature height should stay 1.5 m below the line. However, based on the researcher observation in inner sub

cities of Addis Ababa Street trees are planted less than 1.5 m distance between it and electric poles even contact each other.

According to the standard, the minimum distance between tree stem and a street light shall be 5 m. However street plants causes dark at inner sub cities street of Addis Ababa due to in appropriate location of street lights and plants which is primarily caused by lack of integration and weak institutional set up as shown in picture 4.53 'B'.



Figure: 4. 53 in appropriate location of street utility poles
Source: captured by the researcher, 2017

As shown in the picture 4.53 'C' electric lines are passed in side two main twin branches of the tree and it is exposed to infrastructure damage at the time when the branches are fallen. This shows that there is lack of implementation, lack of proper follow up and monitoring of street trees.

D, Fences

According to the Ethiopian green infrastructures standards, the minimum distance between tree stem and any adjacent built structure shall be 2 m. More space should be allowed for wider trees.



Figure: 4.54: street side trees near the fences and buildings in the study areas
Source: captured by the researcher, march 2017

All branches shall be pruned to allow approximately 1 m clearance from a building. However in the inner sub cities of Addis Ababa, such problems exist as shown in the figure 4.54 above. The trees have wide spreading branches planted close to the buildings as shown in 4.54 figure 'A' and Figure 4.54 'B' which causes the collection leaves on the roof.

In appropriate color of fences

Regarding the fences of street medians, different standards advise the material should be environmental friendly, locally available and economical to increase sustainability. Similarly according to MoUDH(2015) fences should be made of durable, out of locally available materials and should have no pointed finials and sharp edges. In addition fences should have the color of the surrounding building or character. However Street sides and medians trees are fenced without considering the color of the surrounding character as shown in the figure below.



Figure: 4. 55: incompatible color and pointed fences on street from National Bank Area to Amistegna police station

Source: captured by the researcher, march 2017

On the entire street from National Bank Area to Amistegna police station; the color of the surrounding building is not black but the fences are black which causes non-harmonious character in the area.

E, pavements

MoUDH(2015) States in order to avoid compaction through people or cars a tree basin should have a clear demarcation, preferable of permeable material. An appropriate design for edging and demarcating the basin edges and planting zone are cobblestones or brick paving. As well there should be enough space that is provided for plants to grow healthy but street trees particularly street side trees face a challenge of space to grow their root even their leaves due to low commitment and lack of integration.



*Figure: 4. 56 : street side trees near the fences and buildings in the study areas
Source: captured by the researcher, 2017*

Due to poor aeration, and drainage problems caused by compaction as shown in figure 4.56 'A' and 'B' plants cannot grow very well and .

finally dried. The researcher concluded that in appropriate paving is a challenge of street trees in inner sub cities of Addis Ababa since Roots of trees, shrubs and other plants cannot grow optimally in compacted soils. Furthermore, water does not drain well into and through compacted soil.

As shown in the picture 'C' the researcher observed and officials discussed that in addition to the problems to the roots and stems of the plant; the supporting system is not comfortable to pedestrians and brings problems for them like collision and sense of discomfort.

4.4.3 Environmental challenges

One of the intended purposes of Street sides and medians trees are giving environmental services but based on the observation and official's interview they face environmental challenges such as become waste dumping site and sources of pollution.



*Figure: 4. 57 : waste dumping at the street trees in the study areas
Source: captured by the researcher march, 2017*

As stated in the institutional and, management challenges of recreational parks, lack of monitoring and follow up streets plants leads people to dump their wastes in the Street sides and medians trees. On the other hand planters use fertilizers for streets using that are not environmental friendly and suitable for the plants beyond the optimum that plant needs leads water pollution due to infiltration.

4.4.4 Poor Institutional and management challenges

Based on the analysis made by the researcher; Street sides and medians trees are primarily administrated by the Addis Ababa Sanitation Beautification and Park Development Agency like recreational parks of Addis Ababa. Based on the analysis made, Street sides and medians trees share all Institutional and management challenges of recreational parks since they have similar internal and external relationships with other organizations as W/ro Almaz Mekonnen (Manager of AASBPDA) demanding improved institutional set up and management of them.

4.5 challenges of Cobblestone roads in the study areas

Cobblestone roads reduce storm water runoff volume from paved surfaces, reduce peak discharge rates, increase recharge through infiltration, reduce pollutant transport through direct infiltration, and improve site landscaping benefits (UN-Habitat, 2013).. However based on the data drawn from respondents answer only 30 % of them replied; as they are benefited from the Cobblestone roads .In the study areas different types of challenges are found including degradation, water clogging of void spaces, pollution, and discomfort to communities.

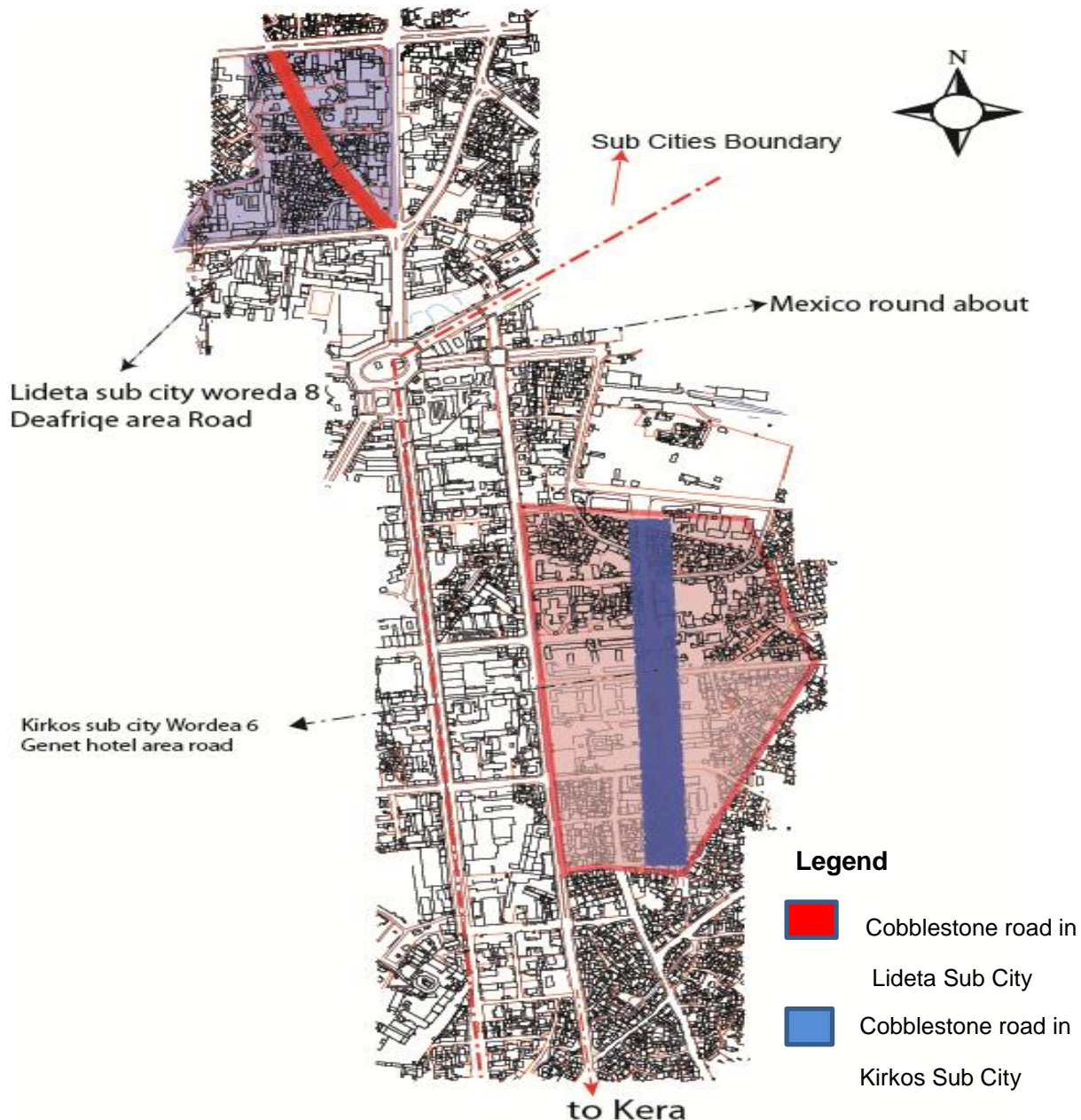


Figure: 4. 58: selected Cobblestone roads in Lideta and kirkos subcities
Source: computed by the researcher, 2017

4.5.1 Physical Challenges

Degradation, water clogging, and comfort to different activities are the physical challenges revealed by the study and discussed follows.

4.5.1.1 Degradation of Roads

Permeable paving is most appropriate for pedestrian-only areas and for very low-volume, low-speed vehicle areas such as overflow parking Areas, residential driveways, alleyways, and parking stalls because it's load-bearing capacity is lower than that of conventional pavement, it should not be used in Areas subject to excessive loads or high-speed traffic (ortiz). However based on the interview made to different officials traffic load of the area is not considered. Just construction of the Cobblestone road is going on through the willingness of Community Development Teams and the community to participate in working the project.



Figure: 4. 59 : degraded Cobblestone roads in the study areas
Source: captured by the researcher, 2017

Based on the researcher observation, in those areas where traffic load and high mobility are, Cobblestone roads are degraded, cracked and water clogged. AACRA road design team Leader and CPCO manager's mention the causes of such challenges are due to poor work man ship, poor sub base work, suitability problems etc.



Figure: 4.60 : traffic congestion in the study area
Source: captured by the researcher

About 48 % of respondents reveal that Degradation is one of the challenges of Cobblestone roads in the area caused by traffic congestion and load.

4.5.1.2 Water clogging of void spaces

Cobblestones can be prone to clogging from sand and fine sediments that fill void spaces and the joints between pavers. As a result, it should be used carefully where frequent winter sanding is necessary because the sand may clog the surface of the material. However based on the data drawn from respondents about 96% of them witness as there is no maintenance at all.



Figure: 4.61: water clogged Cobblestone roads
Source: captured by the researcher, 2017

figure 4.60 'B' above shows that absence of compacted sand for filling the void spaces which protects high infiltration of water to the sub base and leads water clogging aided with high traffic load. Based officials from AACRA and CPCO and the researcher observation, in inner sub cities of Addis Ababa; Cobblestone roads faces technical (absence of suitability analysis: - soil type, Traffic load, and slope) and poor management; water clogging is happened which causes the area uncomfortable and in accessible

4.5.1.3 uncomfortable to residents

As stated by 52 % of respondents in the study areas, Cobblestone roads have more comfort relatively with the gravel and mud roads in the area. Cobblestone development team leader in AACRA expresses Cobblestone roads are not recommended in areas where many people exist and use the road as playing area, and street activities. It is because Cobblestones are easily polluted and degraded related with size of the road, poor drainage, etc which leads to discomfort to residents. The official highly recommended that Cobblestones should not be developed in inner sub cities especially in slum areas.

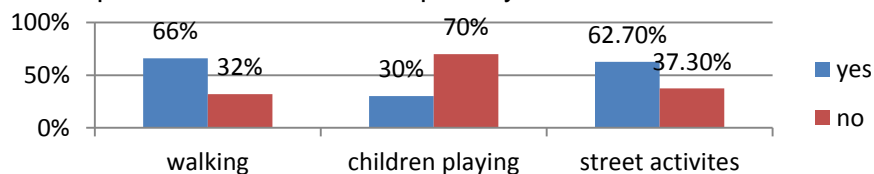


Figure: 4. 62: respondent's reaction to Cobblestone roads comfort for different activities
Source: computed by the researcher, 2017

As shown in the figure 4.61, 32%, 70%, and 37.3 % of the respondents are not comfortable with the Cobblestone roads for walking, children playing, and street activities respectively. They put their reasons like initially Cobblestones are not chiseled softly and lack of fine sand that fill the void spaces together with up and down of the road due to improper vertical alignment; roads are not comfortable for walking and children playing. 37.3 % of the respondents On the other hand stated that; in the study areas wastes are dumped, dusts raised, liquid wastes are leaked and poor drainage are frequent problems that cause air pollution so that it is not comfortable to street activities.

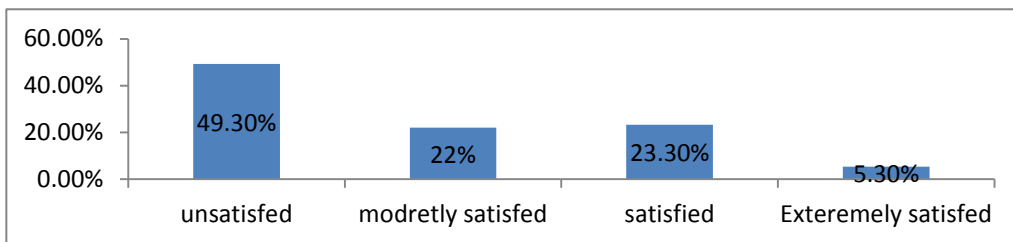


Figure: 4. 63 respondents' satisfaction in Cobblestone roads of the study areas
 Source: computed by the researcher, 2017

Figure 4.62 paints that about 70 % of the residents in the area are not satisfied that shows the presences of problems that should be upgraded.

4.5.2 Environmental challenges

Some of the positive impacts of the cobblestone roads that they do not require melting or boiling like asphalt. Thus, does not contribute anything (temperature) to global warming (Tiwari, 2011).

On the other hand (ortiz) Permeable pavements are those pavements that accumulate and then allow water flow across and in when water passes on them such as storm water runoff. Permeable pavement allows storm water to slowly seep through (infiltrate), reaching the soil and groundwater below the surface.

Thus the researcher conclude that ;It is environmental friendly since It decreases run-off and pollutants materials from entering to water bodies and it is cost effective and locally available material .Cobblestone is one of urban green infrastructures that are given priority by the government of Ethiopia especially in urban areas. However Cobblestone roads in inner sub cities of Addis Ababa, impose environmental problems including soil pollution and air pollution.

4.5.2.1 Pollution

Cobblestone roads are introduced for the objectives of reducing storm water runoff volume from paved surfaces, Reduce peak discharge rates, and Increase water recharge through infiltration, reduce pollutant transport through direct infiltration, and improve site landscaping. However in inner sub cities of Addis Ababa the roads have no site landscaping benefits as they are polluted by liquid and solid wastes dumped which stay many times at the surface of the cobble. Thus, it causes bad smell to the residents of the area; as revealed by 24 % of respondents. It is caused by lack of follow up and monitoring of the Cobblestone roads in inner sub cities. based on results drawn from respondents in the study areas; 75.3% of the respondents justified as residents dumps wastes to the cobble and 24 % of them are challenged by since it aggravates bad smell as shown in the table 4.12. And there is no any monitoring activities or legal actions taken yet due to poor management.



Figure: 4.64 :pollution of Cobblestone roads by liquid and solid wastes

Source: captured by the researcher

As shown in the figure above liquid wastes from residents (figure A), garages (figure C), and other street activities pollutes the road; it is leading to aesthetically unpleasant and bad smell to the surroundings.

Table: 4. 12 : problems mentioned by the respondents in the study areas

challenges	Frequency	Percentage	
water clogging	31	20.7%	
pollution	wastes	36	24.0%
	Dusts	19	12.7%
cracking	29	19.3%	
others	11	7.3 %	
All	24	16.0%	

Source: computed by the researcher, 2017

Periodic maintenance is critical, and surfaces should be cleaned with a vacuum sweeper at least three times per year (Planning Council, Massachusetts Low Impact Development Toolkit). As shown in the table 4.12 dust is mentioned third order problem; 12.7 % of respondents face challenges of dust and it is a problem especially at dry season.it comes from the sub base and surfaces that lack proper construction, proper design ,absence of sweeping and etc.

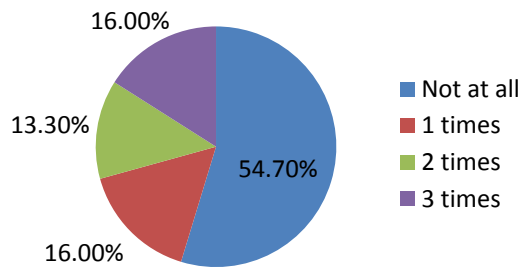


figure 4.66 : weekly sweeping of the roads by government
Source: computed by the researcher, 2017

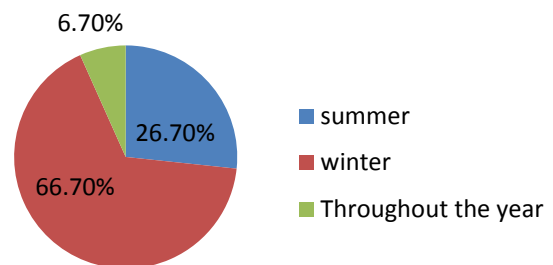


Figure: 4. 65 : Temporal dimension of pollution
Source: computed by the researcher, 2017

Based on the data drawn from respondents in the study areas 54.7% of the respondents replied that streets are not swept totally which shows the probability to be dusty roads. 16 % of respondents replied as they have observed roads sweeping 3 times per week. Related with this 67.7% of the respondents justified that more problems are happened on winter because of dry dust and lack of water to sweep the wastes dumped on the other hand 26.7 % of them asserts the extent of problems is high at summer.



Figure: 4. 67 dust problems in the study areas
Source: computed by the researcher

Picture 4.56 'A' depicts that the presence of soil dusts that is generated from sub base due to absence of compacted sub base and lack of fine sands to fill the void spaces between the pavers. On the other hand picture 'B' shows dusts and soils on the road that come from excavation works for the pavement and infrastructure works. CPCO manager discuss soils that are collected from excavation should be taken to another place by the developers especially AACRA and AAWSA failed to do this.

4.5.3 Institutional and management challenges

According to the interview made with Cobblestone project coordination office manager and AACRA officials; Cobblestone development passes through long processes and different organizations such as AACRA, CPCO, MSE, etc.

Cobblestone project coordination office has primary role on providing training on how to chisel and pave Cobblestones. On the other hand AACRA has responsibility of preparing sub base work for paving. Whereas the basic roles of MSE are selecting trainers, organize, joining to the training institutions and Engaging to work.

Officials exclaim the challenges of the organizations as summarized below.

Cobblestone project coordination office:

- Poor quality of trainings, low willingness to the questions of the contractors
- Time delay for training and for joining the work leads to sub-base degradation prepared by AACRA (sub-base: the layer of selected material placed on the sub grade.)

Challenges observed from AACRA

- Failure to remove the excavated soil in the site and imposes problem to the work and finally to the quality of the Cobblestone and to the quality of the area.
- absence of enough spaces for curb stone and quality sub base work
- Failure to follow up and control the quality of Cobblestones whether is suitable or not.

Challenges observed from MSEs

- low capacity and performing low in construction leads to poor work man ship and degradation
- Involving non trained workers in the paving and chiseling of the Cobblestone roads finally leads to workmanship problem.
- lack of experiences of the enterprises

AAEPA is also a stake holder in selecting the quarry sites and quality of them. The organization prepare manual about environmental protection and Ecological conservation, monitors the implementation as well but it failed to do so.

There are around 12 stake holders for Cobblestone roads construction but their performance is low and poor integration. Generally lack of integration, corruption, lack of follow up and monitoring, etc. are some of the challenges.

4.6 Opportunities for Urban Green Infrastructures in the study areas

According to reports of (MoUDC, 2008) there are different manuals prepared at different time that improve the sustainable development of green infrastructures in urban areas. Based on officials' interview from AASBPDA, different urban green infrastructures proclamations, standard, strategies, policies, and principles that enhance the management and development of UGIs are some of the opportunities. This includes Ethiopian national green infrastructure standard, Urban Greenery strategy prepared by MUDHC in November, 2005.

In this study species selection is one of the challenges for recreational parks and street trees so that according to AASBPDA officials, the manual of urban nursery management practices: seed collection and handling propagation and seedling production (MoUDC, 2015) is an opportunity in producing the needed species. On the other hand the manuals about Development of amenity green space in residential areas, institutions, Religious Compounds Green Infrastructure Development (MoUDC, 2015) forces the private developers and the institutions to provide sufficient Urban Green Infrastructures. Thus it increases the availability of urban green infrastructures in inner sub cities.

Cemetery Management team leader in AASBPDA stated the manual for cemetery management ,2015 is an opportunity to increase the green coverage in inner cities since the manual articulates any cemetery in the inner sub cities should be covered by green. So that it increases the green coverage in inner cities as well as increase connectivity of them.

The establishment of planning commission recently that incorporates many offices including AAUPI, sub city planning offices, office of Development Plan Preparation with 3 primary role of preparing standard, implementation follow up and documentation is an opportunity for UGI. Previously these three tasks have been done by 3 different organizations that make the work unmanageable. Environmental team manager (Bisrat) of AADPO testified that even they have no any clear documentation that has data on green spaces coverage and implementation level of them. however, The official hopefully added that ,being the establishment of planning commission as opportunity, it resolve Lack of follow up and monitoring, lack of integration and collaboration, and poor management of UGI challenges that are revealed in the study.

Similarly river side development and climate change protection office establishment aided with manual of Rivers and river buffer green infrastructure design standard implementation is

another opportunity for green space coverage in inner sub cities. Since the standard articulates rivers should be buffered with 15 m in developed areas and up to 50 m in newly developed and renewal areas so that the offices focus on river side development that was not given attention before. Being the river banks are encroached by the settlements and become waste dumping site in inner city of AA, it increases the availability, connectivity, distribution of green spaces in inner sub cities through buffering and incorporating other green infrastructures.

Based on the (W/ro) Tsegreda official from AAEPa, climate change is global issue that dominantly arises from inner cities and other manufacturing areas. But it could be mitigated or decreased by urban green infrastructures establishment. Recently developed countries and NGOs invest inner cities of developing countries for environmental sustainability through enhancing and preservation of urban green infrastructures. NGOs are the opportunities of urban green infrastructure by funding in inner city rehabilitation and other projects like CLUVA.

A climate resilient urban green development strategy, 2016, prepared by MoUDHC is an opportunity of UGIs in inner sub cities since the development should be climate resilient achieved with urban green infrastructures so that coverage would be increased. Besides this, the involvement of private developers to urban green infrastructures particularly to urban recreational parks a, Street sides and medians trees for the sake of them indirectly enhance the development and quality of the UGIs. Increment of professionals aided with Increment of public need of quality open spaces, pure air, and other recreational parks day to day could be an opportunities to green infrastructures management and development.

Opportunities for Recreational parks, street median and side trees in inner Sub Cities of Addis Ababa

Development plan of 2017 is the main opportunity for urban green infrastructures since it allocates 40%, 30%, and 30% of mixed use, roads, and greens respectively.

According to structural plan 2017 reports, all developments are directed towards developing a more self-sustaining mechanism for constructing and maintaining as for keeping the environment clean. So that at the time of development green infrastructures in inner sub cities get increment in coverage and accessibility while the developer do self –sustaining mechanisms.

On the other hand Environmental team manager (Ato Bisrat) of AADPPO, discusses unlike the pervious development plans, the development plan of 2017 could be updated within 2 years that makes UGI easily monitored and provided when it lacks as well it give solution that has implementation problems like land use change .

Development plan 2017 works special LDPs for in inner city areas such as main city center which is an opportunities for solving the green infrastructures that are faced by technical challenges. The above mentioned official stated that pedestrian oriented road development in inner city is another opportunity for urban green infrastructure development since 60 % of the roads part should be pedestrian.so that following the pedestrian green facilities including shade area, benches with green area, etc. would be provided, thus enhances UGI indirectly. According to the development plan Environmental team manager (Ato Bisrat) the plan has at most vehicular free nodes and streets at least public transport only in inner city areas of Addis Ababa which could be solution for challenges of trees and green spaces damage by vehicles, etc.

Being most inner sub cities are an intervention for urban renewal, LDPs, and upgrading projects, they are an opportunities for the development and sustainability of urban green infrastructures because they incorporate UGIs. For example the river buffer standard for newly developed area is 50 m.

Open space Development and protection Design Standard June, 2015 prepared by Addis Ababa development plan project office which basically states about:“*Any local development plan shall state, as may be appropriate: ...green areas, open spaces, water bodies, and places that might be utilized for common benefits.*”

Opportunities for Cobblestone Roads in inner Sub Cities of Addis Ababa

According to Habtu (CPCO manager) Cobblestone roads need labor force expect low power machines and in inner sub cities of Addis Ababa Cheap labor force is an opportunity. Increment of public awareness and willingness to pay for Cobblestone roads and sense of owner ship for the development is other opportunity .Many access roads and local roads are in inner sub cities of Addis Ababa are undeveloped. They are gravel, earth, and large stone developed by care Ethiopia, thus it is easy to excavate and to change. Attention of government to Cobblestone development projects and generations of professionals from different vocational schools are other opportunities for the development Cobblestone roads in inner sub cities of Addis Ababa.

Table: 4. 13 summary of major research findings

Challenges of Recreational parks	
Social	<p>✚ Unfair distribution and inaccessibility 75 % of park users in Tekele Hymanot go/take greater than 2000m/>15 min to get the nearest Woreda park in city.80 % of the park users in Africa park said that they go/take more than 2000 m/15 m to get woreda park and 55 % of them go more than 4000m.</p> <p>✚ Low services delivery and low satisfaction of users Parks are designed and developed to give maximum satisfaction of residents by giving recreational ecosystem services but based on the questionnaires' those parks that are found in inner sub cities of Addis Ababa are not giving the right services efficiently and effectively.</p> <p>✚ Non inclusive recreational parks for elderly and children recreational parks especially sub city parks in Inner Sub Cities of Addis Ababa does not consider age categories such as child, teenage, adults and elders.</p> <p>✚ Crime problem Theft, Murder, Assault, and Robbery are some crime challenges to recreational parks in inner sub cites of Addis Ababa especially in TekeleHymanot and Gola Park.</p> <p>✚ Illegal activities in the park According to the interview made and the respondents Smoking, chewing chat, removing urine in restricted spaces of the park and etc are some of the illegal activities in the park.</p> <p>✚ Land use change and incompatibility Due to lack of monitoring and follow up of private developers; some recreational parks in inner sub cities of Addis Ababa change the function of the park to another. Based on the officials interview and observation in Tekele hyamnot park, there are activities and services that are not allowed in the park which partially changed the park to commercial hotel. Recreational parks in inner sub cities of Addis Ababa have problems of compatibility. Example Tekel Hymanot Park has compatibility problem because Tekele Hymanot church is located near to the park and causes sound pollution to the people especially in holidays.</p> <p>✚ Security issues (MoUDH, 2015)do not proclaim anything about security issues however interviewed officials from AASBPDA ,the mangers of Africa park and significant number of respondents in stated that example public area and highly secured offices should be separated unless absolute democracy is prevailed in Ethiopia. For instance Africa Park is near the palace, the foreign affairs offices and near economic commission of Africa. As a result the park will be less attractive to the users.</p>

Economical	<p>✚ Low considerations of urban poor Based on the results drawn from respondents of Africa and Tekele Hymanot Park 67.5 % of respondents in Africa Park and 60 % in Tekele Hyamont they testified that entry price of the parks could not affordable. As they also testified the costly entrance fee makes them in order not to come to the park frequently.</p> <p>✚ High land value A Land resource is one of the main challenges of recreational parks in inner sub cities of Addis Ababa. As the land value in inner city of Addis Ababa is high; so opens spaces and green areas are changed and sold to investors for high rise buildings. Recreational parks are not enough and wide due to high land value in inner sub cities of Addis Ababa.</p> <p>✚ Low budget Lack of enough budgets for urban green infrastructures is another finical problem which influences the services and functionality of recreational parks directly or indirectly.</p>
Poor capacity building	<p>Absence of participatory planning Approach 90 % of the interviewers are answered as they do not have participatory planning and more than 85 % of the respondents reveal that they have not participated in park development.</p> <p>✚ Poor management Based on the interview made to officials on whether they have clear hierarchy and responsibility of recreational management 75 % responded as they have no clear hierarchy recreational parks management.</p> <p>✚ Lack of follow up and monitoring There no proper follow up and monitoring to take measures to illegal activities in recreational parks.</p> <p>✚ Low performance of private developers There different facilities that are restricted from the park like drinks, facilities for gambling like korbola and pool which shows that there is low monitoring.</p> <p>✚ Lack of integration and collaboration of different organizations Organizations have their own roles to perform based on the procedures and standards but they are not tracing each other.</p> <p>✚ Human resources Human resources are one of the challenges to recreational parks. Abuse of power and corruption are issues that affect institutional capacity in the area. Based on the manager of SBPDA (W/O Almaz) implementing bodies of UGI, contractors, landscape designers and planners have lacks experience and knowledge on recreational park management and development are challenges.</p>

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Technical</p>	<p>✚ Failure in Plant diversity and plant selection Based on observation and interview of officials in all inner Sub Cities Park there is no fruit trees to support food security expect the presence of two avocado trees in Tekele Hymanot Park. A type of plant species (ornamental trees, fruit trees, shrubs, groundcovers, and grasses) selection problems is also indicated as another challenge in old and newly developed recreational parks.</p> <p>✚ Poor material selection for fences and poor design Some parks like Tekele Hymanot Park have dead and closed fences at all parts except the entrance side. construction material of the fences are iron bar and it is not locally available, environmental friendly in both parks</p> <p>✚ Absence necessary facilities parking, benches, elder’s playground, animals, children paly grounds, water access, Varity of food services, Restrooms and Athletic Fields are some of the facilities that are mentioned by the officials and respondents of the questionnaires’.</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Environmental</p>	<p>✚ In the Africa and Tekel Hymanot Parks sound pollution is one of the challenges for park users that are caused by vehicular and people’s noisy. 60% of respondents attested that they have problems of noise in the park. 95 % of park users in Africa Park complain about the vehicular noise emitted and majority of respondents on the other hand (55%) in Tekel Hymanot Park complain about the bad smell they feel.</p> <p>✚ Poor waste management and aesthetically unpleasant</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Physical</p>	<p>✚ Lack of maintenance and deterioration of facilities Recreational parks are not maintained timely which results accidents to the users and environmental degradation which is due to low attention to parks and poor management as stated in institutional challenges of recreational parks.</p> <p>✚ Lack of comfort and convenience Play grounds have no protective covers, trails, water lines and access roads are not convenient and not feel comfortable. In addition some picnic areas in inner sub cities park are not comfort able due to deterioration, in combatable land use and poor design.</p> <p>✚ size of parks ✚ In inner sub cities all sub city level area of recreational parks are below the standard as shown in table 4.7</p>

Street sides and medians trees Challenges	
Physical	<p>✚ Damage and degradation Based on the observation and interview results of different organizations street trees are damaged due to many causes like vehicular, illegal activities of people arise from lack of awareness and etc</p> <p>✚ Land use change of medians Street medians are intended to give environmental and other ecosystem services but in study in inner sub cities of Addis Ababa some street medians are changed to another function like parking and marketing due to lack of strong institutional set up and poor management.</p> <p>✚ Street vendors and Street persons Interviewed officials added the problems of street persons since they live there the whole night and day so that they damage the plants deliberately for the purpose of sleeping. Street vendors are other challenges for street side trees especially at the initial stage of the plantation and for those which have no protecting cover.</p>
planning and design	<p>✚ Low diversity of street trees Based on the observation plants that are planted in street medians and sides are low and sometimes monotonous; in inner sub cities of Addis Ababa. This means street trees are not in the right plant composition that leads poor streetscape which finally reduces the value of the area.</p> <p>✚ Inappropriate plant selections Based officials interview from officials in Addis Ababa trees are not planted according to the standard due to lack of integration and experienced professionals. When selecting trees for placement on streets, we should consider the exact use of the plants (shade, fruit, seasonal color, beautification, wind break, or screen etc).</p> <p>✚ In appropriate Median tree: shape and Trunk diameter Shape: In streets of the study areas ,trees are not planted by such guide lines because spreading and up right plants exist in the places where columnar plants are more important(suitable) and vice versa. Trunk diameter: There are plants of which trunk diameters are greater than 30cm in median strips less than 2m wide which final leads infrastructure damage, traffic accident, aesthetically unpleasant and etc.</p> <p>✚ Height of shrubs in the medians There are street side plants which have no 2m vertical clearance from the pedestrian walk ways. This is highly depends on the species selected for placement especially in street sides which mobility is high since it does not bring comfort.</p> <p>✚ in appropriate location of trees Street side trees are planted wrongly at the center of the side walk or at the corner of the side walk without considering the dimensions of the sidewalks in the study areas.</p> <p>✚ in appropriate Street trees clearance Due to lack of integration between Addis Ababa traffic monitoring and regulation, Addis Ababa sanitation beautification park development agency and other related organizations traffic signs are located near street trees against the standard in the inner sub cities of Addis Ababa street.</p>

Environmental	<p>✚ Become waste dumping site</p> <p>As stated in the institutional and, management challenges of recreational parks, lack of monitoring and follow up streets plants leads people to dump their wastes in the Street sides and medians trees.</p>
Institutional and management	<p>Street sides and medians trees primarily administrated by the Addis Ababa sanitation beautification and park development agency like recreational parks of Addis Ababa. So that Street sides and medians trees share all Institutional and management challenges of recreational parks since they have similar internal and external relationships with other organizations.</p>
Cobblestone roads	
Physical	<p>✚ Degradation</p> <p>Based on the interview made to different officials traffic load of the area is not considered. In those areas that traffic load and high mobility, Cobblestone roads are degraded, cracked and water clogged. It is due to many causes like poor work man ship, poor sub base work, and suitability problems and etc.</p> <p>✚ Water clogging of void spaces</p> <p>in inner sub cities of Addis Ababa; Due to many causes like Technical (absence of suitability analysis: - soil type, Traffic load, and slope) and management challenges Cobblestone roads in inner sub cities of Addis Ababa water clogging is happened.</p> <p>✚ uncomfortable to residents</p> <p>Based on the interview of different officials Cobblestone roads are not comfortable in areas where many people exist and use the road as playing area, street activities, and others. As stated by 52 % of respondents in the study areas, Cobblestone roads have more comfort relatively with the gravel and mud roads in the area.</p>
Environmental	<p>✚ Pollution</p> <p>In inner sub cities of Addis Ababa Cobblestone roads have no site landscaping benefits as they are polluted by liquid waste and solid waste dumping which could stay many times at the surface of the cobble. So that it causes bad smell to the residents of the area; as revealed by the respondents. It is caused by lack of follow up and monitoring as it is discussed in institutional and management challenges of the Cobblestone roads.</p> <p>dust is mentioned third order challenges; 12.7 % of respondents face challenges of dust and it is a problem especially at dry season.it comes from below sub base and from the surfaces that lack proper construction, proper design ,absence of sweeping and etc.</p>
Technic	<p>Some of the technical challenges that are mentioned by the official's low quality of Cobblestone, poor work man ship, poor sub base construction and etc. As stated by the Cobblestone project coordination office manager; quality problem is one of the challenges of the Cobblestone roads in inner sub cities of Addis Ababa.</p>

Institutional and management	<p>Generally lack of integration, corruption, lack of follow up and monitoring and etc. are some of the challenges.</p> <p>Cobblestone project coordination office</p> <ul style="list-style-type: none"> + poor quality of trainings - low willingness to the questions of the contractors - time delay for training and for joining the work leads to sub-base degradation prepared by AACRA <p>Challenges observed from AACRA</p> <ul style="list-style-type: none"> - Failure to remove the excavated soil in the site and imposes problem to the work and finally to the quality of the Cobblestone and to the quality of the area. - absence of enough spaces for curb stone and quality sub base work - Failure to follow up and control the quality of Cobblestones whether is suitable or not. <p>Challenges observed from MSEs</p> <ul style="list-style-type: none"> - low capacity and performing low in construction leads to poor work man ship and degradation - Involving non trained workers in the paving and chiseling of the Cobblestone roads finally leads to workmanship problem. - lack of experiences of the enterprises
opportunities for urban green Infrastructures	<ul style="list-style-type: none"> + Based on officials" Interview from AASBPDA, urban green infrastructures proclamations, standard, strategies, policies, and principles that are prepared by MoUDC are some of the opportunities. + Development of amenity green space in residential areas, Religious Compounds Green Infrastructure Development (MoUDC, 2015) forces the private developers and the institutions to provide sufficient Urban Green Infrastructures. + The establishment of planning commission recently that incorporates many offices including AAUPI, sub city planning offices, office of Development Plan Preparation with the primarily role of preparing standard ,implementation follow up and documentation is an opportunity for UGI . + Similarly river side development and climate change protection office establishment aided with manual of Rivers and river buffer green infrastructure design standard implementation is another opportunity for green space coverage in inner sub cites. + Besides this the involvement of private developers to urban green infrastructures particularly to urban recreational parks a, Street sides and medians trees for the sake of them indirectly enhance the development and quality of the UGIs. + Increment of professionals aided with Increment of public need of quality open spaces, pure air, and other recreational parks day to day could be an opportunities to green infrastructures management and development. + Cheap labor force, undeveloped access roads local roads, Increment of public awareness and willingness to pay for Cobblestone roads and sense of owner ship for the development are other opportunities mentioned for UGI inner sub cities particularly Cobblestone roads. Generally the government attention towards UGIs provides different strategies, principles, manuals, etc are opportunities.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 conclusion

Green infrastructures are very critical to bring sustainable development by maintaining and regulating the environment (Randolph, 2004). However, increased urbanization and development have placed urban green infrastructures under extreme pressure, while unplanned urban growth has resulted in the loss of urban landscape and ecosystems (Wright *et al.* 2002).

In Lideta and Kirkos Sub Cities, the urban green infrastructure coverage in the development plan of 2017 is about 13% which is low comparing to the AADPPO standard claiming 30% of the city should be planned for urban green spaces. The study areas have problems of distributions, connectivity, and accessibility regarding UGI. The available urban green spaces are concentrated at one part of the sub cities or fragmented which makes them inaccessible. For example recreational parks are concentrated at north east part of the study areas which shows their distribution challenges.

As the study indicates, Recreational parks in the inner sub cities of Addis Ababa have challenges of inadequate investment in landscaping and other community facilities which could be categorized as social, economic, environmental, technical, capacity building and physical challenges. Limited and inadequate public spaces and recreation facilities and Service delivery problems are mentioned as the social challenges of recreational parks. The study also reveals different social challenges such as unfair distribution and inaccessibility of recreational parks, Non inclusive recreational parks for elderly and children, crime, forbidden activities in the park, Land use change, Low services delivery, and low satisfaction of users, Security issues, and land use incompatibility.

Recreational parks in the study areas located at one part of the sub cities and people go more than 4000m and 15 min. Beyond the low budget, Low considerations of urban poor and High Land value are another economic challenges inner sub cities park.

Absence of participatory planning Approach, Poor management, Lack of follow up and monitoring, Lack of integration and collaboration of different organizations, and human resources are other challenges. On the other hand, Failure in Plant diversity and plant selection of recreational parks, poor design, and Poor material selection for fences that meets the standard are also another challenges. Sound Pollution caused by people and vehicles, air

pollution are inner sub cities park challenges due to compatibility problem, poor management, lack of public awareness , poor waste management in the parks and aesthetically unpleasant areas. In addition, urban parks face Physical challenges; such as Lack of maintenance and deterioration which is caused by poor management and low attention to parks; and Lack of Comfort and Convenience caused by poor design and lack of maintenance. Street sides and median's trees faced physical challenges such as damage of trees, land use change, human intervention like street vendors and street persons.

Other pertaining challenges of street sides and medians trees are planning and design challenges including Low diversity of street trees, Inappropriate plant selections, in appropriate location of trees, in appropriate location and spacing, in appropriate color of fences to the surrounding buildings.

In the study areas where high mobility and high traffic loads; degradation and water clogging in cobble stone roads are challenges which are caused by poor suitability analysis and poor management. Less comfortable for children playing and Air pollution that are caused by poor management, lack of monitoring and follow up, low quality of Cobblestone , poor work man ship, poor sub base construction, lack of public awareness, lack of integration of different organizations are another challenges for the residents being the road is cobble.

Generally, In Inner sub Cities of Addis Ababa, urban green infrastructures faced different challenges including social, physical, economic, environmental, and institutional and management challenges. However; They have opportunities that enhance the management and development of them which include: Different urban green infrastructures proclamations, standard, strategies, policies, and principles; Climate resilient urban green development strategies, the 10th Development plan of Addis Ababa, increment of professionals, establishment of planning commission, establishment of river side development and climate change protection office, LDPs, urban renewals and upgrading projects, involvement of private developers including NGOs public awareness about green spaces are some of the opportunities that could be utilized properly in the future.

5.2 Recommendations

The results of this study will help to address the practical problems of the whole Addis Ababa urban green infrastructures especially in inner sub cities so that considerations must be given to foster sustainable development of them. Based on the above findings reached after the detail analysis, recommendations are forwarded as follows:-

The recommendations are basically forwarded to foster sustainable development of urban green infrastructures particularly recreational parks ,Street sides and medians trees , and Cobblestone roads in the inner sub cities of Addis Ababa.

- AASBPDA should add facilities that are lacked and upgrade or renew facilities that are not giving the right services effectively and efficiently in Recreational parks of inner sub cities of Addis Ababa by financing enough budgets. This includes children playgrounds, elders play facilities, parking, water access, sport facilities, and benches.
- Parks should be redesigned in a way that considers equal access for all age groups and government should subsidize private developers or make park entry fee free.
- It is recommended that children play grounds in the parks should have protective covers and areas should be safe and make convenient to children's by redesigning with safe and local materials.
- Theft, Murder, Assault, and Robbery are some crime challenges to recreational parks in inner sub cities of Addis Ababa so that that officials in the park should provide information for park users regarding forbidden activities and crime records for safety measures.
- Lack of public awareness about green infrastructures including recreational parks, Street sides and medians trees, and Cobblestone roads is one of the basic challenges in inner sub cities of Addis Ababa. It is recommended to change thinking skill of people about urban green infrastructures with curriculum about urban green infrastructures starting from high school, promotion with social media like radio, television, etc.
- It is recommended that government should regularly follow and monitor urban green infrastructures in inner sub cities of Addis Ababa whether they are giving the intended purpose or not, whether they are damaged or not, and etc .example recreational parks should be monitored regularly to control change of parks to commercial. It is highly recommended that government should take measures on private developers that do not give the right services.

- Responsible organizations about urban green infrastructures need to build strong institutional capacity, through trainings, research, workshops, seminars, etc. as well they should integrate and collaborate strongly.
- There are no fruit trees to support food security in the studied parks except the presence of two avocado trees in Tekele Hymanot Park. So that it is recommended, according to the standard of (MoUDH, 2015), 50 % plants in recreational parks should be fruits to support food security. Similarly in Street sides and medians, variety of plant species should be planted to increase the landscape value rather than being monotonous.
- There should be proper plant species selection for street medians and street sides that do not damage infrastructures, which consider pedestrian safety, sun orientation, trunk diameter, height of the plants, shape of the canopy and etc.
- It is recommended that Street trees should be planted with the standard clearance from traffic signs, Utility Boxes, Utility Poles, fences, and buildings. They should get wide spaces with the right protective cover to grow the root.
- Noise reduction mechanisms should be planned and designed in those parks that have noise problems and newly proposed recreational parks should consider suitability and compatibility regarding noise pollution and other land uses.
- AASBPDA and Solid Waste Recycling and Disposal Project Office should integrate and collaborate strongly to combat the air pollution challenges and unpleasant areas.
- It is recommended that Cobblestone roads should not be developed in inner sub cities of Addis Ababa especially in areas where there is dense settlement and high traffic loads.
- AACRA should repair the damaged and water clogged roads regularly. As well, they should do proper suitability analysis of soil type, slope, and traffic load of Cobblestone roads before development.
- It is recommended that government should give awareness creation programs to the community about the Cobblestone roads in order not to dump their wastes to the roads.
- MSEs which are responsible for paving should do proper follow up and monitoring in the quality of sub base work that are done by AACRA. And AACRA should properly check and monitor the quality of the Cobblestone from the producers in order to mitigate the problem of dust, water clogging and degradation.
- Since excavated soils are causes of air pollution, Soils that are excavated for the Cobblestone roads or other purpose should be removed timely by the organization who excavate.

- It is recommended that in inner cities urban green infrastructures should be given more privileges in size than outer due to concentration of activities so that government should utilize effectively the advantage of renewals and upgrading especially for recreational parks and Street sides and medians trees.
- Government should prepare awareness creation about UGIs for street persons and street vendors and take measures for those who do illegal activities.
- It is recommended that concerned organizations must evaluate the implementation of green infrastructure strategies, manuals, proclamations, and principles.

Finally other researches should be done regarding urban green infrastructures in inner sub cities of Addis Ababa that could come up with real and practical solutions like the researcher wants to study further on ***development of monitoring system for street trees*** that could relieve the stress of them.

References

- AASBPDA. (2015). Manual for Recreational Parks Development and Management. Addis ababa.
- Amare, A. (2008). Problems and Constraints of Urban Green Area Management in Addis Ababa: The Case of Kolfe- Keranio Sub-City. 11.
- Anna Serra-Llobet, M. A. (2016). Opportunities for green infrastructure under Ecuador's new legal framework. Elsevier.
- Asmelash, F. (2013). Green infrastructure for sustainability and climate resilience. Addis Ababa).
- berihun, m. (2015). assessing cobblestone roads management and maintenance: the case of addis ketema sub city. addis ababa.
- Cecil C. Konijnendijk, Anders Busse Nielsen, Sreetheran Maruthaveeran, (2013). Benefits of Urban Parks. Copenhagen & Alnarp.
- Cheng, c. (2013). social vulnerability, green infrastructure, urbanization and climate change- social vulnerability, green infrastructure, urbanization and climate change induced. amherst.
- Chirisa, Abraham Matamanda and Innocent (2014). Ecological planning as an inner-city revitalisation agenda for Harare, Zimbabwe.
- Christopher Kost, M. N. (2011). Better streets, better cities. *Environmental Planning Collaborative*.
- CLUVA . (2013). Green Infrastructure: An essential foundation for sustainable urban futures in Africa.
- Dale A. Getz, Alexander Karow, and J. James Kielbaso (1982). inner city preferences for trees and urban forestry programs.
- Danquah, L. (2010). The causes and health effects of river pollution.
- David Dodman, Gordon McGranahan and Barry Dalal-Clayton (2013). key principles and approaches for cities in the 21st century. Nairobi: at United Nations Environment Programme.
- David Reid, David Hutch, Mike Hunter, Darcy Bertram, Dave Turner (2004). *Urban Forestry Master Plan Phase II (Street Tree Master Plan)*. North Vancouver.
- Demuzere, K. O. (2014). Mitigating and adapting to climate change: Multi-functional and multi-scale assessment of green urban infrastructure. *Journal of Environmental Management*.

- Dubbale Daniel A., T. J. (2010). Urban Environmental Challenges in Developing Cities: The Case of Ethiopian Capital Addis Ababa . International Scholarly and Scientific Research & Innovation, 164.
- Dubbale Daniel A., Tsutsumi J., and Michael J. Bendewald. (2010). Urban Environmental Challenges in Developing Cities:The Case of Ethiopian Capital Addis Ababa. International Journal of Environmental, Chemical, Ecological, Geological and Geophysical Engineering Vol:4, No:6, 2010, 166.
- Elgendy, S. &. (2004). New challenges for City- and regional planning:Inner development of cities and regions for promoting sustainable development. 40th ISoCaRP Congress, 1.
- Enyew, A. (2013). assessment of the challenges and prospects of micro and small enterprises operating on solid waste collection activity.
- European union. (may 2016). Urban ecosystems. Luxembourg.
- European Commission. (2013). Building a Green Infrastructure for Europe. Luxembourg: Publications Office of the European Union.
- Eyob, Tenkir, Shikur (2010). Challenges and problems of urban forest development in Addis Ababa, Ethiopia.
- Farley, J. (2013). Street Tree Diversification and Location Considerations. Utah State University.
- Fernando Aragón-Durand, J. C.-M. (2014). Urban Areas. USA.
- Gebeyehu, A. (2014). An Assessment of Green Area Development in Addis Ababa with Particular reference to Gullelle Sub city.
- Paul H. Gobster. (1998). Managing Urban Parks for a Racially and Ethnically Diverse Clientele, Chicago, Illinois, USA
- Gossye, a. (2015). inner-city renewal and its impact on the economic dimension of livelihoods of displaced people in addis ababa city, ethiopia: the case of people relocated from lideta to goffa.
- IBRD. (1996). Urban Management Programme: Participation and Partnership in Urban Infrastructure Management. A policy paper.
- Jeremy Whitehand, R. M. (n.d.). Urban Morphology and the sustainable provision of Ecosystem Services. Birmingham.
- Jing ZhangTongliga Bao 1, 2. (2016). Assessing the Distribution of Urban Green Spaces and its Anisotropic Cooling Distance on Urban Heat Island Pattern in Baotou...
- Josh Foster, A. L. (2011). The value of green infrastructure for urban climate adaptation.

- Joshua P. Newell *et al.* (2012). Green Alley Programs: Planning for a sustainable urban infrastructure? *elsevier*.
- Kaczorowska *et al.* (2016). Ecosystem services in urban land use planning: integration. *Ecosystem Services, in press*.
- Kahsay Woldegerima, T. (2016). Study of the Urban Environment and Ecosystem Services of Addis Ababa: Implications for Urban Greenspace Planning.
- Kathleen Barnhill, R. S. (2012). Gaining Ground: Green Infrastructure Attitudes and Perceptions from Stakeholders in Syracuse, New York. *Environmental Practice*, 9.
- Kramer, M. G. (2014). Enhancing sustainable communities with green infrastructure. usa: u.s. environmental protection agency.
- Kremer *et al.* (2016). Key insights for the future of urban ecosystem services research. *Ecology and Society*.
- Kumelachew, y. (2011). Green area typologies and mapping of green structures in addis ababa and dar es salaam. addis ababa.
- Kumlachew, Y. (2013). 15th Annual General Assembly Meeting of FSS Held. Addis Ababa: New Acquisitions.
- Lein., J. K. (2003). Integrated environmental planning. Ohio University.
- LeVario, S. (2011). Crime in Pomona's Parks.
- Losarcos, L. (2010). Green infrastructure in-depth case analysis.
- Loukaitou-Sideris, 1995. Urban form and social context: cultural differentiation in the use of urban parks
- Marthe L *et al.* (2016). Green infrastructure for urban climate adaptation: How do residents' views on climate impacts and green infrastructure shape adaptation preferences? *Elsevier*, 107.
- Martina Artmann, O. B. (2017). Using the Concepts of Green Infrastructure and Ecosystem Services to Specify Leitbilder for Compact and Green Cities.
- McGee, L. P. (2017). Inclusive recreation services. *livable new york resource manual*, 1.
- Mensah, C. A. (2014). Nature and challenges of urban green spaces in africa. birmingham.
- MoUDH. (2015). Ethiopia national urban green infrastructure standard. addis ababa.
- Mulaw, G. B. (2015). Assessing cobblestone roads management and maintenance: the case of addis ketema sub city. addis ababa.
- Munir, A. (2012). Inner city river side development and Land Use Transformation: in the context of Addis Ababa. *MSC Thesis in Urban Settlement Studies*, 1.

- Planning Council, A. M. (n.d.). Massachusetts Low Impact Development Toolkit.
- Randolph, J. (2004). *Environmental land use planning and management* . london: Island Press.
- Rozalija Cvejić, K. E. (2015). A typology of urban green spaces, eco- system provisioning services and demands. germany: green surge project.
- Samson, A. (2014). Assessment of urban green infrastructure in Addis Ababa
- Sara Khoshkar, J. A. (2015). Opportunities and Challenges for the Integration of Green Qualities in the Densification of Regional Cores of Stockholm. Stockholm.
- Sipe, J. B. (2010). Green and open space planning for urban consolidation – A review of the literature and best practice. Urban Research Program.
- Sri Maryatia, A. N. (2015). Green infrastructure development in Cisangkuy Subwatershed,Bandung Regency: potential and problems. Elsevier.
- Tekle, W. K. (2016). Study of the Urban Environment and Ecosystem Services of Addis Ababa: Implications for Urban Greenspace Planning.
- Thomas, P. Z. (2013). Environmental challenges of urbanization: A case study for open green space management. Full Length Research Paper, 106.
- Tiwari. (2011). Role of Indigenous Technologies in Urban Infrastructure Provision: An Evaluation of Cobblestone Roads in Dire Dewa, Ethiopia”. The IUP Journal of Infrastructure, Vol. IX, No. 1., 74.
- Tsige, B. (2015). Enhancing Green Infrastructure of Mekelle City: Through Green Technology, Elements and Green Corridor Development.
- UN-Habitat. (2013). Cobblestone- Youth Job Creation Initiative:The Ethiopian Experience. Scroll of Honor Award Competition.
- Wheeler, S. V.-L. (2011). An Introduction to Park Management. Sagamore Publishing LLC.
- William P. Cunningham, M. A. (2006). *PRINCIPLES OF Environmental Science*. New york: Mc GrawHill.
- Wuhan, G. I. (2013). USER MANUAL.
- Yigitcanlar, T. (2015). Planning the Green Walkable City: Conceptualizing Values and Conflicts for Urban Green Space Strategies in Stockholm. Open Access.

Annex I: Check lists, Questionnaires and Interviews

Check lists for observation of recreational parks

1. physical challenges they face such as compatibility, damages, suitability
2. Park functions: is land use changed or not?
3. pavements: comfort and convenience
4. fences and walls: durability, availability, environmental friendly, safety and comfort
5. Facilities: are they functional and in safe conditions all time? availability of necessary facilities
6. diversity of plant species (ornamental trees, fruit trees, shrubs, groundcovers, grasses)

Check lists for street trees and street medians

1. street trees clearance from Utility Boxes, Sewers, Utility Poles, buildings, fences
2. median tree: shape (columnar), upright, trunk diameters
3. height of shrubs in the median
4. human intervention
5. land use change of median
6. location consideration and spacing

Check lists for Cobblestone roads

1. Comfort
2. Physical status
3. pollution

Questionnaires' for residents of recreational parks

This questionnaire is prepared by Alemaw Kefale, Addis Ababa University, Master of Environmental Planning and Landscape Design Graduate candidate student, who is currently working on challenges and opportunities of urban green infrastructures in Inner Sub Cities of Addis Ababa: the case of LIDETA Sub City and KIRKOS Sub City. This questionnaire is prepared for data gathering purpose for Research regarding recreational parks and I ask you politely to help me in filling the questioner.

Dear respondents, first of all I want to thank you in advance for your willingness to fill this questioner paper; In filling the questioner try to be very honest, free and open; because your responses to each and every question on the questioner paper will have high contribution for the validity and reality of the paper as a whole.

1. where is your place of Residence--- sub city ----- Woreda ----- -Occupation --
----- Age -----

2 what benefits and interesting things you get from the park?.....

3 have you participated in improving and investing in parks and recreation areas?

A, Yes b, No

4If yes who mobilizes you and what were your roles?.....

5, How far do you from your home to the nearest park?

A 1000 m b 2000- 3000m C 3000- 4000 m D > 4000m

6, How many minutes you spent to reach at the nearest park on foot?

A <15 minutes, B 15-20 minutes, C >20 minutes

7, by what kind of transportation mode do you come?

A, walking B, bus C, Taxi D, Automobile E, Other

8 are you comfortable with the entrance fees. A yes B no

9, do you get children's playground equipment's satisfactory and safe? A yes B no

If No what do you miss? -----

10, on a scale from 0 to 5, where 0 is “not at all satisfied,” and 5 is “extremely satisfied,” how satisfied are you with the number and distribution of sub city parks?

A, 0 B, 1 C, 2 D, 3 E, 4 F, 5

11, on a scale from 0 to 5, where 0 is “not at all satisfied,” and 5 is “extremely satisfied,” how satisfied are you with the accessibility of sub city parks?

A, 0 B, 1 C, 2 D, 3 E, 4 F, 5

12, on a scale from 0 to 5, where 0 is “not at all satisfied”, and 5 is “extremely satisfied,” how satisfied are you with the quality of sub city parks?

A, 0 B, 1 C, 2 D, 3 E, 4 F, 5

13 Which of the following aspects of existing City Park are most in need of improvement or attention?

- A. Water or beach access
- B. Play equipment
- C. Trails
- D. Restrooms
- E. Picnic Facilities
- F. Parking
- G. Athletic Fields
- H. Maintenance
- I. Other

14, which type of activities and facilities do you want to add? -----

15 which external factors disturb you while you are recreating?

A, noise pollution from people and traffic B, dust pollution C, smell from poor waste management D, other’s please specify-----

16, have you observed illegal activities in the recreational park? A, yes B, No

if yes, please mention them-----

17, Are there any reasons that discourage you to recreate in this park? -----

18, on a scale from 0 to 5, where 0 is “not at all satisfied” and 5 is “extremely satisfied, generally how satisfied with the park?

A, 0 B, 1 C, 2 D, 3 E, 4 F, 5

Questionnaires' about Cobblestone Roads for residents

This questionnaire is prepared by Alemaw Kefale, Addis Ababa University, Master of Environmental Planning and Landscape Design Graduate candidate student, who is currently working on challenges and opportunities of urban green infrastructures in Inner Sub Cities of Addis Ababa: the case of LIDETA Sub City and KIRKOS Sub City. This questionnaire is prepared for data gathering purpose for Research regarding Cobblestone Roads and I ask you politely to help me in filling the questioner.

Dear respondents, first of all I want to thank you in advance for your willingness to fill this questioner paper; In filling the questioner try to be very honest, free and open; because your responses to each and every question on the questioner paper will have high contribution for the validity and reality of the paper as a whole.

1. Where is your place of Residence--- sub city ----- Woreda -----?
2. How far is your house from the Cobblestone road?
A, 5m B, 10m C, 15 m D, >15m
3. What benefits you get from the Cobblestone streets environmentally, economically, socially?

4. Are you comfortable with the Cobblestone roads in your area for? If no why?
Walking A, yes B, No If no why? -----
Playing children A, yes B, No If no why? -----
Street activities A, yes B, No If no why? -----
5. What kind of problems do you observe in the Cobblestone roads of your area?
A, clogging C, dusty
B, pollution D, cracking E, others-----
6. When do you observe many problems of Cobblestone roads?
A, winter (dry) season B, summer season
7. Do residents dump their wastes to the Cobblestone roads? A ,yes B ,No
If yes what kind of measures you and government take? -----
8. Is there any traffic load on the Cobblestone roads?
A yes B no
If yes what impacts imposed by the traffic load? -----

9. Have you observed any road maintenance? A, yes B, No if yes how many times per year? -----
10. How many times did the Cobblestone streets; are swept per week? -----
11. During the construction of the road in the Area, was there a good corporate social responsibility?
A, Yes B, No
12. What was the modality? -----
13. Do you think Cobblestone roads are recommended in your area? A, Yes B, No
If No why -----
14. On a scale from 0 to 5, where 0 is "not at all satisfied" and 5 is "extremely satisfied," I am happy with the quality of Cobblestone roads in my Area.
A, 0 B, 1 C, 2 D, 3 E, 4 F, 5
15. Generally what do you recommend for improving the quality and sustainability of Cobblestone roads in inner city areas? -----

Interviews for officials

For recreational parks

1. Name of the organization-----
Department-----Name of the official-----
2. What are your vision, goals, and programs towards recreational parks? -----
3. What types of opportunities do urban green infrastructures have particularly recreational parks in inner cities? Please justify in your professional perspective -----

4. Do you have hierarchy of recreational park management? A, yes B, No
If yes, up to what level-----
5. Who primarily manages the park? -----
6. Do you have participatory planning approach? A, yes B, No
If No why -----
7. Do you have collaboration and integration with other organizations to manage the recreational parks? A, yes B, No
If yes what are they? -----
8. What are your roles towards recreational parks? -----
9. Do you do timely maintenance of recreational parks if you are concerned?
A, yes B, No If No why? -----
10. Do you do proper follow up and monitoring to take measures to illegal activities in recreational parks? A, yes B, No If No why -----
11. Do you think supply and demand of recreational parks are equal? -----
12. Do you think in inner cities recreational parks should be given more privileges in size than outer? A, yes B, No please justify-----
13. Are there any privileges that are done and proposed regarding recreational parks before?
A, yes B, No please justify-----
14. What kind of challenges do UGIs have and face regarding recreational parks in inner sub cities? A, financial B, human resources C land resources D others please specify-----
15. What are the best strategies or options that you use in your organization to bring sustainable development of the recreational parks in inner part of the AA particularly in the sub city? -----
16. Generally what do you recommend for improving the quality and sustainability recreational parks in inner sub cities of AA? -----

For Street sides and medians trees

1. Name of the organization-----
Department-----Name of the official-----
2. What are your vision, goals, and programs towards Street sides and medians trees? -----
3. What types of opportunities do urban green infrastructures have particularly Street sides and medians trees in inner cities? Please justify in your professional perspective -----
4. Do you have hierarchy of Street sides and medians trees management? A, yes B, No
If yes, up to what level-----
5. Who primarily manages Street sides and medians trees? -----
6. Do you have participatory planning approach? A, yes B, No If No why? ----
7. Do you have collaboration and integration with other organizations to manage Street sides and medians trees? A, yes B, No If yes what are they? -----
8. What are your roles towards the Street sides and medians trees? -----
9. Do you do timely maintenance of the Street sides and medians trees if you are concerned?
A, yes B, No If No why? -----
10. Do you do proper follow up and monitoring to take measures to illegal activities in Street sides and medians trees? A, yes B, No If No why -----
11. Do you think in inner cities Street sides and medians trees should be given more privileges in size than outer? A, yes B, No please justify-----
12. Do you think Street sides and medians trees are planted in standards regarding proper spacing and suitable plants? A, yes B, No please justify-----
13. What kind of challenges do you have regarding Street sides and medians trees in inner sub cities? A, financial B, pollution C, lack of follow up D, others please specify-----
14. what are the best strategies or options that you use in your organization to bring sustainable development of the Street sides and medians trees in inner part of the AA particularly in the sub city?-----
15. Generally what do you recommend for improving the quality and sustainability of Street sides and medians trees in inner sub cities of AA? -----

For Cobblestone Roads

1. Name of the organization-----
Department-----Name of the official-----
2. What are your vision, goals, and programs towards Cobblestone roads in Inner Sub Cities of Addis Ababa? -----
- 3, what types of opportunities do urban green infrastructures have particularly Street sides and medians trees in inner cities? Please justify in your professional perspective? -----
4. Do you have hierarchy of Cobblestone roads management? A, yes B, No If yes, up to what level-----
5. Who primarily manages Cobblestone roads? -----
6. Do you have participatory planning approach? A, yes B, No If No why -----
7. Do you have collaboration and integration with other organizations to manage Cobblestone roads? A, yes B, No If yes what are they? -----
8. What are your roles towards Cobblestone roads? -----
9. Do you do timely maintenance of Cobblestone roads if you are concerned? A, yes B, No If No why? -----
10. Do you do proper follow up and monitoring to take measures to illegal activities in the Cobblestone roads like dumping wastes, using as garage? A, yes B, No If No why? ----
11. What types of challenges do urban green infrastructures face and have, particularly the Cobblestone roads in inner cities? Please justify in your professional perspective. -----
- 12 do you think Cobblestone roads are recommended in Inner Sub Cities of Addis Ababa.?
A, yes B, No please justify-----
- 13 what parameters do you follow when the roads are designed and constructed? -----
- 14 what are the best strategies or options that you use in your organization to bring sustainable development of the Cobblestone roads in inner part of the AA particularly in the sub city? -----
- 15 Generally what do you recommend for improving the quality and sustainability of Cobblestone roads in inner sub cities of AA? -----

Annex II: supporting tables

Table 14 some urban green spaces in Kirkos and Lideta sub cities in 2008 E.C
Source: Addis Ababa sanitation, beautification, and park development agency

Types of the green spaces																											
		Round about				Street medians				Street sides				Street islands				Recreational parks									
		developed		undeveloped				developed		undeveloped				developed		undeveloped				developed		Under developed		Undevelope d			
sub city	Total	no	k/m	No	k/m	Total	no	k/m	no	k/m	Total	no	k/m	no	k/m	Total	no	k/m	no	k/m	Total	No	k/m	No	k/m	no	k/m
Kirkos	11	8	3536	3	3100	23	4	10252	19	29265	30	28	18135	2	2599	6	3	355	3	2575	3	1	45707	1	167900		-
Lideta	5	4	4196	1	2828	9		21020			8	7	6900	1	3000	2	1	500	1	600	6		43799	2	1592	1	7756
Total 53660	16	12	47732	4	5928	32		31272			38		25035	3	5599	8	4	855	4	3157	9	3	89506	3	169492		-

Computed by: the researcher April 2017

Table 15: Availability and Distribution of recreational parks in Kirkos and Lideta sub cities in 2008 E.C

Sub city	Park name	Area in m2	Development status
Lideta	T/Haymanot	4371	Developed and starts work
	Gola park	9625	>>
	Ethio Cuba	29803	>>
	Lideta Renewal	12192	>>
Kirkos	Africa park	45707	>>
	ECA park	167900	Not developed
	Olympia park	647	developed

Table: 16 Availability of Roundabouts in the study areas

Sub city	woreda	places	Area in m ²	Developer	Status of dev.t
Kirkos	01	Around Urael church	350	Romel Trading	undeveloped
	01	Around Babis brige	250	Enat Bank sc	
	01	Around Babis brige	400		
	02	Wollo sefer	150	Government	
	03	Around wengelawit	300		
	05	Around kera	1582	Government	dev.
	06	Mexico round about	2400		
	07	Felweha area	200	Government	
	07	National area	654	Gov. and glories	undeveloped
	09	denbel	150	Government	undeveloped
	08	Sidestigna polisstation	200	Government	undeveloped
	Total		6636		3100 3556
Lideta	02	Torehyloch round about	1962	DH geda	undeveloped
	03	Koka mazoriya	314	Kefata arat School	
	09	National bank area	400	Ethiopian teachers association	undeveloped
	10	Africa union	1520	Midroc Ethiopia	undeveloped
		Total		7024	

Source: Addis Ababa sanitation, beautification, and park development agency

Computed by: the researcher April 2017

Table 17 : Availability and Distribution of street islands in Kirkos and Lideta sub cities

Sub city	Were da	Name of the place	Area in m ²	Develop er name	Status of development
Kirkos	07	Tele bar area	2075	-----	Undeveloped
	07	Legehar area	350	-----	>>
	07	Mesqel square	150	-----	>>
	08	Kasnchis area	148	GOV.	develped
	08	Yordanos hotel area	150	HUSIEN	>>
	08	Gerbraiel chafe	57	GOV.	>>
Lideta	04	Abent round about at two sides	600	-----	Undeveloped
	06	Down town/infront of Meda garajii	500	GOV.	>>

Source : field observation march,2017 and Addis Ababa sanitation, beautification, and park development agency

Table 18 Availability and Distribution of street medians in Kirkos and Lideta sub cities

Sub city	woreda	Place name	Area in m 2	Developer name	Status of development
Kirkos	01	Estifanos church to NOC madiya	2000	AACRA	developed
	02	Debel round about to kara mara brige	1500	GOVERNMENT	developed
	02	Wollo sefer to ibex hotel	310	>>	undeveloped
	03	Olompiya to Meskel flower hotel	2000	>>	developed
	03	Gotera masalecha and gotera chafe	260	>>	undeveloped
	03	Ibex hotel to Gotera chafe	100	>>	undeveloped
	04	Gofa mazoriya to cherkos church	3052	>>	developed
	05	Bulgaria to kera round about	2359	>>	undeveloped
	06	Mexico to Africa union	7087	>>	undeveloped
	06	Around sarebet	500	>>	undeveloped
	06	Bulgaria to Africa union along Michael church	1700	>>	undeveloped
	07	National to Mexico round about	210	>>	undeveloped
	07	Palace to felwuha along foreign affairs	5104		
	07	Stadium area	1400		
	07	Harmabie hotel to meskel square along Ghion	1480		developed
	07	Buna ena shay to stadium along leghaer	3200		
	07	Ambassador to Sheraton hotel	1480	GOV.AND SHERATON	
	07	In front of Ethiopia hotel	270	SUB CITY AND HOTEL	
	08	Urael to gebi geberial along menharyaia	2633	SUB CITY AND HIRUT FAMILY	
	08	Inter-continental to yordanos hotel	1023	GOV.	
	09	Meskael chafe to denbel	1000	GOV.	
	07	Tele up to leghar	500	ETHIO TELCOM	
	Total				
Lideta	05	Beriberi bernda to 43 gulet	1000	GOV.	developed
	06	T/haymanot to metrology	15000	GOV.	>>
	08	Amestigna to chefe meda along gejjja sefer	700	GOV.	>>
	09	Metrology to Goma kuteba	400	GOV.	>>
	09	Amestigna to Goma kuteba	650	GOV.	>>
	09	Goma Kuteba to national bank	1200	GOV.	>>
		Post office to mekalkeya	800	GOV.	
		Post office to ambassador theatre	270	Gov.	
		total	21020		21020

Source: Addis Ababa sanitation, beautification, and park development agency

Computed by: the researcher April 2017

Table 19 Availability and Distribution of street sides in Kirkos and Lideta sub cities

Sub city	woreda	Place name	Area in m ²	Developer name	Status of development
Kirkos	01	Urael church to AA health office	18	GOV.	developed
	01,02	Meskel square to karamara bridge along bole road	700	GOV.	developed
	02,03	Wollo sefer	237	GOV.	>>
	04	Gofa mazoriya to cherkos church	250	>>	>>
	04	Gotera ehel dipo	120	>>	>>
	05	Infront of AACRA	600	AACRA	>>
	06	Mexico to Gumuerk	320	GOV.	>>
	06	Federal small enterprises agency	1565	FSEA	>>
	06	Around Mexico	1933	AACRA	>>
	06	Around Mexico	349	COCA COLA	>>
	06	Around Mexico	245	TOTAL	>>
	06	Bulgaria to Africa union along Michael church	800	GOV.	>>
	07	Around Mexico	2280	COMMERCE COLLEGE	>>
	07	Ethiopia hotel to legehar	6378	4 ORGANIZATIONS	>>
	08	Sedistegina police station	300	TOSA TERARA HOTEL	>>
	08	Estifanos to urael	520	GOV.	>>
	09	Meskel chafe to denbel	150	GOV.	>>
	09	Meskel square to to Reche	175	GOV.	>>
	10	Cherkos church area	185	GOV.	>>
Lideta	09	In front of national theatre	1200	MOUD	>>
	09	Next to national bank	1000	COMMERCIAL BANK	>>
	02	Awash wine to torehyloch	600	AWASH WINE S.C	>>
	03	Coca mazorya to wendmamachoche	1500	PRIVATE	
	04	Lideta high court area	3000		Not
	08	Saint George beer factory area	500	BGI	demolished
	08	Arekie factory area	600	GOV.	Developed

Source: field observation march, 2017 and Addis Ababa sanitation, beautification, and park development agency