Challenges of Urban Green Infrastructure Planning and Implementation in Bishoftu City A Case of Dukem Sub-City

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A Thesis Submitted to the Department of Architecture

College of Civil Engineering and Architecture

Presented In Partial Fulfilment of the Requirement for the Degree of Masters in Urban Planning and Design

Office of Graduate Studies

Adama Science and Technology University

November, 2024

Adama, Ethiopia

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DECLARATION

I hereby declare that this Master Thesis entitled “Challenges of Urban Green Infrastructure Planning and Implementation in Bishoftu City a Case of Dukem Sub-City” is my original work. That is, it has not been submitted for the award of any academic degree, diploma or certificate in any other University. All sources of materials used for this thesis have been duly acknowledged through appropriate citations.

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Student Name	Signature	Date

RECOMMENDATION

I/we, the advisor(s) of this thesis, hereby certify that I/we have read the revised version of the thesis entitled entitled “Challenges of Urban Green Infrastructure Planning And Implementation in Bishoftu City A Case Of Dukem Sub-City” prepared under my/our guidance by Ebisa Michael Ligaba submitted in partial fulfillment of the requirements for the degree of for the degree of masters in urban planning and design. Therefore, I/we recommend the submission of the revised version of the thesis to the department following the applicable procedures.

_____	_____	_____
Major Supervisor	Signature	Date
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Co-Supervisor	Signature	Date

APPROVAL SHEET

I/we, here by certify that the recommendation and suggestion given by the proposal review committee are appropriately incorporated into final thesis/dissertation proposal entitled “Challenges of Urban Green Infrastructure Planning And Implementation in Bishoftu City A Case Of Dukem Sub-City” by Ebisa Michael.

Seleshi Azagew (PhD) _____ _____

Major Advisor/Supervisor Signature Date

We, the undersigned, members of the Board of Examiners of the thesis by Ebisa Michael have read and evaluated the thesis entitled “Challenges of Urban Green Infrastructure Planning And Implementation in Bishoftu City A Case Of Dukem Sub-City” and examined the candidate during open defense. This is, therefore, to certify that the thesis is accepted for partial fulfilment of the requirement of the degree of Master of Science in Urban Planning.

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

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School Dean Signature Date

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Office of postgraduate studies, Dean Signature Date

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ACRONYMS

GIS	GEOGRAPHICAL INFORMATION SYSTEM
SPSS	STATISTICAL PACKAGE FOR THE SOCIAL SCIENCES
UGI	URBAN GREEN INFRASTRUCTURE
UN	UNITED NATION

ABSTRACT

Urban forestry and green spaces have less priority in urban planning. This research intends to assess the policy and planning of urban green spaces with their potential implementation status and challenges in planning and implementation. The general objective is to assess urban green space planning, policy, and implementation strategies and challenges encountered in Dukem Sub-city. The primary data will be collected through key informant interviews, focus group discussions, and field observation; secondary data from a literature review along with examining policy and master plans of Dukem Sub-city. The mapping of stakeholder and institutional arrangements is analyzed using stakeholders consultation. Triangulation is used for data validation and analysis. Existing policy and proclamations must be supported by legislative regulations and implementation frameworks that provide the basis for concrete action plans. The land use land cover (LULC) dynamics in Dukem Sub-city using remote sensing & GIS techniques between 2003 and 2019 years revealed that built-up area augmented severely from 698.06 ha (16.45%) in 2003 to 3,091.67 hectare (72.81%) in 2019. Specifically, agricultural land extremely decreased in all years from 2,764.37 hectares (65.12%) in 2003 to 999.05 hectare (23.53%) in 2019. According to Dukem Sub-city structural plan documents, Urban Green Infrastructure and Resort recreation is a potential of Dukem; however, resort and related facilities always exists as long as the setting (environment) is well kept. In the case of Dukem sub-city the hilly sites are places of attractions, thus parks and recreational areas are planned considering these assumptions. The proposal tries to harmonize the environment and recreational facilities.

The research concludes that, regulations and directives are not clearly drafted by responsible bodies, and low enforcement is hardly applied with respect to the green space development of Dukem Sub-city. Therefore, principles, regulations and directives should be provided by the responsible body through creating awareness, ensuring its inclusiveness and implementations.

Keywords: Dukem Sub-city, Urban *Green Infrastructure, planning principles, strategies*

CHAPTER ONE

1.INTRODUCTION

1.1. Background

More proportion of the world population currently lives in urban areas than rural areas. Studies suggested that people residing in urban areas have reached 53% (UNDESA, 2014). Furthermore, the rate of urbanization is higher in developing countries, including those in Africa despite their low level of current urban population. As the world continues to urbanize, sustainable development challenges will be increasingly concentrated in cities, particularly in the lower-middle-income countries where the pace of urbanization is fastest. In this case, it needs to formulate integrated policies to improve the lives of urban dwellers and sustain a healthy environment (Tsegaye Ginbo and Dawit W. Mulatu,2017).

In Ethiopia, the current rate of urbanization is high. According to (World Bank, 2015), urbanization in Ethiopia increases by 5.4% per a year, which put the country among the top 10 fastest urbanizing countries in the world. The main drivers for current rapid rate of urbanization in Ethiopia include the expansion of existing cities, rural-urban migration and transformation of small rural villages to the towns. However, rapid urbanization demands balanced investment in basic infrastructure such as health, education, roads, water and sewerage, housing and recreational facilities (AfDB, 2016). The provision of such facilities is challenging in urban areas of Ethiopia including the capital city, Addis Ababa (Ibid).

Green infrastructure (GI) is one of the key infrastructures, defined as parts of an urban area with a mix of street trees, parks, cultivated land, wetlands, lakes, and streams that are interconnected. The economic, social, and environmental benefit of green infrastructures is not very well documented. Green infrastructures can be a direct source of income and food (Fisseha Asmelash, 2013). They help in cleaning air pollutants, store and sequester carbon dioxide, provide biomass fuel which is renewable, reduce noise pollution, support biodiversity and also act as a de-fact sanctuary, reduce urban heat island and have a general cooling effect, reduce water pollution, and reduce flooding. They also have psychological benefits, health benefits, recreational benefits, and increase peoples sense of community. Therefore, green infrastructures ensure sustainability and make urban areas

resilient to climate change since they have a cooling effect, increase habitat connectivity and act as de-facto sanctuaries, and reduce flooding (Fisseha Asmelash, 2013.)

World urban areas are increasingly dabbling with the triple challenge of pollution, congestion and environmental degradation. The quest for sanity and healthy urban living led to the introduction of urban green space initiatives.

Here Green infrastructure means greening of infrastructure with the intention of 'minimizing environmental damage while maximizing environmental benefits related to the use of material and energy during the construction and operation phases (Giordano, 2014). Although the term is most commonly associated with the 21st century, the concept of green space integrated into an urban fabric for environmental and human health purposes dates back to mid-19th century urban planning (Ibid).

Central to the concept of green infrastructure are the themes of multi-functionality, connectivity/network and ecological services. Multi-functionality, as the name implies, refers to multiple purposes and functions of green space(s) (Mell, 2008). One of the crown jewels of Olmsteds Emerald Necklace Park system in Boston was the Back Bay Fens, the first known example of a wetland constructed to manage a citys sewage and water pollution, which has been identified as a clear predecessor to modern GI (Eisenman, 2013).

Urban green infrastructure is a quality life of fundamental importance for the quality life of our ever-increasing urbanized societies. However, the term green infrastructure means different things to different people depending on the context in which it is used. Because of this it has many definitions used by authors working on the concept. Hence, in this paper, urban green infrastructure refers to space located in the urban web which include green spaces (i.e., Recreational parks, greenery areas, roadside trees, medians trees, and sport fields, urban forests, urban agricultures, lakes and water buffers. Urban green spaces have important amenity and recreational value contributing towards quality of urban life. However, due to the challenges of planning, implementation and lack of proper distribution of GI components are not sufficiently developed as establishment of the town. Thus, the study was focused on analysis of the challenges related to the

planning and implementation practices of urban green infrastructure and intends to offer proper solutions to minimize the challenges in Dukem Sub-city, Moreover, the study tries to address the root cause of the problems relating to green infrastructure planning and implementation as well as and recommended some solutions for the communities and responsible body.

Generally, the introduction part of the study comprised of background of the study, statement of problem, objectives of the study (general and specific), research questions, significance of study, scopes of study, and description of the study area and organization of the paper.

1.2. Statement of the Problem

Rapid urbanization in the city leads to unbalanced development. Indirectly, it affects the urban populations lifestyle, including their social life, behavior towards their surroundings, and the impact of the development on the environment (Li, 2014). Most development focuses on constructing the building structure, leaving little space for the communal area such as urban gardens or parks (Dagley, 2019). Due to the scarcity of space in metropolitan areas, thoughtful planning and design are required to utilize the site to benefit the community, ecology, and environment (Schueler, 2015).

The rapid growth of most towns and cities in Ethiopia without properly planned urban green spaces has generated environmental problems, including: increase of temperature, air and water pollution and greenhouse gas emissions. Urban green areas and forestry should be managed to improve air quality and mitigate national and global climate change (ENUGFS, 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).

Dukem Sub-city is one of the fast-growing urban centers of Ethiopia, which is increasing physically as well as demographically. Like other town of Ethiopian, since the towns green area is not well planned and implemented, it doesn't give their acquired green infrastructure services to its residents. It is obvious that well

planned, implemented and managed urban green infrastructure (playground, green area, buffer (river and lake), recreational park, urban agriculture land, street sides trees, medians trees) and other components can positively influence the quality of the life of people in urban areas. On the opposite, unless using it in an appropriate way, it has a negative contribution to the wellbeing of urban community.

Dukem Sub-city actually faces many problems that were hindering a sustainable urban development due to the absence of effective planning and implementation of urban green infrastructures. Lack of sufficient place for children, youth, adults to play and recreate in a healthy environment; forest, trees and greenery around a river or buffered in the sub city are encroached by human activity; Lack of buffer zones in urban settlement and environmentally sensitive area (streams, protected area, gorges); Loss of natural green and vegetation cover of the study area due to different activities and the lakes and rivers are being deteriorated by different activities of society are some of the main issues in the study area.

In general, function of urban green infrastructure in relation to the community is not well grasped and understood by professional person and the public at large. Furthermore, better planning, management and implementation of urban green infrastructure was is not carried out; for these reasons some of these green infrastructures in study area such as playground, green area, recreational park, river buffer, lake (dam), street side trees and median trees have challenges in urban areas. Therefore, it requires a study on the challenges related to the planning and implementation of sustainable green infrastructure.

1.3. Objectives of the Study

1.3.1. General objective

The general objective of the study is to develop effective urban green infrastructure planning strategies in Bishoftu City, specifically in Dukem Sub-city, by accessing challenges related to plan preparation and implementation of urban green infrastructure.

1.3.2. Specific objectives

1. To assess the existing structural plan preparation and implementation in relation to UGI,

2. To identify the major challenging factors of UGI implementation in Dukem Sub-city and
3. To Evaluate the proposed and implemented UGI focusing on the distribution, functionality and accessibility of green space in the town.

1.4. Research Question

1. How is the existing structural plan preparation and implementation in relation to UGI in Dukem Sub-city?
2. What are the major challenging factors to implement green infrastructure in the town?
3. What measures are to be taken to improve the existing UGI planning and implementation practices in the study area?

1.5. Significance of the Study

The study of green infrastructure is very important for several reasons. In an expanding human world, competition for use of a finite land base can only increase. This is not a problem that is going to go away on its own. Green infrastructure is an important part of any planning effort, and can be closely associated with integrated water management planning at the city or local scale (CLUVA, 2013).

This study investigates the challenges of urban green infrastructure in urban areas on the planning and implementations of green infrastructure as well as contributes to the understanding of that and factors that hinder it. So, the study has benefits as to identify best practice, feedback for all responsible body to bring about environmental sustainability, and support sustains the development of green infrastructure. The findings can also help Dukem Sub-city administration in coordinating different stakeholders towards the development process by bridging the gap between green infrastructure proposal and implementation. It helps for decision makers, planners, plan implementers, local administrations and concerned stakeholders to design appropriate strategies to plan and implement UGI.

1.6. Scope of the Study

The study will be limited to spatial, thematic and temporal scopes.

Spatial scope of the study: Spatially the study has been conducted in Bishoftu City specifically in Dukem Sub-city which covers four kebeles, (koticha, Tedecha, Melka, and Gogecha) from the administrative boundary of Dukem Sub-city.

Thematic scope of the study: Thematically, the study has been focused on the urban green infrastructure such as playground, recreational park, buffer (river and lake), and street sides trees and medians trees in the study area. The study only focuses on assessment of the challenges related to the planning and implementation of urban green infrastructures.

Temporal scope of the study: The study has been conducted within the period of December 2023 -July 2024.

1.7. Operational Definitions of Key Terms and Concepts

In this study, the researcher used the following operational definitions of variables.

Green Infrastructure Components: Spaces located in the urban web which includes forest, urban green spaces and urban agriculture own definition adopted from Mark A, Benedict (2006).

Green Space Elements: Space located in the urban web which includes recreational parks, greenery areas, roadsides, medians, roundabouts, football fields cemeteries (Mark A, Benedict, 2006).

Green Infrastructure Management: Administration (controlling, maintaining, regulating) of the green infrastructure and its development.

Green Infrastructure Network: Physical network that links conservation areas and other types of open spaces that live there (Mark A, Benedict 2006).

Green Infrastructure Plan: A plan that identifies green infrastructure resources within community, region or state and describes the methods that will be used to project, restore and maintain those resources for the benefit of nature and people.

Median: The center area of the street, or a non-vehicular space, such as a planted median, transit median or a paved surface (raised or at grade).

Open space: Undeveloped lands suitable for passive recreation or conservation uses.

Wetlands: Swamps, marshes, fens, and bogs.

CHAPTER TWO

2. REVIEW OF RELATED LITRATURE

2.1. Definitions of Urban Green Infrastructure

Green Infrastructure is a term that appears more and more frequently in land conservation and development discussions across the countries and around the world. Green infrastructure is defined in different ways by different authors. For example, Benedict and McMahon (2002) defined green infrastructure as an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations. More recently Davis *et al.* (2012) defined green infrastructure as parts of an urban area with a mix of street trees, parks, cultivated land, wetlands, lakes, and streams. The latter definition is synonymous with the definition of urban forests. Where, urban forest is defined as trees, forests, green spaces and related biotic, abiotic and cultural components in and around cities (Carter, 1995).

According to Dee Merriam (2010) "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 (Ashley Lowe; Steve Winkelman; 2011). Green infrastructure exists in both urban and rural environments, and can be made up of many different man-made and natural elements, ranging from green roofs and walls, parks and allotment gardens, to forests, rivers and wetlands, restored forest landscapes or regenerated Brownfield sites.

2.2. Concept of Green Infrastructure

The concept of green infrastructure is rapidly becoming critical issues in land use planning studies from developed nations which show GI provides environmental evidence for development plan production as well as serving as practical means of delivering sustainable development (Biazen, 2015). Definitions of green infrastructure have included the concepts of the planning and management of interconnected natural and open space areas and the associated benefits for humans, wildlife, and ecosystems (Mell, 2013, Benedict & McMahon, 2006). Consequently, green infrastructure may encompass features as diverse as large parks, green ways, and forest lands and agricultural as well as smaller-scale green

roofs, trees, rain gardens, planters, vegetated swales, and pocket wetlands that may be more appropriate for urban contexts (Rouse; 2013, Jessica Fisch, 2014). Green infrastructure is an essential part of any planning effort and can be closely related with integrated water management planning at the city or local scale (CLUVA, 2013). In urban areas where land is valuable and the challenges are greatest, the quality of green space is important and the objective should be to attainment areas of multi-functionality. Since the rapid rates of urbanization in most developing countries have led to massive housing shortages and qualitative absences, as a result the water, open space and vegetation within and around African cities are over exploited, due to unplanned and illegal sellers. Likewise, there is a witness African city are losing a number of green resources and associated welfares through rapid development and inadequate planning (Ibid).

Originally, green infrastructure was identified with parkland, forests, wetlands, greenbelts, or flood ways 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 Foster, Ashley Lowe, Steve Winkelman, 2011)

As a phrase, green infrastructure has numerous different definitions in the literature. "Just as gray infrastructure describes the functional support system of urbanized areas, green infrastructure the 'noun refers to natures life support system (McDonald, 2005). "Green infrastructure the 'adjective refers to an approach to conservation planning that is a landscape-scale, driven by a broad-reaching public process, and results in an implementation strategy to protect an ecological network of conservation lands (Ibid). Where the term green space implies something that is nice to have, green infrastructure refers to something we need. Green space is thought of as isolated parks, where green infrastructure emphasizes interconnected systems (Benedict 2006). Interconnected open space is important for two reasons, "the first is ecological; the second is human (Erickson 2006, Timothy Dennis Young Quist, 2009).

2.3. Component of Green Infrastructure

Green infrastructure is the system of natural environmental component and a

green and blue space that in urban areas, which gives numerous social, economic and environmental advantages. UGI has town particular components that include urban forest, urban green space, waterways, , lakes, rivers, ponds and urban farming.

2.3.1. Urban Green Space

Dunney, Swanwick and Woolly (2002) define urban green space as the umbrella term for all areas of land covered by grasses, trees, or vegetation in the urban area. Green space has become a popular term, widely used in recent years to describe any piece of urban land colonized by plants and/or composed of natural rock outcrops or water. Green space includes natural areas, parks, trails, green ways and other types of open space that are not developed; green space can preserve natural ecological values and function and provide places for resource-based recreation and other forms of human enjoyment. The term originates from the environmental sector to distinguish open spaces with potential wildlife value. Definitions tend to include all types of land regardless of ownership or access rights.

A proportion of open space that is retained in a mostly undisturbed vegetative state. It can be partly or completely covered with grass, trees, shrubs, or other vegetation (NUGIS; 2016).

Harrison et al (1995) defines "natural green space" as: Land, water and geological features, which have been naturally, colonized by plants and animals as well as which are accessible on foot to large numbers of residents."

2.3.2. Urban Forest

As indicated by FAO (2007) Urban Forest is characterized as land spinning 0.5ha with trees higher than 5 meters and a cover 10% or tree ready to reach threshold in situ except agriculture and urban land uses. However, arbitrarily forests in particular urban areas can be classified into forest patches, the plantations in the same green spaces and plantation in private and institutional gardens. It is quite clear that urban forest varies from natural forest in many ways. It is an urban green referring to a re-vegetation by planting trees, shrubs or herbs with intended design to improve environmental quality, economic opportunity and aesthetic value.

2.3.3. Urban Agriculture

Urban farming has been seen and characterized from various measurement by various writers

As indicated by Rchtel et al (1995), it is not area of farming, which recognizes it from rural agriculture, yet the way that it is implanted in and communicating with urban ecosystems, and also as indicated by Mougeot (2000), the general meaning of urban agriculture is the development of plants and the raising of creatures for food and different uses within urban areas and peri-urban regions.

Urban open spaces: -Miller (1986) described an urban open space as "any large, medium sized or small area of land or water in or near an urban area that can be used for recreational, esthetical, or ecological functions. Enter and Smith (2000) added that urban open space simply means not occupied or changed for development.

Green Structure is organizational aspects of the city's green spaces-how such spaces are best planned, designed and managed in relation to the other land uses of the city. The urban green structure encompasses all urban open spaces from designated public to private open space (residential, commercial, industrial and services), include necessary urban open spaces, e.g, along roads and railway lines.

Green Corridor: - Green corridors include towpaths along canals and river banks cycle ways, right of way disused railway line. The primary purpose is to prove opportunities for walking, cycling and horse riding, whether for leisure purpose or travel opportunities for wildlife migration.

Street Trees: Are trees growing along a public street right-of-way and managed by the city, account for a relatively small fraction of the entire urban forest, but are prominent because of their visual and physical impact on the quality of urban life (McPherson et al, 2016).

2.4. Benefit of Green Infrastructure

Green infrastructures are very well known to afford economic, social and environmental importance to communities (Forest research, 2010) and since green infrastructures are mainly plants, they live many years in perpetuity. Thus, provide the economic, social and environmental benefits not only to present

communities but also, with little management cost, to the future communities as well. Thus, green infrastructures ensure the sustainability of cities and urban areas (Fisseha Asmelash, 2013).

Environmental Benefits: -Green infrastructure is the physical environment within and between our cities, towns and villages. It is a network of multi-functional open spaces, including green corridors, street trees, formal parks, gardens, waterways, woodlands, and open countryside. It comprises all environmental resources, and so a GI approach also contributes towards sustainable resource management. (Nugis, Jan.2016).

As mentioned by the European Commission, (2011) GI is a contested term; it is generally described as an interconnected network of green spaces, which together deliver ecosystem benefits to society. Interlinked with GI on a landscape scale, urban green infrastructure (UGI) planning is a planning approach aimed at creating networks of multifunctional green space in urban environments. Green infrastructure represents an approach to landscape planning where ecological and social values are used in combination with land use developments" (Aegisdóttir et al., 2009; Faehnle et al., 2014, Lafortezza et al, 2013**).** Green infrastructure helps maintain Environment of ecosystem services in the different ways, such as air quality regulation, Erosion protection, Water flow regulation,Water purification, Maintenance of soil structure and quality and Climate regulation and pollination etc.

The primary benefit of the GI is its ability to improve the overall hydrological health and function of a watershed (Rowe & Bakacs, 2017; US EPA, 2015). A GI installation collects, filters, and slows the flow of water, by reducing the risk of flooding or combined sewer overflow (CSO) events during storms (Ibid). Green infrastructures can also improve river flow, watershed health, and wildlife habitat by increasing ground water recharge UNEP, 2014). Plants and soils used in GI improve water quality and protect waterways from pollution by absorbing and filtering oils, sediments, nutrients, chemicals and metals from roads, cars, buildings, and farms (Dunn, 2010; Rowe &Bakacs, 2017; US EPA, 2015). Trees and plants also improve air quality by absorbing ozone (smog), pollutants, and CO2 in the atmosphere, thereby mitigating the urban heat island effect (Ibid). Because of the proven positive environmental impacts, the GI has been identified as a key

strategy for climate change mitigation (Roseen, Janeski, Houle, Simpson, &Gunders, 2011; US EPA, 2015).

Social benefit: -Green infrastructure and urban green space have also been shown to improve human physical, mental, and social health. In conditions of physical health, green infrastructure reduces human exposure to extreme urban heat and polluted air and water (Ibid). Green streets, green ways, and parks provide opportunities for outdoor recreation and exercise as well as social gatherings or encounters (Rowe &Bakacs, 2017; Wolch, Byrne, & Newell, 2014). Green infrastructure improves the overall community aesthetic, and by extension community pride and engagement, leading to vibrant, healthy communities and social cohesion.

Economic benefit: - The more our natural resources are compromised the more we become aware of their ecological and economic significance. The value of good quality, accessible green infrastructure to the local economy can be quantified though; inward investment and job creation, land and property values, local economic regeneration. More obvious economic benefits of urban forests are fuel wood, food, grazing for livestock, timber and poles, spices, fiber, medicines and other non-timber products other benefits (e.g.,Beautification, privacy, wildlife habitats, sense of place, and wellbeing) attributed to urban trees are difficult to price. But the fact that trees reduce building energy cost and those environmental services (e.g., Reduced pollution and carbon stored) can be valued in money (McPherson et al, 2005).

2.5. Provision and Implementation of Green Infrastructure

The broad objectives of the plan are to guide the development of the plan for a specified time period and promote the land use pattern, which most efficiently fulfills the objectives of the government. A more appropriate and dynamic planning tool for developing countries is structural planning (Ambe J. Njoh, 2003). The approach highlights the critical issues and prioritizes infrastructure in investment, which are a key issue for shipping city growth. It provides a broad framework for local decision making and it involves public participation. However, provision and implementation of practice green infrastructure are commonly affected by structural plan (Mpofu, 2013). Therefore, the distribution of land use in the

structural plan should follow convectional planning principles (MUDC, 2012). Some of the planning principles are participatory, monitoring and evaluation.

2.5.1. Monitoring and Evaluation of Plan

Monitoring and evaluation of structure plan are a participatory process which should be applied to check that; standards, principles, norms, regulations and proposals of the structure plan and its components are applied in the design of the LDPs / NDP and implementation projects are working appropriately. The function of monitoring and evaluation is to get information about the status of the structure plan preparation and implementation processes to build up to date result. According to UN-Habitat 2009 report, interest in urban planning applications of plan evaluation emerged in the mid-1990s in developed countries, reflecting increasing concerns for efficiency, effectiveness and accessibility, as well as performance and productivity in municipal government. However, the first phase of urban plan monitoring and evaluation occurred in the 1960s and early 1970s, coincident with the emergence and early rise of generic development, program evaluation theory. Also, to identify impacts of the plan preparation and problems of implementation of urban plans, whether urban planning has improved (or undermined) the quality of life and wellbeing of the citys residents.

In South Africa, the city of Johannesburg has formulated a 'framework for improved monitoring and evaluation for the city within all municipal entities and internal departments. Monitoring and evaluation shape part of the performance management framework, which encompasses setting performance indicators, measuring them over time, evaluating them periodically and finally, making course corrections as needed. Plus, it has been implemented for many years in a range of environments, with increasing focus on the importance of an outcomes or 'results based or 'theory of change approach (Joburg, 2012).

In Egypt monitoring and evaluation is considered as a significant instrument of management in urban planning practice and the central authority responsible for preparing urban plans and implementation mechanisms (Riham A. Ragheb, et.al, 2013).

Evaluation should provide information that is credible and useful, enabling the incorporation of lessons learned in the decision-making process of both recipients

and donors (UNDP, 2002). Where monitoring focuses on the ongoing tracking of projects, programs, activities or deliverables, evaluation may focus on assessing different types of issues, e.g.; Efficiency, effectiveness, relevance, impact or sustainability (Joburg, 2012).

The major characteristics of good indicators include measurable, precise, timely and valid. The indicators provide critical information on every aspect of development endeavor and thus are the cornerstone of effective monitoring and evaluation system (UNAIDS, 2010).

2.5.2. Public Participation in Planning

The effective structural plan is undertaken in a participatory way and must be in line with community needs. That means the structural plan that is developed in non-participatory approach meets strong resistance in its implementation (Mansah, 2014). As a result, some authors pointed out that during the planning and management process, a consideration of user' perception should be considered (Irum, 2002), if the urban green infrastructure development strategies fail to include stakeholder' participation, there will be the reflection of the neglect of social and environmental function (Balram and dargicevic, 2005). This will affect environmental quality of the town. The study made by Wandimu (2007) on green space in Addi's Ababa city, finding that the distribution of green space much concentrated in few areas whiles other area lacking accessibility to this area which concur with this finding. There is a lack of existing green area conformity to the plan under implementation.

Political commitment is one of the indicators that fostering efficient implementation of urban green areas (Mensah, 2014). One of the key principles of structural plan is the participation of community and stakeholder to identify communities interest and prioritize the problems and determine the local needs and goals, particularly the residents of the locality (ORAAMP 2002). Participation and partnership to become successful and sustainable in the development and provision of urban green spaces, they must be based on agreed principles that includes diversity, equity, transparency openness, accountability and trust. (Ryan, Robert, 2000).

The purpose of participation is to create awareness among officials and another

member of the public. Without the proper awareness and commitment of officials at different levels of government, it would be very difficult to establish the required effective participatory system.

Public information, consultation (public input), collaboration (public involvement) and empowerment, Participation Manual for Urban Planning, 2007.

2.6. Problems in Development and Management of Green areas

Buildings often replace and reduce green areas of the town. The common, but very dangerous problems in a town that lost the quantity and quality of green areas are illegal settlements in the green areas and other open reserved public places. These problems are common, especially on the fringes of urban areas. In general, the problems can be grouped as planning problems, development (investment) related problems, lack of awareness about the benefits of green areas, and lack of professionals in the field.

Planning problems implies that both the implementation and preparation process deficiency. In the planning process, most planning authorities, including the Ethiopian National Urban Planning Institutes (NUPI, 2015) and Regional Urban Planning Institutes (RUPI) lack community participation. Due to lack of awareness among the community, they prefer the green areas to use for different purposes like grazing, dumping site of wastes, storing site of construction materials, crop production, as a local market (open market). On the other hand, the local authority neglects and gives less attention and tries to change the proposed land use for green areas to other land uses like residential, commercial and for investment purposes. Because of these and other related problems, urban green infrastructure is increasing and contributes to the global warming at global level. There are acute shortages of professionals and even when the professionals are present, they are unwilling to work as a park and green area workers.

2.7. Empirical Literature Review

2.7.1. Challenges of Urban Green Infrastructure in Inner City of Johannesburg

A number of factors, contributed to high land values and rentals in the central business area, overcrowding, lack of parking spaces and a restructuring in the office market that saw demand for office parking grow and subsequent

development of suburban shopping centers. Johannesburg Development Agency (2001) states some of the urban green infrastructures challenges in the Gauteng the economic hub of South Africa, which includes lack of enforcement of municipal laws, particularly in relation to land use; building control regulations, especially in relation to the illegal conversation of office buildings and factory space to residential use and overcrowding of existing residential properties and illegal dumping waste. Serious problem is arising from deregulated and un managed informally and street trading; of residential, limited and inadequate public space, recreational area, street and west management in residential areas. Serious problems arising from deregulated and unmanaged informal and street trading; decay of residential buildings, lack of reinvestment and maintenance, overcrowding and illegal settlement and construction of buildings; vulnerability of children living on street sides, homelessness, limited and shortage public space and recreational facilities; service delivery problems particularly in regard to waste management in residential areas and street. (Johannesburg Development Agency, 2001).

The solution taken to address the challenges are:

Focusing on this basis: Efficient service delivery, especially regarding 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: As Chirisa (2014) discussed, the inner city in Johannesburg emerges that collaboration with the private sector yield the best result in revitalization initiatives and they have done five critical issues. These are;

The city is an ecosystem with natural social, political, economic organisms and processes; Conceptualization and rethinking of the concept of sustainable development in cities through ecological planning and paradigms such as garden city and eco-cities are long overdue; The principal objectives of inner-city development are 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 socioeconomic and environmental assets in the inner city.

2.8. Ethiopian Experience in Urban Green Infrastructure Development

2.8.1. Overall policy

The overall goal of environmental policy is to improve and enhance the health and quality of, life of all Ethiopians and to promote sustainable social and cultural resources and, the environment as a whole, so as to meet the needs of the present generation without compromising the abilities of future generations to meet their own needs (FDREEPA 1997).

The Conservation Strategy of Ethiopia (Ibid) sets out detailed strategies and action plans as well as the institutional arrangements required for the implementation of the sector as well as cross sector institutions for the management of the countrys natural, man-made and cultural resources.

Article 43 and 44 of the constitution of the FDRE (1995) states the people of Ethiopia have the right to live in a clean and healthy environment as well as, in article 92 the citizens have an obligation to protect their environment. The Constitution guarantees the right of citizens to participate in development activities affecting them and that the government would promote popular participation (see article 43 (2) and 89 (6)).

2.8.2. Urban Policy and Standard Response to Green Infrastructure in Ethiopia

In last decades little consideration was given to urban green infrastructure planning, implementation and management while the urban center of Ethiopia is developing randomly. Because of the poor planning and preservation strategy, the existing green infrastructure was exposed to natural and manmade disasters, like deforestation, erosion and deterioration. According to structural plan preparation and Implementation manual, (2016) the allowable proportion of green space is 15-20 % of the total land use town. Structural plan standard, 2016 authorize sustainable land use proportion of a city or town is 30, 30 and 40%. Which means Urban Planning, Preparation and Implementation Strategy, (2014) to 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 (NUGIS, 2015).

The rationale for development of urban environmental policy are; lack of urban green area, lack of proper waste management, pollution problem and informal settlement. Now a day, Ethiopian government incorporates environmental sustainability in the constitution and in the national economic policy, program and strategy as key for permanent success (Ibid).

Also, NUGIS (2015), states experts shall designate land for urban agriculture activities preferable on vacant land, near rivers, and around on wetlands to promote urban agriculture in order to function as part of the food security system and job creation and residents of the city/town live within a 15-minute walk of a green space.

In addition, article 15 of the proclamation stipulates those public hearings, before the approval of plans, would be held for the public at large, public organizations and the Kebele councils and one of the basic principles in article 5, which is about ensuring "the satisfaction of the needs of the society through public participation," is, in fact, at the heart of participatory planning.

2.9. Urban Green Infrastructure Standard

2.9.1. The green components

The green components of communal green space are woody plants that provide aesthetic, ecological and economic benefits to the surrounding communities. The components of green infrastructure shall have mostly open areas, i.e., Lawn, for passive recreational use and informal, active recreational use (e.g., informal ball games). Also, the 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 and competent authorities shall ensure that within a park, at least 50 % of trees are fruit trees to support food security. Additionally, shall have more than 40 trees per hectare, i.e., Approx. 200 to 400 in a park of 5 to 10 ha, providing a good amount of natural shady areas as well as should have ornamental shrubs and flower beds.

2.9.2. Street trees, greeneries and landscaping

Medians shall consist of trees for shading part of the carriage ways and shrubs for absorbing sound and emission and also beautification; Minimum width of pedestrian walkway required to have street trees is 2m;The minimum width of medians having trees shall be 1.5m;All streets except share streets shall have street trees and greeneries; Street trees shall be fitted with tree grates of circular shape with diameter or square shaped 1.2-1.5m or 1.2-1.5X1.2-1.5m made of cast iron, iron, concrete, or tiled in all cases flashed with pedestrian walkway surface; Trees shall be located at 0.35m from the edge of the curb and shall be uniformly located and spaced; New tree plantations shall have temporary metal grilled protection from physical abuse by people or animals.

2.9.3. Planting Spacing

Street tree spacing shall be determined by the expected mature size of the tree. A tree should fit in the available growing space without major pruning since frequent pruning increases maintenance costs. Generally, trees should be planted with the following spacing:

Small trees (< 7 m crown diameter at maturity) should be planted 6 m on center; Medium trees (5-11 m crown diameter at maturity) should be planted 8m on center; Large trees (> 11 m crown diameter at maturity) should be planted 10m on center; Wherever opportunities are available (e.g. within roundabouts), competent authorities should encourage planting trees in small groups; The size of a tree basin shall never reduce the minimum width of 1.3 m of a clear path of travel, i.e., for the pedestrian / through the zone.

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 4m clearance over the center of the street surface and 3 m clearance at the street surface edge; Sidewalk / path – all branches shall be pruned to allow a minimum of 2m 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 and 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.

2.9.4. Recreational parks

Recreational parks are the main element in most urban green infrastructure network systems.

Competent authorities shall establish a hierarchy of parks: Neighborhood Park, WoredaPark, Sub-City Park and City Park.

Neighborhood Park: A Park site located in the approximate center of each neighborhood (sub-district or kebele level) the park provides active (e.g., Walking, jogging, bicycling) and passive (e.g. Reading, bird watching, taking) recreation opportunities, but may be dominated by facilities and Sport Fields. Every inhabitant that uses a neighborhood park should be able to access the park within an average distance of 500m. A neighborhood park should be around 5,000m2 and can serve up to 5000 people.

Woreda park: A park site located in the approximate center of an area structure plan that accommodates major recreation centers, primarily active outdoor sport fields and natural recreation sites. Every Inhabitant that uses a woreda (district level) park should be able to access the park within an average distance of 1000 to 1500m. A Woreda (or district level) park should be around 30,000m2 and can serve up to 40, 000 people.

Sub-City Park: A park site located in the approximate center of a sub-city and that can serve and attract people from across the sub-city. It can provide active or passive recreation opportunities, primarily for residents of the sub-city. Every inhabitant that uses a sub-city park should be able to access the park within an average distance of 4000m. A Sub-city park should be around 80,000 m2 and can serve up to 160,000 people.

City Level Park: The Park may provide active or passive recreation opportunities for every resident of the city.

Every inhabitant that uses a city level park should be able to access the park within an average distance of 6000m. A City Park should be more than 150,000m2 and can serve up to 300,000 people.

Parks should be located within the city so that every inhabitant can reach from his/her home within a maximum distance of:

A neighborhood park (or a bigger park, or a comparable green open space) of a size of at least 0.3 ha; 1,000 m to 1,500 m a Woreda park (or a bigger park); 4,000 m a Sub-city park (or a bigger park); 6,000 m a city park.

The parks should have following approximate minimum sizes, carrying capacities and locations:

A neighborhood park should be around 0.5 ha, can serve up to 5,000 people in a radius of 500 m, with a carrying capacity of 0.1 ha/1,000 pop and shall be located on local or collector streets, not arterial streets; 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 (a 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; A city Park should be more than 15 ha (city), can serve up to 300,000 people in a radius of 6,000 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

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.

2.9.5. Parks and Forests

The urban area where structured with green system at kebele, sub-city and urban levels. Generally, 12 - 25 percent of an urban center should be reserved for green and natural open space. It includes green areas (formal or informal), green in or along streets or boulevards, pedestrian, lanes, parking areas, parks, woodlands, buffer zones, green areas along gullies and on preservation areas, protective forests, etc.

Table 2.1: Standards for Green Areas or Parks

No	Gross Area (m2 /in ha)	Catchment Areas	Lists of Green Areas and Parks
1	2-8	Kebele	Green areas and plantation connected to services, pedestrian, lanes, parking areas, woodlands, and green
2	≤ 0.4	Sub-city	Formal green areas (recreation parks, collector street
			Buffer zones between adjoining zones intended to reduce
			Protective forest on hazard-prone lands (marshy lands,
3	≤ 0.5	City wide	Large green areas reserved for recreational activities and festivals such as parks, zoo, golf sites, botanic gardens,
			Green belt encircling the urban area reserved for different purposes: soil conservation and erosion control,

2.9.6. Water Body

Appropriately developed or preserved, the corridors and shores provide additional green open space and recreational opportunities, increase property values, increase environmental awareness, and enhance the city ‘s attractiveness as tourist destinations.

At least 30% of the total urban land area of urban centers shall be reserved for greenery and unsealed spaces; At least 15% of the total area of plots shall be reserved for green and shall be unsealed.

Table 2.2: Water Buffer Distance

Functions	Minimum recommended buffer width (in m)
Stream stabilization	15
Water quality protection	30
Flood attenuation	100-year flood plain plus 8m
Riparian/ wildlife habitat	100
Water fisheries protection	45

2.9.7. River and canal corridors and lake shores

Most scientific recommendations for minimum buffer widths range from 15 to 30 meters. Competent authorities may expand the 30 m buffer to include: Any steep slopes greater than 25 %;1.3 m per 1 % increase in slope over 5 %; Delineated wetlands, critical habitats, forest conservation; Abattoir should be at least 2 km away from sources of water supply (e.g., deep wells, ponds, lakes,) and it is preferable if the slope is about 5%.

2.9.8. Play Grounds

All play facilities like playgrounds should be in safe condition all times; Pavements on playgrounds should have protective surfacing; Playgrounds may include a seating area for parents around the play equipments.

Location and accessibility: Sport Facilities include all types of sport field such as football fields, athletics, basketball, volleyball, handball, table tennis, ground, tennis, swimming pool, gymnasium, Walkway, green and contingency. Competent authorities shall ensure following sizes for outdoor sports fields and facilities and may locate them in following public locations.

Table 2.3: Location and Size of Playground

Type of sport	Size (m^2)	Area (m^2)	Location notes
Basketball	15*28	420	In all park settings, amenity open space, Administration, compounds, schools or
Football	65*100 75*110	6,500 8,250	Sub-city /city park, schools or institutions
Tennis	23.77*10.97	261	Sub-city/ city park, schools or institutions
Table tennis	7*14	98	In all park settings, amenity open spaces,
Volleyball	9*18	162	Woreda, Sub-city, city park, schools,
Handball	20*40	800	Sub-city / City Park, schools or institutions
Swimming	25 * 13	425	Sub-city / City Park, schools or institutions

2.9.9. Open Spaces in Administrative and Commercial Areas Standards

A minimum of 30 % of the total area of an administrative compound should be open space and allocated for green; The main front of administrative buildings should be set back by a minimum of 20 m from the right of way / sidewalk. This 20 m shall be allocated for green.

2.10. Length and Spacing of Streets

Streets shall have appropriate slopes for visibility, safety, comfort, proper drainage and aesthetics; In laying down the network streets shall not be fully against the contour to avoid overflow of the drainage channels and also accelerated storm water run-off.

2.11. Managing Urban Green Spaces in Ethiopia

In Ethiopia in many urban areas due to ignorance about function of green areas, lack of skill, lack of experience on how-to manage and lack of budget, open

recreational and green area is few. Out of 68 towns and cities with the plans in Ethiopia, only 53 of them have relevant information about the area located for the green area purpose. According to NUPI (2003), out 53 towns having plans indicating recreational sites, only Bishoftu fits a national standard for its allotment of 10% of the total urban area for recreation purpose.

The real challenges in green space implementation is the capacity to implement what is planned at different levels (Wondimu, 2007). This bottleneck can be either in financial availability a capacity or skilled people. In the same line municipal financial capacity is a crucial factor in ensuring sustainable green space development and management in the town (Edwards, 2010) and municipal financial capacity is a crucial factor in ensuring sustainable GI development and management in the town (Edwards, 2010).

2.12. Conceptual Formwork

Urban Green Infrastructure (UGI) is a strategic planning approach that intertwines networks of multifunctional green spaces with the built environment. The conceptual framework for studying UGI typically encompasses effects on ecological sustainability, climate change mitigation, human health, and socio-economic benefits (Tzoulas et al., 2007).

Ecological Sustainability: Green infrastructure significantly contributes to urban ecological sustainability. It helps maintain biodiversity by providing habitats for numerous species within a city setting. Furthermore, the preservation and enhancement of natural components in urban landscapes support vital ecosystem services, like water filtration and air purification (Benedict & McMahon, 2006).

Climate Change Mitigation: UGI plays a crucial role in climate change mitigation. By increasing vegetative cover in cities, it aids in sequestering carbon dioxide, thereby reducing greenhouse gas concentrations. Additionally, UGI can help alleviate the Urban Heat Island effect, moderating local microclimates and making cities more resilient to extreme heat events (Gill, Handley, Ennos, & Pauleit, 2007).

Human Health and Well-being: UGI has profound impacts on human health and well-being. Green spaces, including parks and community gardens, offer opportunities for physical activity and relaxation, contributing to decreased stress levels and improved mental health. Exposure to green spaces has also been linked

to improved concentration and better respiratory health due to cleaner air (Maas et al., 2006).

Socio-economic Benefits: Green spaces contribute to the aesthetic appeal of urban areas, potentially leading to increased property values in surrounding areas. These spaces can also play a significant role in community integration, serving as gathering spots that foster social interaction and where communal activities can take place (Chiesura, 2004).

In conclusion, the significance of Urban Green Infrastructure extends beyond mere aesthetics, offering a myriad of benefits including ecological conservation, climate change mitigation, enhanced health and well-being, and socio-economic development. Given these multifaceted benefits, integrating green infrastructure should be a key component in urban planning and development processes.

2.13. Research Gaps

Despite its recognized importance, urban green infrastructure (UGI) remains an under-researched area with many opportunities for further investigation.

Population Health and Well-being: There is a recognized gap in comprehensive evaluations of health benefits associated with UGI. While several studies have made connections between green space availability and improved mental health (Gascon et al., 2015), more research is needed to understand the overall impact on physical health and the mechanisms through which UGI influences well-being. The pathway from exposure to green spaces to health outcomes warrants further investigation, including looking at the effects of different types of greenery and accounting for social and demographic factors (van den Bosch & Sang, 2017).

Climate Resilience: Research has indicated that UGI can play a significant role in mitigating the impacts of climate change by reducing urban heat island effects and facilitating stormwater management (Rosenzweig et al., 2006). However, detailed evaluations of how various aspects of UGI contribute to climate resilience, including the most effective types and designs of green spaces to mitigate climate change impacts, are lacking and need further exploration.

Socio-Economic Gaps: While it's clear that urban green spaces can bring aesthetic and recreational benefits, a comprehensive understanding of the socio-economic

impacts of UGI remains a gap. This could include analyses of property value impacts, potential for job creation, effects on local businesses, and impacts on community cohesion (Lafortezza et al., 2013).

In summary, while urban green infrastructure certainly provides myriad benefits, research gaps exist, particularly concerning health and well-being, climate change mitigation, and socio-economic impacts. Bridging these gaps with robust research could significantly contribute to urban green infrastructure planning and development effectiveness.

CHAPTER THREE

3.MATERIALS AND METHODS

3.1. Description of the study area

3.1.1. Location

Description of Dukem Sub-city

Dukem Sub-city is one of fast-growing town in Ethiopia with an estimated total population of 25,214. Dukem Sub-city is located 37 km to the south east of Addis Ababa next to the main road to Adama. Physically, Dukem spans an area of 9,630.6 hectares between latitudes $8^0$4525 N and $8^0$5030 N and longitudes $38^0$5155 E and $38^0$565 E. Dukem is situated at 2,100 meters Above mean Sea Level. Within the Oromia Regional State and Dukem is one of the reform towns of the region and has a city administration municipality and four kebeles, or neighborhood associations, which are the smallest unit of local government in Ethiopia. It is the administrative center of Akaki woreda that is defined by the third level administrative division of Ethiopia and is composed of a four kebeles. These areas have four kebeles namely Malka Dukem, Tadacha, Gogecha, and Dukem Koticha.

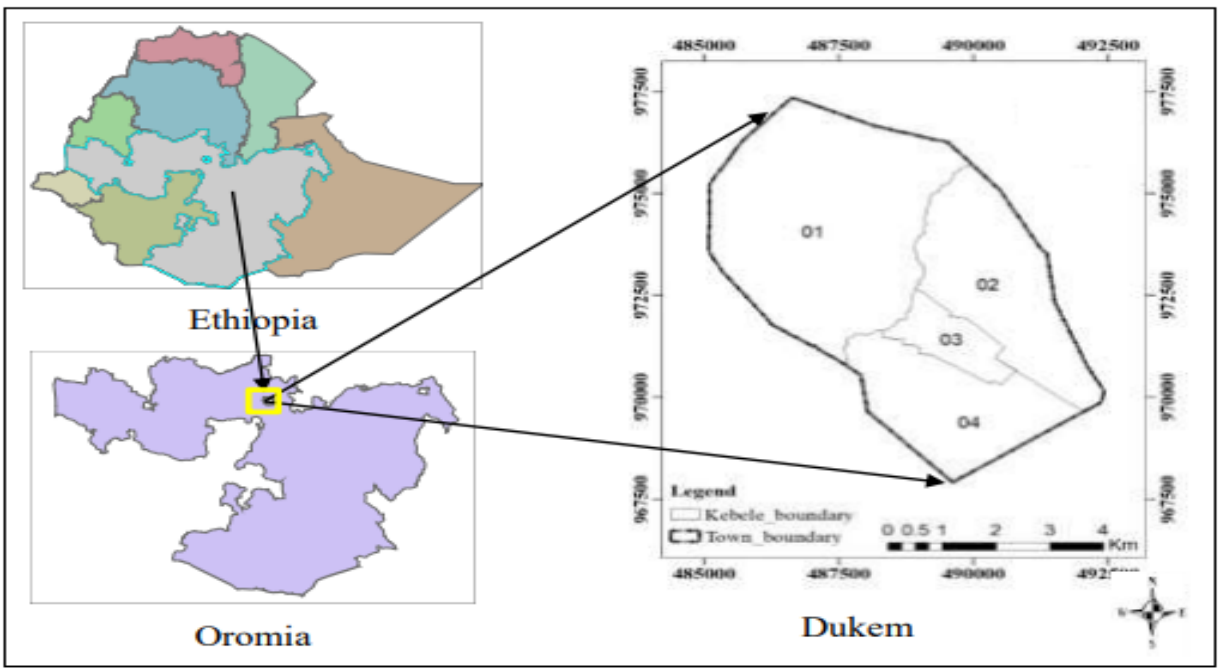


Figure 3.1: Location Map of Dukem Sub-city

3.1.2. Topography

The elevation of Dukem Sub-city ranges from 1890m to 2300m above MSL with an altitudinal range of 410 meters. The north eastern, northern and eastern parts of the town are generally characterized by rugged topography (OUPI, 2017).

On the other hand, the southern and western parts of Dukem have monotonous flat topography. The elevated topography in the north eastern and northern parts of the town is responsible in determining the southwest flow direction of major perennial and seasonal streams. There is also flush water from Eastern Industry Zone (EIZ). The rugged topography in the northern and north eastern parts of Dukem Sub-city is inaccessible with stony landscape and steeper gradient that has impact on the infrastructure development (OUPI, 2017).

3.1.3. Slope

The analysis of slope is an important input to link different land uses with topography of an area. The town has slope classes ranging from 0% to over 20%. The different slope classes are found in different parts of the town. The largest slope class (1-2%) covers various parts of the town. It covers a total area of 2691.6 hectares (63.4%) of Dukem Sub-city. It covers south- eastern, southern and central parts of Dukem Sub-city settlements, commercial activities and institutions are established (OUPI, 2017).

The second largest slope class of Dukem Sub-city ranges from 5% to 10%. It is found distributed in different parts of the town especially to west direction of the town. Slope class ranging from 5% to 10% is also found in the north-eastern part of the town (OUPI, 2017).

The third largest slope class covering various parts of Dukem ranges from 0% to 1%. This is extensively found in the southwest. This is the area where flood accumulates due to flow direction of Dukam streams from northeast direction and flush water from Eastern Industry Zone (EIZ). Slope over 15% is found in pocket areas over Gimashe upland and in northeastern areas of Dukem Sub-city. These areas are considered as one of the most inaccessible areas of Dukem Sub-city. Currently, these areas are used as grazing land because of the presence of grass

over these areas. They are covered with scanty natural vegetation and eucalyptus trees (OUPI, 2017).

3.1.4. Industry Linkage

As we all know Dukem Sub-city is the main center for the purchasing of consumable goods, grain, pulses and dairy products, most of the industries are linked to the main road for insuring proximity.

3.1.5. Geology

Dukem is found in the main Ethiopian rift valley near the western escarpment. Volcanic rock materials of various compositions cover the area. Due to weathering of the rock, and subsequent erosion and deposition, thick residual clay and silty clay soil covers most part of the plain topographic landforms.

3.1.6. Climatic Condition

According to OUPI, (2017) the agro climatic relationship between altitude and temperature in

Ethiopia indicates that the climate of Dukem Sub-city falls in the semi temperate agro-climatic zone with temperature range of 150C to 200C. On the other hand, the metrological station of Akaki which is located at a distance of 15kms is used to analyze the climate of Dukem Sub-city as shown in (Table 3.1).

Table 3.1: Climatic data of Dukem Sub-city from 1997 to 2017

Elements	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
PPT(CM)	13	17	52	80	76	107	228	241	114	28	8	5
Temp	19	20	21	22	22	20	19	19	19	20	19	19

According to OUPI, (2017) the average annual rainfall of Dukem Sub-city and its surrounding is

800.3mm. The total average annual rainfall of Dukem Sub-city is 963mm. The seasonal distribution of rainfall in Dukem Sub-city indicates that the rainy season starts in spring and lasts up to the end of August. On the other hand, the driest season of the town is winter (December to February). The remaining seasons of the year (autumn and spring) are characterized by having moderate amount of rainfall that is below the amount of rainfall occurring during the summer season. Because of this, the growing period of Dukem Sub-city starts as early as spring

season and lasts in autumn season. As it is shown by the rainfall and temperature graph of Dukem Sub-city, the highest temperature within the year occurs during the spring season of the northern hemisphere. In fact, the temperature continuously rises from January to May with the maximum amount of temperature occurring in May.

3.2. Research Approach

This study was used both qualitative and quantitative research approaches. Because this approach helps to analyze quantitatively in figure and narrate qualitatively in words for the data that was collected from primary and secondary sources.

3.3. Research Design

The study was used the descriptive case study method to achieve the purpose of the research. This is because the descriptive survey method is applied for fact finding study with adequate and accurate interpretation of the findings. Therefore, to assess the status, to address the challenges of planning and implementation of urban green infrastructures and causal analysis of Dukam sub-city. This type of research gives room to observe the social reality and it also allow describing the observed reality.

3.4. Method of Data Collection

Although collecting data from the whole residents living surrounded by green infrastructure at a time through questionnaires take a long period of time and make the study butter, the researcher was used some sampling units and distributed it. While from municipal professionals such as team work members of planners and environmentalist was interviewed by the researcher himself. In additional researcher himself interviewed municipal official and conducted field observation on green infrastructures.

Table 3.2: Methodology and data collection techniques

Methodology and Data collection Techniques		
Methodology	Type	Why to chose
Research design	Case study	To analysis problems and causes of planning To identify challenges and hindering factors implementing UGI differ To get why the proposed and implemented UGI differ
Research approach	Both qualitative & quantitative research approaches	To explore the challenges, To analysis the causes, To compare proposed & implemented UGI
Sources of data	Both primary & secondary data	To get more quality data/information
Data collection tool	Questionnaire, interview & field observation	To obtain information from respective body To collect qualitative and quantitative data To see the practical ground reality and cross check
Sampling method	Both probability sampling	For households
	Non-probability sampling techniques	For officials and expertise
Sampling frame	Households, offices,	To get more accurate data
Sample size	165 respondents house holds 10 Officials and 23 Experts	Capable of answering research questions
Method of data analysis	GIS, Auto CAD, SPSS, Excel	To increase quality and speed data analysis, to minimize time

Table 3.2: Operationalization of the Research Objectives

Research objectives	Concepts	Dependent and independent Variables	Method of Data Collection	Methods of Data Analysis
To assess and identify cause the existing SP problems related to UGI in the study area	Problems of Proposed land use (respect to GI).	Compatibility, Standard, Accessibility, Available, Distribution,	Questionnaire Interview Observation Document review (From Existing SP.)	Descriptive statistics, Proposal analysis

	cause	Stakeholders Participation Skilled manpower	Questionnaire Interview	Descriptive statistics
To assess the major challenges and hindering factors of urban green infrastructure implementation	Challenges of the implementation and existing GI situations	Existing Situation (Land use change, Available, quality Accessibility, Compatibility, Maintenance) Standard (Area in hector, quantity in number (%)), Implementation status	Questionnaire Interview Observation Document review (From Existing SP, Satellite Images,)	Descriptive statistics Implementation and buffer, for conservation area analysis
	Challenges or hindering factors	Awareness, Poor management, Illegal settlement, Financial, Material, Shortage skilled manpower,	Questionnaire Interview, Documents review Observation,	Descriptive analysis
To identify the main cause observed challenges	Cause	Monitoring and Evaluation, Community participation; Organizational capacity,	Questionnaire Interview Observation,	Descriptive statistics

Source: Own notion, 2024

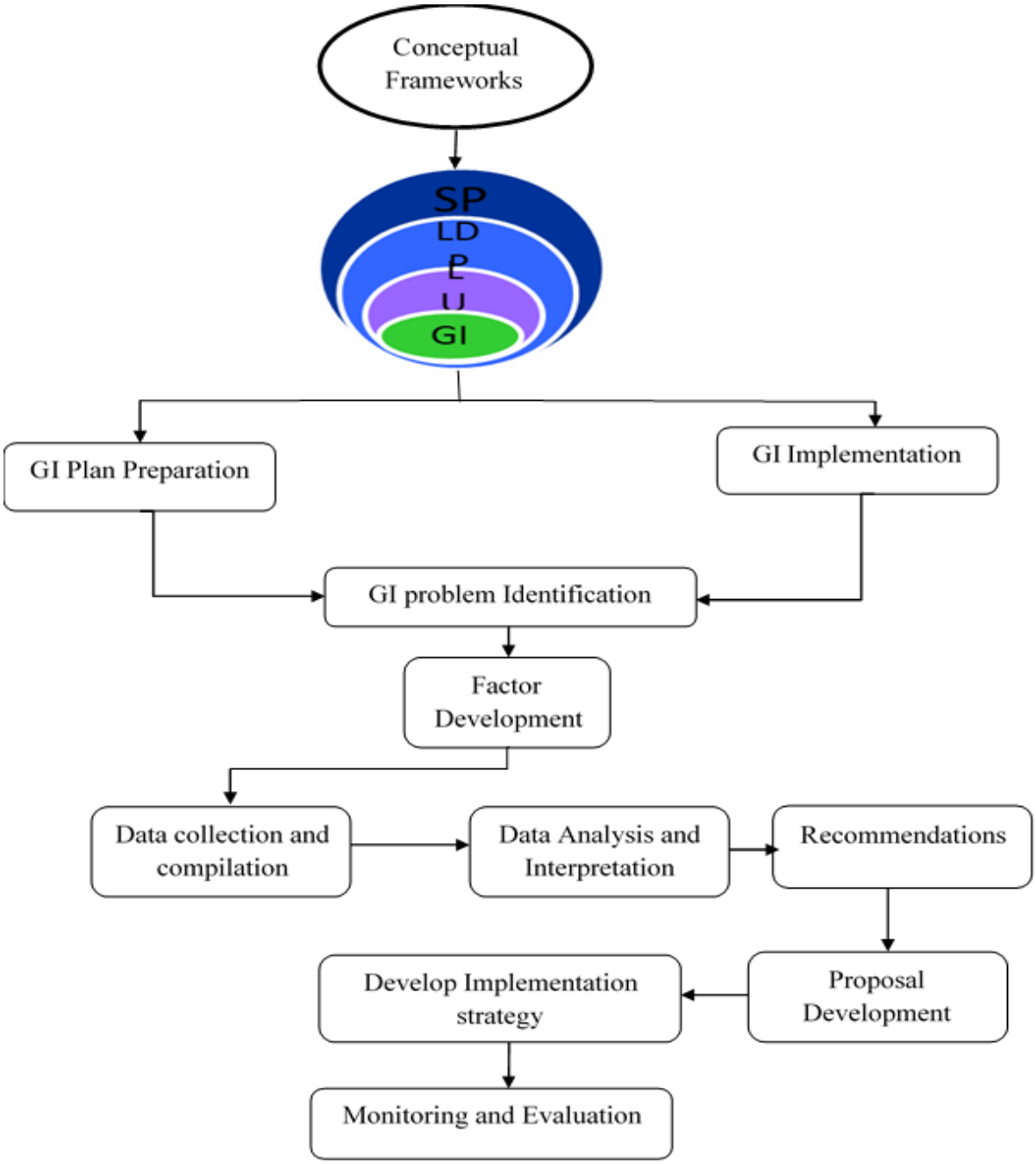

Conceptual Frameworks
SP
LD
P
U
GI
GI Plan Preparation
GI Implementation
GI problem Identification
Factor Development
Data collection and compilation
Data Analysis and Interpretation
Recommendations
Develop Implementation strategy
Proposal Development
Monitoring and Evaluation

Figure 3.2: Technological Schemes of the Study

3.5. Types of Data Sources

The data will be collected from both primary and secondary data sources. The primary data were collected from respondents through observations, questionnaires, and interviews. Besides, the secondary data were collected from different published and unpublished documents related to the study, internet, Journals and different sectors annual report of Dukam sub-city.

3.5.1. Primary Data

The primary data were obtained from respondents through questionnaires from households and experts offices (municipal, land development and management, OUPI, environmental protection, beautification and greenery, sport and youth office, and kebeles) as well as through interview form office heads and experts of (municipal mayor, Land Development and Management, OUPI, Greenery and beautification) plus experts of environmental protection, sport and youth office head, experts of Kabeles office and ownership as well as through direct field observation of the researcher. The instruments of data generation are explained as below.

Questionnaires: it will be used to collect primary data on the challenges faced by the community processing in green infrastructure in the study area. This required sample surveying on selected households. The questions were designed to collect both qualitative and quantitative data. The qualitative questions were open ended questions, whereas quantitative questions were closed ended questions. For this thesis, questionnaires were distributed for residents and experts which linked urban green infrastructure.

Key Informant Interview: it will be held with municipal mayor and expert, office heads and experts (Land Development and Management office, OUPI office, office, greenery and beautification office, environmental protection office and kebele offices) and ownership who have experience in urban green infrastructure and to get data on the values of playground, buffer (lakes and rivers), recreational parks, street trees, urban forests and urban agricultures planning and implementation challenges. Semi structured so questions were prepared for the officials and experts of these organizations to get more information about the research

objectives.

Field Observations and Mapping: Observation will be the main source of data collection method to show existing situation of urban green infrastructure and also to cross check collected data from interview of municipal officials and expert. This method to identify incompatible land uses respect to UGI, the changed by zoning, the mismatch between proposed and implemented as well as distributions of GI use currently found on the ground cross check with a proposed plan of the town. Additionally, for the identification of GI on the ground and locating on the map, characterization of them in terms of sizes, development status, problems, physical condition of UGI, the environmental condition of UGI, social conditions of UGI etc.

3.5.2. Secondary Data Sources

Secondary data will be collected from the relevant written document. These secondary data sources included minutes, reports, land related documents (structural plan, local development plan), urban planning, and green infrastructure policy, standard, and strategy documents, books, project documents, reports, maps, internet, published and other unpublished documents relevant to the issue under study.

Document Review: - Documents of the selected town will be reviewed structural plan and related planning documents in order to get the necessary information with regard to the effect of land use planning and implementation respect to the urban green infrastructure in the study area. Moreover, extra information was collected from relevant books, journals and other literature materials.

3.6. Sample Design

The research was used both probabilistic and nonprobability sampling methods. In order to select samples from the entire government institutions in the town non-probability (purposive) sampling used and the type of probability (simple random sampling) will be employed to select households living in four kebeles. Sampling design includes a population of study, sample frame, sample unit, sampling techniques and sample size.

3.7.1. Population

Populations are peoples or unit of investigation with the features that the researcher wishes to study. The identification of targeted population is important to ensure that it consists of people who have relevant information sought by the researcher. The current estimated total populations of the four Kebeles (koticha, Tedecha, Melka, and Gogecha) that are administered under Dukem Sub-city are 63703. Hence, the average family size of Oromia is 5, thus, the households of the study area are 63703/5=12741.

3.7.2. Sampling Frame

The sample frame of this study included a list of households of four Kebeles (koticha, Tedecha, Melka, and Gogecha), Oromia urban planning institute, municipal office, land development and management office, environmental protection office, greenery and beautification and kebele offices. The sample units of this study will be households in the four Kebeles (koticha, Tedecha, Melka, and Gogecha), and experts and officials from Municipal office, land development and management office, OUPI, environmental protection office, sport and youth office, greenery and beautification, the heads of four kebeles and ownerships.

Professional of municipal office and OUPI (urban planners, urban engineers, surveyors and expert direct work on green infrastructures), the researcher selected simple random sampling and purposive technique to get respondents from different parts of the community of the four kebeles in the study area.

3.7.3. Sampling Technique and Sample Sizes

Sampling techniques: - In order to gate and to draw important conclusion about the study area, both probability and non-probability techniques will be used. In non-probability sampling; purposive sampling will be used by focusing on concentrated bodies or stakeholders who directly involve preparation, implementation and/or management in another way direct work on urban green infrastructures area, such as Oromia urban planning institute, Dukem municipality officials and experts. Technically the sample respondents will be selected from each kebele using sample random sampling, also kebeles will be selected purposely from all the kebeles demonstratives.

Accordingly, four kebeles will be selected purposefully from the administration of the study area. Then, using the samples of the population from each kebeles sample will be selected randomly until the sample populations are reached.

According to (C.R. Kothari, 2004) approach provides a systematic way to determine the sample size for a research study. By specifying the confidence level, estimated proportion, and desired margin of error, the researcher has been calculated the appropriate sample size to ensure that the study result is statistically valid and reliable as outlined in the following formula:

$$n = \frac{z^2 * p(1-p)}{E^2}$$

Where:

n = required sample size

Z = Z-score corresponding to the desired confidence level (95%)

p = estimated proportion of the population that has the attribute of interest

E = desired margin of error (5%)

Accordingly,184 sample size has been selected; Out of the 184 questionnaires (165 for households and 19 for experts), 100% were successfully collected. The combination of purposeful selection for interviews and the high response rate for questionnaires provided a robust dataset for the study area.

3.9. Methods of Data Analysis and Interpretation

Before analyzing the collected data, data organizing, and figuring processes has been done. During the analysis several stages interrelated procedures were performed to summarize and rearrange the data. Therefore, the analysis of this study has been employed by using narrative descriptions, the collect quantitative data gather from respondents then enter into the Statistical Package for Social Science (SPSS) software to develop and guide the extraction of data from the questionnaires. These data have been analyzed by using descriptive statistics such as, frequency and percentage and the highest percentage was taken as a fact for interpretation. For the descriptive analysis tabulation, graph, photograph and

percentage was used to present and describe relevant variables. Additionally, using GIS tools to show the incompatibility and existing situation problem on the ground.

3.11. Data Presentation

The information that will be obtained from reports, statistical records and interviews will be incorporated in the analysis and presented through narrative descriptions. Both primary and secondary data will be analyzed and presented using statistical tools like tables, charts and figures or photography to facilitate the presentation of the result more enumerative.

3.12. Ethical Considerations

The nature, goal and aim of the research was explained to the respondents and they get a chance to ask questions relating to the research and confidentiality assured in that none of the informal respondent names was attached to the questionnaires. The researcher was respecting the culture, values and views of the residents and other peoples, while gathering the relevant information to the study. The researcher was also acknowledged the works of other peoples which he thinks useful for the research. Moreover, the researcher tries to avoid personnel bias and stick to professional knowledge and the ground reality.

CHAPTER FOUR

4.DATA ANALYSIS AND INTERPRETATIONS

4.1. Introduction

This chapter focuses on the key challenges faced in planning and implementing green infrastructure (GI) in the study area. Based on the objectives of the research, the collected data was analyzed through quantitatively and qualitatively. Therefore, the findings are presented in tables, percentages, graphs, and pie charts for quantitative data, while qualitative data is explained in text qualitatively.

4.2. Response Rate

In this research, a multi-method approach was employed, including the distribution of 165 household questionnaires and 19 expert questionnaires, which achieved a 100% response rate. Additionally, purposeful selection led to direct interviews with 17 officials and experts from various sectors in Dukem Sub-city. Observations and document reviews were also utilized as data collection tools to ensure a comprehensive analysis.

The response rate in this research was exceptional, with all distributed questionnaires completed and returned. Out of the 184 questionnaires (165 for households and 19 for experts), 100% were successfully collected. The combination of purposeful selection for interviews and the high response rate for questionnaires provided a robust dataset for the study area.

4.3. Background Characteristics of Respondents

4.3.1. Sex and Age Characteristics of Respondents

Examining the sex and age characteristics of respondents provides valuable insights into the demographic composition of the study sample. This information allows for comparisons between different groups and can help identify potential disparities or similarities in their responses. In this research, analyzing the sex and age distribution of respondents ensures that the study represents a diverse range of perspectives and experiences, enhancing the validity and generalizability of the findings.

Table 4.1: Sex and Age Respondents

Category	Characteristics	Frequency	Percent
sex	Male	97	58.8
	Female	68	41.2
	Total	**165**	**100**
Age	18-30 years	43	26.1
	31-45 years	66	40
	46-60	44	26.7
	Above 60 years	12	7.3
	Total	**165**	**100.0**

The table presents the distribution of respondents by sex and age categories. Accordingly, out of 165 respondents, 97 (58.8%) were male, and 68 (41.2%) were female. Moreover, the respondents were categorized into four age groups. 43 (26.1%) were between 18-30 years old, 66 (40%) were between 31-45 years old, 44 (26.7%) were between 46-60 years old, and 12 (7.3%) were above 60 years old.

Therefore, by examining demographic characteristics such as sex and age enables the researcher to ensure the representativeness of their study sample, identify potential disparities among different groups, and contextualize the results, ultimately contributing to the validity, reliability, and applicability of the research findings.

4.3.2. Education and Income Level of Respondents

The following table presents the distribution of respondents based on their education level and monthly income, which are essential indicators of socioeconomic status.

Education Level: Out of 165 respondents, 11 (6.7%) had no formal education, 34 (20.6%) had completed grades 1-10, 27 (16.6%) had completed grades 11-12, 52 (31.5%) held a diploma, and 41 (24.8%) had a degree or higher.

Monthly Income: In terms of monthly income, 20 (12.1%) had a monthly income between 1-1000, 81 (49.1%) had an income between 1001-2000, 23 (13.9%) had an income between 2001-3000, 15 (9.1%) had an income between 3001-4000, and 26 (15.8%) had an income greater than 4000.

Interpreting these results can grasp to understand the socioeconomic diversity within the study sample and the potential implications of their findings. For example, differences in education levels and income may be associated with

variations in access to resources, opportunities, or health outcomes, which could influence the respondents' perspectives and experiences. Additionally, this information can inform policy and program development, as it highlights the need to consider socioeconomic disparities and tailor interventions accordingly to effectively address the needs of different population groups.

Table 4.2: Education Level and Monthly Income of Respondents

Category	Characteristics	Frequency	Percent
Education Level	No formal education	11	6.7
	Grade 1-10	34	20.6
	Grade 11-12	27	16.6
	Diploma	52	31.5
	Degree above	41	24.8
	Total	**165**	**100.0**
Monthly Income	1-1000	20	12.1
	1001-2000	81	49.1
	2001-3000	23	13.9
	3001-4000	15	9.1
	>4000	26	15.8
	Total	**165**	**100.0**

Source: Field survey results, 2024

4.4. Existing Land Use type in Dukem Sub-city

The 2014 structural plan of Dukem Sub-city, currently under revision, has been guiding the town's development over the past decade. Designed for a 10-year planning period, the plan encompasses various land uses, including administration, commerce, residence, manufacturing and storage, transport and road networks, reserved areas, urban greenery, and social services.An analysis of the existing structural plan reveals that urban greenery dominates the land use categories, emphasizing the importance of green spaces within the town. The next most significant land use categories are residential areas and proposed social services, followed by manufacturing and storage sectors.

Table 4.3: Existing land use type and its area coverage

No.	Main Land use classification	Code	Area (Ha.)	Area (%)
1	Residence	R	2931	30.43
2	Business and commerce	CBA	869	9.02

3	Administration Offices	AD	895	9.29
4	Services	S	1251	12.99
5	Manufacturing & Storage	P	845	8.77
6	Transportation	RUT	1524	15.82
7	Open space & Environmental Sensitive Areas	EA SF	1315.6	13.66
		Total	9,630.6	100.00

Source: Dukem Sub-city structural plan, (2014)

Based on the table 4.3 above the dominant land use in the study area is residence which accounts 30.43 % of the total land use. These land use composed of pure and mixed residence.

4.5. Plan Preparation Problems with respect to UGI

Dukem Sub-city has initiated some efforts towards green infrastructure development. However, the proportion of green infrastructure elements in comparison to built-up areas remains significantly low.

The town faces a shortage of green infrastructure elements like recreational parks, sports fields, and street trees. The existing green spaces consist of current green areas and land reserved for future green areas. The ideal proportion of green areas in small, medium, and large towns should be 15-20% of the total land use, according to (FUPI, 2006). However, the current green infrastructure coverage in Dukem Sub-city is double the recommended standard proposed in the structural plan.

Information gathered through questionnaires and interviews with experts reveals that some green infrastructure components were not considered during the structural plan preparation. Several major planning issues related to green infrastructure exist and are discussed below.

4.5.1. Existing Urban Green Infrastructures Elements in the study area

Ethiopian national urban green infrastructure standard (2015) categorized UGI into 17 types. Out of these the major urban green infrastructures element exists in Dukem Sub-city are recreation parks, sport field, urban agriculture, buffer, urban forest, street trees, and other green space areas. Green infrastructure

development in the town is either natural and man-made as information obtained from household respondents, 72.7% natural and 27.3% man-made; such as recreational parks, urban forest, buffers (river and lake), sport field, urban agricultures, wetland, etc., According to the current information obtained from the structural plan in the above table 4.2, 39.89%of the total land area of the town is reserved for green areas. Out of the all-green land use patterns, forest as a whole (both urban forest and forest along river) has great proportion with 32.52%. This is a large proportion in terms of total land use as well as the total greenery land of the town. On the other hand, all experts (100%) interviewed confirm that green areas in the town are decreasing from time to time. In the municipality, there is no recorded data on GI coverage in hectare or percentage. The major available green infrastructure topologies in the Dukem Sub-city are listed in the following table 4. 4.

Table 4.4: Existing Urban Green Infrastructure Elements of Dukem Sub-city

No.	Green Infrastructure Type	Area (Ha.)	Area (%)	Ownership
1	Open space	7	0.07	Government
2	Urban agriculture	5	0.05	>>
3	Buffer	1.5	0.02	>>
4	Green area	2.87	0.03	>>
5	River bank green	30	0.31	>>
6	Mountain green frame	2.8	0.03	>>
7	Parks	16.7	0.17	Private
8	Recreation areas	2.7	0.03	>>
9	Zoo	0.5	0.01	>>
10	Forest	60	0.62	>>
11	Sport & Recreation	10	0.10	Government
12	Play ground	19	0.20	Gov'tand private
13	Stadium	12	0.12	Government
14	Roadsides and median trees	9,630.6		

Source: Computed by the Author, 2024

4.5.2. Urban Greenery

There are different kinds of green infrastructure topologies exist in Dukem Sub-city. The proposed greenery in the Dukem Sub-city includes recreation, forest, and forest along river, sport field, urban agriculture and green open space accounts about 39.89% of the study area. Depend on this the proposal of the GI component accounts good way respect to the standard of structure plans. The reason behind

the proposal were most of the areas have natural constraint (gentle slope) that forbid the development and encourage preservation.

However, on part of the housing unit (commercial and residential), social service and road network are proposed on existing green areas; especially environmentally sensitive area mainly water body (rivers), wetlands, urban agricultures and recreational parks which founds to the north-east and south-west part of the town.

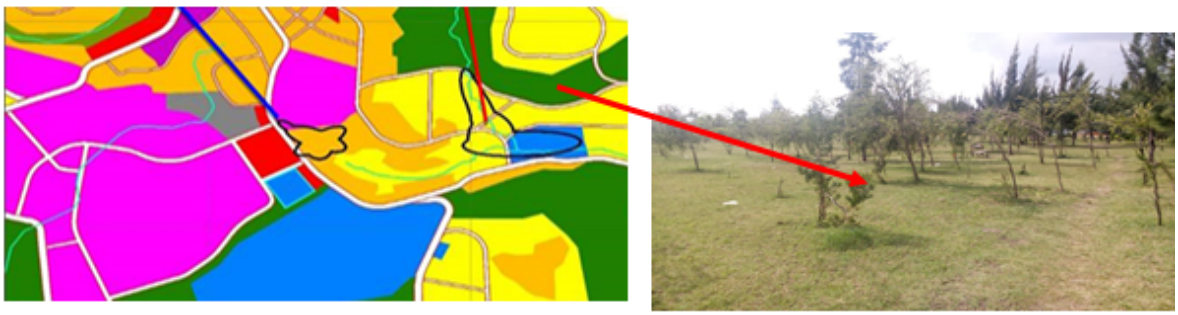
Recreational Park: Dukem is devoid of recreational facilities and places for recreation centers. From the revised (SP, 2009) the residence and commerce were proposed on the recreational center and urban agriculture. UGIS (2015) standard state woreda park should be around 3 ha; can serve up to 40,000 people in a radius of 1,000 to 1,500 m, with a carrying capacity of 0.075 ha/1,000 pop. Even the proposed recreational didnt full the standard.

The absence of recreational park was not only an obstacle to life of the people and the town, but also posed negative socioeconomic implications on the whole town residents. It also impacts on the income, gain from the park service. The structural plan manual (2012), additionally states that these green areas should be connected to service, walking street planted with 10 meters distance gap and parking areas. Ignoring all these, on the structural plan proposed could not propose and distributed as the standard

Urban agriculture: Mainly the proposed structural plan has problem on the green infrastructure element as it proposed housing (residence) and social service on the existing urban agricultures and wetland in the study area. Existing urban agricultural land, which constitutes agriculture areas under activity both in dry and wet seasons, is totally ignored except in a few places.

According to NUGIS (2015), experts (planners) shall designate land for urban agriculture activities preferable on vacant land, near rivers, and around on wetlands to promote urban agriculture in order to function as part of the food security system and job creation.

Figure 4.1: Map Show violation of Existing Recreation and Urban Agriculture



Source: Digitized from Dukem SP (using GIS) and photo during field observation

Computed: By the Author, 2019

River buffer: -During the proposal, land uses were proposed without a respecting river buffer, requirements as a buffer area on some river in some place of river bank of the town were ignored, which protect the river from settlement so, the proposed land use violets the planning standards which is NUGIS (2015) authorizes most scientific recommendations for minimum buffer widths range from 15 to 30 meters. The residence and social service were proposed on the river

bank area mainly on river body, without buffer between land uses and river body. River buffers in the area may have green benefits like water purification, ground water recharge, climate moderation, runoff reduction and habitat for many lives.

4.5.3. Road

The proposal of the road network cannot match with the concept of structural plan. What is observed from the structural plan, there is constraint of the proposed road network of study area for development since it proposed on wetland and urban agricultures. These effects may challenge town administration.

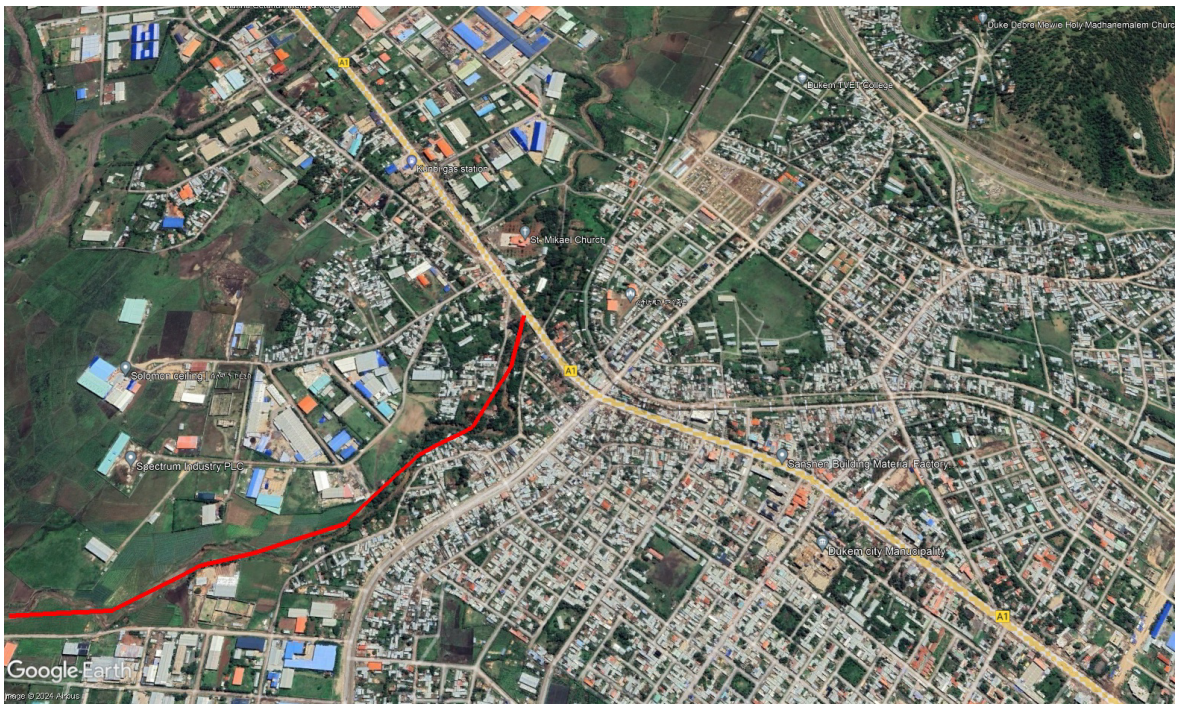


Figure 4.2: Shows proposed road on wetlands

Figure 4.3: Map Show Improperly Proposed Land Use and Road Network

Source: Digitized from Dukem SP using GIS and photo during field observation

4.5.4. Factors affecting the plan

From the land use planning of the study area, the preparation of the plan has factors contributed for some failure of the planning approaches. The problems of this plan link with some of the external and internal factors contributed to the falls of the planning approaches have been observed. The external factors affecting the quality of the plan specifically the GI plan units are lack of all stakeholders participation in the plan preparation. The primary stakeholders like community, investors, NGO, religious group, professional experts (e.g., from technical staff and policy maker) and private participation should participate in all staged during plan preparation.

Table 4.5: Summary of the Response of Household and offices

Summary of the response of Household			
Are you participated in the plan preparation and approved stage?	Items	Frequency	Percent
	Yes	11	6.7
	No	154	93.3
	Total	165	100.0
Do you know where green infrastructures are proposed?	Yes	4	2.4
	No	161	97.6

	Total	165	100
Summary of the response of officials			
Did you participate in the preparation of structural plan and/or local development plan?	Yes	3	15.8
	No	16	84.2
	Total	19	100.0
How do you evaluate the participation and the corporation? of all stakeholders in planning and maintenance of green Infrastructure?	Excellent	0	0
	Very good	0	0
	Good	0	0
	Poor	13	68.4
	Very Poor	6	31.6
	Total	19	100
What are the major challenges you have observed on urban green infrastructure in the planning process?	Lack of all stakeholders participations	16	84.2
	Shortage of use skilled manpower/ experience	14	73.7

Source: - Based survey results, 2024

As clearly indicated from the answer in the above table 4:4, majority154 (93.3%) of the households replied that they were not participated in the plan preparation and approved stage as well as no information about the structural plan, particularly about urban green infrastructures of town and only 11 (6.7%) of respondents participated. Similar proportion, 97.6 % of sample households confirmed that they didnt know where green infrastructures were proposed. A similar pattern of response is observed from officials experts; where 84.2% reported that they didnt participate in the plan preparation process. Moreover, expert indicated that participation of stakeholders in the planning and maintenance of GI has been Poor and Very Poor which accounts for 68.4% and 31.6%, respectively.

The results from officials and experts, interviews, confirm the during the plan preparation the all communities were not actively participated. Even though, those communities and leaders participate in the planning, their participation was for the sake of formality.

Additionally, the answered by expert indicates participation of all stakeholders in the planning and maintenance of GI were Poor and Very Poor which is 68.4% and 31.6% respectively which come from lack of participation and awareness.

The results from officials and experts interview, confirm the during the plan preparation the all communities was not actively participated. Even though, those communities and leaders participate in the planning, their participation was for the sake of formality.

Additionally, the internal factors that cast a shadow image on the quality of the structure plan where the skill gap and experience of the plan preparation group. The expert response authorizes the above ideas, which means 16 (84.2%) and 14 (73.3%) of respondents answered the challenges observed on urban green infrastructure in planning process includes, lack of all stakeholders participations and shortage of use skilled manpower/experience; such as multi professional particularly related fields while the town plan has been prepared. So, there was believably less consideration has been given to the green infrastructure components during plan preparation.

4.6. Levels of UGI Implementation

Out of the total proposed 2153.8ha green area by structural plan, very small percent has been developed and huge percent were found underdeveloped and changed to other purpose.

The data collected through questionnaires, interview and field observation indicated more percent of the green area site didnt develop for the purpose accepts the median trees are not changed. They are simply used for other urban services. Land reserved for the green area site is changed to other urban services as field observation, and by responding households and experts.

Table 4.6: Summary of the official's Household

Summary of the response of Household			
1. Do you think the available green infrastructures are properly managed?	Items	Frequency	Percent
	Yes	11	6.7
	No	154	93.3
	Total	165	100.0
2. Do you think the available green infrastructures are accessible to all?	Yes	4	2.4
	No	161	97.6
	Total	165	100

Table 4.7: Summary of the Response of Officials

Summary of the response of officials			
What is status of community participation in the green infrastructure implementation?	Items	Frequency	Percent
	Very high	0	0

	High	0	0
	Medium	0	0
	Low	6	31.6
	Very low	13	68.4
	Total	19	100
Do you think the urban green infrastructures specifically recreational parks, street trees and median, buffer (river and lakes), urban agricultures and sport fields are implemented according to the SP proposal?	Yes	3	15.8
	No	16	84.2
	Total	19	100.0
What services are giving now or to which land use the green infrastructure were changed?	Housing	16	84.21
	Social service	10	52.63
	Car Park /car wash	11	57.89
	Used for waste disposal and construction material dump site	14	73.68
	Trade	15	78.94
How do you evaluate the size (proportion) urban green infrastructure in your town?	Increasing from time to time	0	0
	Decreasing from time to time	19	100
	The same all the time	0	0
	Total	19	100

Source: - Based survey results, 2024

The above table shows that the lands reserved for green area where change service and currently used for other urban purpose, the response indicates 16 (84.21%) of officials respondents noted that it is changed to housing; 15 (78.94%) the respondent used for trade; 14 (73.68) used for solid waste and construction material dumping site; 11 (57.89%) of them said that used for car parking and 10 (52.63%) of them responded that it used for social service.

Regarding green area site implementation according to the SP as described in table 4.6 and table 4.7 officials said that more site was not implemented as proposal which means changed to other development purpose. Moreover16 (84.2%) respondents from the land development and management, greenery and beautification, Oromia urban planning institution, municipal official, environmental protection official and each four kebeles office expert said that green area site plan were changed to other developmental purpose. The field observation also clears there were site plan changed. Similarly, Figure below shows land reserved for the GI site was totally changed to residential house and social service in all kebeles at different sites. However, the interview conducted with Municipal and Land development and management expert land development and management

head described that there was no GI site change for other development. The table below shows the response of officials expert regarding the present states of green space elements in Dukem Sub-city.

Table 4.8: Response of Officials Concerning the Existing UGI Components

UGI components	Current state	Responses by Percent							
		Strongly agree	Agree	Neutral	Disagree	Strongly Disagree	Total Agree	Total Disagree	Total
Recreational parks	Well fenced and protected		15.8		36.83	47.37	15.8	84.2	19
	Well, planted and developed		10.53		68.42	21.05	10.53	89.47	19
Sport fields	Well fenced and protected		5.26		47.37	47.37	5.27	94.73	19
	Well, planted and developed				10.53	89.47		100	19
Roadsides and median trees	Well fenced and protected		5.26		52.63	42.11	5.27	94.73	19
	Well, planted and developed		10.53		52.64	36.83	10.53	89.47	19
	Used dump site of solid waste and storing and selling construction materials		73.68		26.32		73.68	26.32	19
	Used for informal trades	78.94	5.26		15.8		84.2	15.8	19
River Buffer	Well protected				10.53	89.47		100	19
	Occupied by informal settlement		73.68		26.32		73.69	26.31	19
Urban forest	Well protected				42.11	57.89		100	19
	Occupied by informal settlement	68.42	21.05		10.53		89.47	10.53	19
Urban agriculture	Well protected		15.8		78.94	5.26	15.8	84.2	19
	Occupied by informal settlement		68.42		31.58		68.4	31.6	19

Source: - Based survey results, 2024

From the above table, one can easily infer that all of the elements of GI in Dukem Sub-city are not well fenced and protected likewise none of the existing green infrastructure elements is well planted and developed. The result in the table shows 73.68% respondents validate the street sides of the town used for dump site of solid waste as well as storing and selling construction materials. As the result, in the table indicates all respondents (100%) confirm river buffers and urban forests totally not well protected and more percent (84.2%) of respondents said urban agricultures were not well protected. From the table it is clear that more percents (73.69%, 89.47%, and 68.4%) of the respondents answered that currently

the existing river buffers, urban forests and urban agriculture respectively in the town occupied by informal settlements. This was also confirmed by field observation and the interview responses.

The following photos show some of the current state of the existing UGI element (unprotected, not developed and degraded UGI elements, etc.).

Plate 4. 1 : Photos showing unprotected street sides used as solid waste dumping and construction material storing on streets

Source: Picture taken by the Author, 2024.

Plate 4. 2 Photos showing road sides used for informal trades

Plate 4. 3 Photographs showing not planted and developed street sides and median

Source: Picture taken by the Author, 2024.

Hence GI element is not in good condition it requires great attention. Generally, almost all of the existing GI elements are not in a worthy situation they require great care additionally. Especially excluding the medians and sport fields of the town, GI elements are currently in degraded condition and totally on changing, so it requires immediate attention. Implementation status and related challenges of selected GI elements are described separately in the following sections.

4.6.1. Challenges of Recreational Park in the Study Areas

Due to many challenges and constraints, the green infrastructures of the town are not implemented and providing adequate economic and environmental benefits. As a result of these challenges which discussed above GI formal recreational parks not adequate, standardized and accessible.

The main problems that observed in the existing recreational park are they were not well distributed in an equitable manner; not functioning in accordance with the existing expansion of the town with high residents demand, interests and size of population. The other problem which is being observed on the existing recreational park's facilities they lack inter-organizational management. From the interview response of the officials expert and recreation park owner there was the lack of financial capacity to conserve, preserve, maintain and improve the existing

parks are on another bottleneck for sustainable recreational park development.

(UGIS, 2015) standard state the local residents of a wider neighborhood and shall provide for their recreational (active and passive) needs. Shall have mostly open areas, i.e. Lawn, for passive recreational use and informal, active recreational use (e.g. informal ball games) as well as shall have seating and tables; shall have litter bins; shall have adequate lighting.

Mati resort: -The area of the park is 2.7 ha. In this park there is on one cafeteria that serves as food and alcoholic drinks in the park one restaurant give service and administrated by private owner.

Recreation Park facilities such as cafeteria, seats and pathways should preferably be designed and constructed in a local style from locally available materials. Seats made from locally available and accessible materials should be used in recreation Recreational Parks Development and Management Manual (RPDMM, 2016).

The parks lack the above-mentioned facilities and standard at woreda or kebele level. As field observation the community satisfied with green components of the park since they are in good conditions (not dried, not damaged etc.) and it is the only one of the two recreational park which gave service during recreational and ceremonial service (Sergi, Holiday, Birthday), but there are challenges and problems observed in the park. The Park has no enough shelter, no enough toilets (only one), and no enough shower.

Plate 4. 3 Partial view of Recreation Park in the study area

Source: Photo taken by Author, 2024

Recreational Park: -The area of the park is 1ha area. This Park is neutral i.e., protected, clean, organized with natural elements. It has good proportion of plant coverages with 65% grass and trees coverage from the total area, which administrated by private owner. But underneath the standard and facilities mentioned above in UGIS (2015) and RPDMM, 2016, such as not well fenced and lack of facilities like no paved walkway, sport facilities as all, children playground, and respect to the above standard said. As indicated above not only mentioned facility is left as general, those two parks not full or below the standard.

4.6.2. Play Ground

Proposed sport field in structural plan consists of small to large stadium to provide various benefits for the surrounding area and as all for town itself. According to UGIS (2015), all schools and kindergartens should be provided with good and safe playgrounds, with playgrounds should have at least 5 types of play equipment and adequate space around the equipments. Pavements on playgrounds should have protective surfacing. In revised structural plan manual of 2012 and 2016, play lot and playground should be provided with in radius of 120m and 400m respectively. Nevertheless, in all kebeles particularly, in 03, 06 and 07 kebeles of Dukem Sub-city it is impossible to get neither play lots nor playground even in 1km radius. Currently the town has sport field under the owner of town

administration and school organization are presented in table below.

Table 4.9: Sport Field and Its Distribution by Kebeles

No	Types of Sport field	Quantity	Location	Remark
1	Not Available	0		
1	Foot ball	4		
2	Basket ball	3	In school	
3	Hand ball	2	>>	
4	volley ball	2	>>	Below standard

Source: Sport and youth office

Sport facilities in town are not well distributed in a balanced manner and total spatial coverage of sport field is 27.8 ha off total land use of the town. The total number of the sport field in the town are four which one main stadium and three mini stadiums, three basketballs, two hand ball and two valley balls.

In Dukem Sub-city as data obtained from sport and youth office; kindergartens and grade1-12 total 63 schools. As information obtained from interview of offices of youth and sport office of the town and field observation as the generally there is no availability and accessibility of sport field even the existing sport field have no any facilities. In general, the spatial distribution of sport fields in town is not equally distributed. As result most of the time children play on unacceptable place and on street.

4.6.3. Street Sides Trees

Due to the existence of informal settlement, informal construction and topographical challenge the street network lacks connectivity and the street that takes user to the built ceased. The existing streets networks have one principal arterial. Collector streets and the others are local streets in hierarchical terms but the existing width of the street is no standardized. The streets lack street amentias like street trees, public seats, street light and pedestrian way except PAS. The junction of the street is acute angle junction and not comfortable for car rotation. From various parameters like safety, security, convenience and attractiveness, the existing pedestrian lane have a lot to fulfill to meet the criteria of pedestrian walk way. The existing street also lack safety and some activities are performed on the local street like dumping the material on the street and

using street as clothes drying area.

The (NUGIS, 2015) affirms that the main front of any administrative and commercial buildings should be setback by a minimum of 20m from sidewalks and this 20m shall be allocated for greenery. Additionally, the minimum distance between tree stem and any adjacent built structure shall be 2m. In Dukem Sub-city majority of built structure next to the main streets were constructed without confirming to the standard for setback. Street sides trees spacing for small, medium, and large trees are 6m, 8m and 10m respectively. But trees on all surveyed road sides were planted spontaneously without professional knowledge, thus their spacing was not standardized. In the town, road sides trees planning and development practices shows that there are irregularities in pattern, design, spacing and species selection all over the town. From the existing situation most of the offered street trees are developed by the government and very few places are planted by private developers in front of their building. Trees planting on the road sides and median of the roads are the vital to create peaceful and healthful environmental for living. However, currently except in front of some government organization and few private buildings, all in all there are no street sides trees are planted in the town. Questionnaires experts and interview with officials from municipality, land development and management and urban greenery department responded and the author field observation confirmed that the street sides of town in all kebeles were not planted, additionally it wasnt convenient for pedestrians movement, Because; used for business activities, such as; owners of shops, hotels, restaurants and butcheries garages on made the space for street greenery, concrete and stretched out the veranda of the buildings and use these spaces for their business. Particularly, roadsides of around commercial area of the town were getting narrow and narrow almost totally occupied by constructions. Additionally, houses and sheds are constructed on the street sides; by community for different activities. Not only street side on the ditch construction is built for business activities. In most kebeles, street sides serve as market places.

As a whole with in the town width of the spaces between the street the property line is very narrow below the standard. On these very narrow strip pedestrians, street traders, parking, buried water pipes, electric and street light polls;

advertisement boards and telecommunication lines are all competing for spaces.

Environmental Challenges: - One of the intended purposes of street sides trees are giving environmental service but based on the observation and from HH formal and informally they face environmental challenges such as became waste dumping sites and sources of pollution. In Dukem Sub-city totally there is no temporary waste collection pit as a result, the street sides in the town were dumped by the wastes generated from houses day to day. Thus, rather than giving normal service, street sides used for storing and selling of constriction materials, used for car wash and used for gnomist. As general the implementation and management condition of street trees you can say all in all not in good situation.

4.6.4. Median Trees

Median trees spacing for small, medium, and large trees are 4.5-6m, 7.5-9m and 9m respectively. But trees on all surveyed medians were planted spontaneously without professional knowledge, thus their spacing was not standardized. In the town, median trees planning practices shows that there are irregularities in pattern, design, spacing and species selection all over the town.

4.6.5. Urban Forest

Due to urban expansion high demand of housing the forest coverage of the town and the area proposed for forestry of the town and the surrounding area forests are deteriorated. According to information obtained from official questioner and interview of ULDM, municipality, greenery department and author field observation the exist and proposed urban forests almost all in all

occupied by informal settlement except few places protected by individual person owner and organization especially religious organization like MakenaYesus church, Muluwangel church, Orthodoxic church and Muslim religious protect forest (green area) in their compounds and cemetery place. Some place proposed for urban forest is formally changed to housing given for societies by municipality. More percent proposed urban forest totally occupied by informal settlement for residential purpose coupled with inefficient urban management and due to poor consideration is given by municipal. In general, the existing urban forest in the town is vulnerable to informal and formal activities: miss utilization urban forest

which will hinder the livability of the town.

4.6.6. River Buffer

According to NUGIS (2015), the most scientific recommendations for minimum buffer widths range from 15 to 30 meters and minimum of 80 % of land within the buffer should be covered with vegetation. Out of this, trees shall cover 20 %, groundcovers 50 %, and shrubs 10 % of the total vegetation. Opposite to this standard according to interview, official questions and field observation misuse and poor management of this area causes a critical risks or damages for these water body and environment.

Most of the settlement in Dukem is developed on relatively gentle land; significant proportion of the town is affected by runoff reduction flood water bogging. The settlements in buffer zone on river sides were highly observed and the critical issues of the town. Especially in most place not only buffer zone; contractions were on built on the river edges and no attention is given all-in government body plus community, so as general no respect buffer standard. During field observation the author saw in some places building and the fence of building the same like to bridge constructed on the river edge and the river pass under the building and fence of community property.

Existing Pollutant Source of the River

According NUGIS (2015), solid waste landfills or junk yards (100 m) from the river body, the author saw Dukem waste disposal site nearest to river in very short distance especially in many places community dump waste on water edge and river body. Particularly Dukem waste disposal site incompatible with environment particularly closed to river. More percent of solid and liquid waste generated from houses and organization unlawful for the environment, especially to green infrastructure element like river banks, street side and open spaces etc.

According to structure plan preparation and implementation manual, 2016; abattoir should be located at least 2 km away from sources of water supply (e.g., deep wells, ponds, lakes,). Also, Ethiopian constitutions, confirms on article 44 (communities the right to live in clean environment) and article 92 (development should not damage the environment). However, liquid waste generated from Dukem slaughterhouse direct pollute river and the polluted river directly inter to

Lakes. Additionally, liquid wastes generated from the Dukem prison direct pollute Rivers and water bodies. Ignoring all these, the municipality of Dukem Sub-city implements some land uses. The responsible body didnt have any care about the river body. As a general, the author saw during field observation in Dukem Sub-city rather implement and treat river for future generation the rivers are polluted by the waste generated from different sources. The major polluting sources of rivers are Municipal drainage, car wash and garages, some Municipal service and individual house hold waste. The squatter neighborhood always suffers from lack of proper service distribution and they use the river side as waste disposal area. See the below figure photo show liquid waste generated to and polluting river.

4.6.7. Lake Buffer

Lake buffers play a vital role in protecting the ecological health of urban lakes while offering numerous benefits for surrounding communities. By incorporating lake buffers into urban design plans and implementing effective management strategies, the town can achieve sustainable development and create healthier, more livable spaces.

4.6.8. Urban Agriculture

Urban agricultural lands which constitute agriculture areas under activity both in dry seasons and wet seasons is totally ignored. The urban agriculture in the town is those urban wet land under production during dry seasons and changed to swampy lands in rainy seasons. The other categories of urban agriculture are those under activity only rainy seasons and changed to dry and bare land during dry seasons. It contributes to the betterment of the environment and provides fresh vegetables and other food items for the owners and the population of the town ship. They are also some fruit and vegetable gardens and plots in the town Urban agriculture is furthermore an important sector for creating jobs for the unemployed. However, the proposed urban agricultures land use and the existing urban agricultures areas changed to settlement, which limiting the above benefits that the town can get from the urban agricultures. The existing urban agriculture in many places worsens by informal settlement.

According to NUGIS 2015 Crop and horticultural growing areas should be set back at least 6 m from the edge of the river or lake. But in Dukem Sub-city the

existing urban agriculture use all in all without live the river edge for river protection.

4.7. Interpretation and Discussion

The main purpose of this section is to interpret answers coming from the study with respect to the three questions that were indicated earlier.

4.7.1. Assess the existing structural plan problems related to UGI

The study aimed to assess the existing structural plan problems related to urban green infrastructure in the study area and identify their causes. The findings revealed that the current green open spaces do not conform to the country's urban planning standards for green infrastructure in terms of compatibility, accessibility, distribution, and facilities.

The land use distribution in the structural plan did not adhere to conventional planning principles, norms, and standards outlined by (MUDC, 2012). The planning process did not properly consider the town's total population, ecology, existing green infrastructure, and growth conditions. Consequently, land for green spaces, such as recreational parks and other open spaces for future use, was not adequately reserved within the town's boundaries.

Problems encountered during the plan implementation phase were primarily attributed to issues arising during the planning process. The study identified three major contributing factors: lack of skilled professional/technical manpower, inadequate stakeholder participation, and low awareness of the benefits of urban green infrastructure among the society and town administrators.

These problems stemmed from internal factors, including the plan preparation group's skill and experience gaps, which led to the proposed land use violating planning standards and principles. For instance, existing green areas were proposed for settlement and other social services, contradicting (NUGIS, 2015) guidelines that encourage designating land for urban agriculture near rivers and wetlands. Additionally, the proposed land use and road networks did not respect river buffers, posing challenges for the river ecosystem.

The provision and implementation of urban green infrastructure are often influenced by development plans (Mpofu, 2013). This study examined the

effectiveness of the structural plan in guiding urban green space provision and implementation practices in the Town. However, the non-participatory approach in developing the structural plan has led to resistance during implementation (Mansah, 2014).

An effective structural plan should involve community participation and address local needs. In the study area, inadequate community involvement in green infrastructure planning indicates a disconnect between designers' and users' perspectives. This disconnect affects the quality of existing green infrastructure elements, resulting in limited implementation of green spaces and reduced environmental quality.

The evaluation of existing green infrastructure in each kebele, based on the set criteria, revealed unsatisfactory results. A significant majority of respondents (93.3% of household heads and 84.2% of professional experts) did not participate in the preparation of Dukem Sub-city's structural plan, which may have contributed to the lack of information and poor quality of existing green infrastructure in the area.

To improve green infrastructure in the study area, it is essential to ensure community participation and involvement of professional experts during the planning process. This collaborative approach can lead to better-informed decision-making and higher-quality green infrastructure that meets the needs of the local community.

Incorporating stakeholders' perceptions in the planning and management of urban green infrastructure is crucial for its success (Irum, 2002). Neglecting community participation can lead to a decline in social and environmental functions of green spaces (Balram & Dargicevic, 2005), ultimately affecting the town's environmental quality.

This study reveals that, existing urban green spaces in the study area are not easily accessible to most of the community, emphasizing the importance of proximity and usage considerations during planning and design phases. To address these issues, MUDHC policies, standards, and manuals (ULDMPS, 2005; NUGIS, 2014; NUGIS, 2016; MUPPIM/E, 2017; SP standard, 2016) recommend allocating land use proportions of 30%, 30%, and 40% for sustainable

development in cities or towns.

4.7.2. Factors Hindering UGI Plan Implementation

Several factors can hinder the implementation of Urban Green Infrastructure (UGI) plans. These factors can be broadly categorized into institutional, financial, technical, and societal challenges.

The author identified several key challenges hindering the successful implementation of Green Infrastructure (GI) projects.

These challenges include:

- A lack of public awareness and understanding about the benefits of GI,
- Poor management practices that hinder effective implementation,
- Insufficient resources, such as materials and equipment, needed to build and maintain GI projects,
- Difficulty controlling illegal activities, like informal settlements and unauthorized construction, that can threaten GI integrity,
- Limited financial resources or budget constraints that can restrict project development,
- A shortage of skilled professionals with the expertise to plan, design, and maintain GI systems and
- Low levels of community participation, which can hinder project acceptance and long-term sustainability.

Table 4.10: Respondents Level of Agreement on the Factors of UGI Implementation

Rank	Items/challenges/problems	Number of respondents			
		Yes		No	
		Frequency	%	Frequency	%
1	Lack of awareness governance	17	89.5	2	10.5
2	Poor management	16	84.2	3	15.8
3	Informal settlement	14	73.7	5	26.3

4	Lack of Financial/Budget	14	737	5	26.37
5	Shortage of use skilled manpower (technical)	10	52.6	9	47.4
6	Inadequate Materials (Instrument)	7	36.9	12	63.1

Source: Field Survey result, 2024

This table presents the results of a survey that asked respondents to identify the challenges or problems they face in a UGI implementation. The table shows the rank of each challenge, a description of the challenge, and the number of respondents who answered "Yes" or "No" to experiencing that challenge. The Frequency column shows the count of respondents for each answer, and the % column shows the percentage of respondents for each answer.

- Lack of awareness governance emerged as the primary challenge identified by respondents, with 89.5% (17 out of 19 respondents) acknowledging it as a major issue. This highlights the need for improved communication, stakeholder engagement, and capacity building to promote awareness and understanding of governance structures within the target area.
- Poor management was identified as the second most pressing concern, with 84.2% (16 out of 19 respondents) confirming its significance. This finding emphasizes the importance of effective management practices, transparent decision-making processes, and robust evaluation mechanisms.
- Informal settlement ranked as the third most significant challenge, with 73.7% (14 out of 19 respondents) acknowledging its impact. This data suggests that addressing informal settlements through integrated urban planning and development approaches is crucial to alleviate the associated challenges.
- Lack of Financial/Budget is another critical concern, as indicated by 73.7% (14 out of 19 respondents). This highlights the need for increased funding, efficient resource allocation, and innovative financing strategies to support sustainable development initiatives.
- Shortage of skilled manpower (technical) was identified as a challenge by 52.6% (10 out of 19 respondents). This suggests that enhancing technical skills through targeted training programs and partnerships with educational

institutions can contribute to addressing this issue.

- Inadequate Materials (Instrument) was recognized as a concern by 36.9% (7 out of 19 respondents). Addressing this challenge may involve improving supply chain management, fostering local production, and leveraging public-private partnerships to ensure access to appropriate resources.

In general, this analysis provides valuable insights into the key challenges experienced within the study area. Addressing these concerns will require a multifaceted approach, including effective governance mechanisms, improved management practices, targeted capacity building, increased funding, and strategic partnerships. By addressing these challenges, it is possible to promote sustainable development and enhance overall quality of life within the study area.

4.6.2.1. Cause of the Hindering Factors of GI Implementation

The hindering factors of Green Infrastructure (GI) implementation can be attributed to various causes, which can be broadly classified into the following categories:

Inadequate policy support: Existing policies and regulations may not adequately prioritize or incentivize GI implementation, hindering its adoption.

Institutional fragmentation: The lack of coordination among different government departments and agencies can lead to inefficient decision-making and resource allocation, slowing down GI implementation.

Lack of political will: Insufficient political commitment and leadership can result in a lack of funding, resources, and attention towards GI initiatives.

Limited funding: GI projects often require significant initial investments, and a lack of financial resources can be a major barrier to implementation.

High maintenance costs: Ongoing maintenance and monitoring of GI systems can be costly, deterring their adoption.

Uncertainty in cost-benefit analysis: Inaccurate or incomplete assessments of the economic benefits of GI projects can lead to skepticism among decision-makers and potential investors.

Knowledge gaps: Limited knowledge and expertise in GI design, construction, and

maintenance can impede successful implementation.

Lack of appropriate tools and technologies: The absence of locally appropriate and cost-effective tools and technologies can make GI implementation more challenging.

Limited monitoring and evaluation: Insufficient data collection and analysis can make it difficult to assess the effectiveness of GI interventions, leading to uncertainty and reduced support.

Limited public awareness: Low levels of public understanding about the benefits of GI can lead to a lack of support and engagement from the community.

Resistance to change: Traditional development practices and preferences for conventional infrastructure can lead to resistance towards adopting GI solutions.

Social inequity: The distribution of GI benefits and costs may be uneven, leading to concerns about social equity and fairness.

Land scarcity: In densely populated urban areas, finding suitable land for GI implementation can be challenging.

Land tenure issues: Unclear or contested land rights can lead to disputes and delays in GI implementation.

High land values: High land prices can make it financially difficult to secure land for GI projects.

4.6.2.2. Gaps between the planned and implemented UGI

This study, in line with (Njoh, 2000), acknowledges the potential of structural plans for guiding urban development in developing countries, particularly through public participation. However, the findings suggest a critical mismatch between the town's structural plan and GI implementation. The plan, intended to promote efficient land use and guide development, appears to lack alignment with established standards and principles for GI development. This misalignment acts as a significant obstacle to the successful implementation of green infrastructure projects in the study area.

This study highlights a significant discrepancy between planned and implemented green infrastructure in Dukem Sub-city. While the structural plan

proposes an exemplary green space allocation (39.89%) exceeding recommended standards (15-20%), the actual implementation falls considerably short. Notably, the current land use allocation fails to meet the standard 30-30-40% division. This substantial gap between planned green space and its on-the-ground realization requires investigation to understand the underlying factors hindering implementation and maximize the economic and social benefits associated with urban green infrastructure.

This study identified another discrepancy between planned and existing green infrastructure in the town. While the plan might propose an even distribution, the actual green spaces are concentrated in specific areas, leaving other neighborhoods lacking access. This uneven distribution suggests potential issues with:

- Design and planning: The green spaces might not be strategically placed to serve all neighborhoods.
- Implementation or mismanagement: The planned distribution might not be effectively translated into action, or existing green spaces could be poorly managed.
- Participation: Limited community participation in planning could lead to neglecting the needs of certain neighborhoods.

These findings align with (Wandimu, 2007) study on Addis Ababa, highlighting the challenge of achieving equitable green space distribution within urban areas. Addressing this issue is crucial to ensure all residents benefit from the social and economic advantages of green infrastructure.

This study identifies several key challenges hindering the implementation of urban green infrastructure (UGI) in the study area:

Land Use Conflicts:

- Riparian land (along the river) has competing uses, some unplanned and occupied for purposes like urban agriculture.
- Vacant open spaces lack proper zoning and planning for designated UGI functions (e.g., recreation).

Misalignment and Management Issues:

- The structural plan's UGI provisions are not reflected in current practices.
- Existing green spaces are misused for waste disposal, construction materials storage, trade activities, parking, and even residential development.

Underlying Causes:

- **Public awareness:** Limited understanding of UGI's environmental benefits.
- **Waste management:** Lack of proper waste disposal infrastructure and practices negatively impacting green spaces.
- **Governance:** Weak management systems, inadequate maintenance capacity, and potential corruption hindering efficient implementation.
- **Planning shortfalls:** Existing development plans may not adequately address UGI needs.

Alignment with Existing Research:

These findings align with (Mensah, 2014), who highlights the importance of "biased commitment" (strong leadership and dedicated resources) for successful UGI implementation.

This study identifies financial and human resource limitations as significant institutional constraints hindering urban green infrastructure (UGI) development in the town.

Budget allocation for green space development and management is insufficient, creating a funding gap. Moreover, shortages of skilled professionals in sanitation, beautification, and park development hinder effective implementation. These findings align with (Wondimu 2007) and Edwards (2010), who emphasize the critical role of Municipal financial capacity and Skilled personnel.

The survey results confirm or support these findings, revealing that Poor budgetary allocation for UGI implementation and Shortage of skilled professionals needed for sanitation and park development in the study area.

Therefore, the town's institutional framework presents challenges due to limited funding and skilled personnel. Addressing these constraints, through increased

budgetary allocation and investment in workforce development, is crucial for overcoming this bottleneck and creating a more enabling environment for successful UGI implementation.

4.7.3. Evaluation UGI in the study area

To evaluate the proposed and implemented Urban Green Infrastructure (UGI) in a town, focusing on the distribution, functionality, and accessibility as shown in the following tables:

Table 4.11: Distribution of UGI in Dukem Sub-city

UGI Type	Proposed Area (ha.)	Implemented Area (ha.)	Distribution across the town
Parks	5	3	1 ha north,0.5ha south,1.5ha east and 0 ha west
Playgrounds	4	3.5	1.5 ha north,1ha south,0.5ha east and 1.5 ha west
Urban forests	3	1.5	0ha north,0.5ha south,1ha east and 0 ha west

Table 4.12: Functionality of UGI

UGI Type	Proposed functionalities	Implemented functionalities	Remarks
Parks	Recreational	Recreational	
Green Corridors	Connectivity	Connectivity	
Urban forest	Climate regulation	Agriculture	Violated

Table 4.13: Accessibility of UGI

UGI Type	Accessibility	Average distance from residential area (m)	Percentage of Population Within 500m
Parks	Public	800	70
Green Corridors	Public	900	60
Urban forest	Public	700	75
Community gardens	Community Members	600	80

In this study root cause and stakeholder roles, level of public participation and monitoring and evaluations have also investigated.

A. Root Causes and Stakeholder Roles

This study identified several core issues hindering urban green infrastructure (UGI) development in the study area. These are:

Weak Leadership and Uncoordinated Management: The town administration demonstrates a lack of commitment and prioritization for UGI. In addition to this, overlapping responsibilities between different offices (urban land management, planning, beautification) create confusion and hinder effective implementation in the study area.

Inadequate Resources and Public Engagement: Limited budgetary resources and skilled manpower pose significant challenges. Moreover, the structural plan fails to consider the needs and interests of the community, potentially leading to a lack of ownership and support in Dukem Sub-city.

Stakeholder Roles and Responsibilities: The municipality and the sanitation and beautification department play crucial roles in UGI development and management. Lack of awareness among government officials and the public, coupled with resource constraints, limits their ability to fulfill these roles effectively in the town.

So, addressing these root causes is essential for overcoming the town's UGI implementation challenges. Enhancing leadership commitment, fostering coordinated management across different departments, and securing adequate resources are critical steps. Additionally, raising awareness and engaging the community in planning processes can help ensure broader support for UGI development and management in the Town.

Table 4.14: Root Causes and Stakeholder Roles

Challenges in UGI Development	Root Causes	Stakeholder Roles
Inadequate UGI coverage	Limited funding	Government: Allocate funds Private sector: Invest in UGI NGOs: Fundraise and support projects
Low public engagement	Lack of awareness	Government: Promote UGI benefits Community groups: Organize events and workshops

The above table highlights key challenges in UGI development, identifies their root causes, and outlines the responsibilities of various stakeholders in addressing these challenges to improve UGI coverage and public engagement in the study

area.

B. Public Participation

This study exposes a critical shortcoming in town's urban green infrastructure (UGI) development process - the lack of public participation.

As highlighted by (ORAAMP, 2002), a key principle of structural planning is public and stakeholder engagement to identify community interests, prioritize problems, and determine local needs and goals. (Ryan, 2000) has also emphasized the importance of participation and partnership based on agreed principles (diversity, equity, transparency, accountability, and trust) for achieving successful and sustainable urban green spaces. However**,** the study reveals a complete absence of public participation in structural plan preparation and UGI implementation in the study area. This lack of engagement likely contributes to several issues such as Low Public awareness and Limited Community Participation.

The study further highlights also a contrasting between national policies promoting citizen participation (articles 43 and 89(6) of the Ethiopian Constitution) and the reality in the study area.

The example of the Charles River Watershed Association's Blue Cities Program (2014) demonstrates the effectiveness of engaging community groups in green infrastructure projects.

Public participation fosters awareness among officials and residents regarding UGI plans (Participation Manual for Urban Planning, 2007).

To address the lack of participation, the study suggests Organizing public discussions throughout the planning and implementation process and engaging a broad range of stakeholders, including private sector, youth & women's associations, community leaders, and government officials.

Table 4.15: Public Participation

UGI Planning Stages	Level of Public Participation	Methods
Initiation	Low	Public meeting
Plan preparation	Medium	Focus group discussion and workshops
Implementation	Low	Information session

Monitoring and Evaluation	Low	feedback

This table demonstrates the varying levels of public participation throughout different stages of UGI planning and development, emphasizing the importance of appropriate engagement methods to involve the community in shaping their urban environment. Ensuring public participation can lead to more successful UGI issues that better align with community needs and preferences.

C. Monitoring and Evaluation

This study sheds light on a critical gap in Dukem's urban green infrastructure (UGI) implementation process - the lack of monitoring and evaluation.

As highlighted by (UN-Habitat, 2009), Monitoring & Evaluation is essential for enhancing the efficiency, effectiveness, accessibility, and performance of municipal management, specifically regarding plan implementation. In addition to this, research by (Ragheb et al., 2013) emphasizes the role of Monitoring & Evaluation as a vital management instrument in urban planning practices, allowing for course correction and improved outcomes.

According to (Joburg, 2012) framework demonstrates, how Monitoring & Evaluation can be integrated into performance management systems, setting measurable indicators and facilitating necessary adjustments.

However, the study suggests a complete absence of Monitoring & Evaluation for the structural plan in Dukem Sub-city. This lack likely contributes to the observed problems, such as poor management and plan violation.

Therefore, the absence of Monitoring and evaluation creates a significant blind spot in the study area for UGI implementation. So, establishing a robust Monitoring & Evaluation system, aligned with best practices like those mentioned above, is crucial for identifying weaknesses, ensuring adherence to the plan, and promoting successful UGI development in the town.

CHAPTER FIVE

5.CONCLUSION AND RECOMMENDATION

5.1. Conclusion

This study investigated the challenges hindering effective urban green infrastructure (GI) development in Dukem Sub-city. We employed a problem-oriented approach to identify key issues, underlying causes, and factors impeding GI implementation. The study revealed that, the current structural plan overlooks existing green spaces and suffers from inadequate stakeholder participation, leading to a disconnect between planned and actual GI. Moreover, the municipality's limited resources, expertise, and outdated management strategies result in the deterioration of existing green infrastructure in the study area.

The study also concludes that, a lack of public awareness regarding GI benefits leads to misuse and degradation of green spaces in the town. Stakeholder and community exclusion from planning processes hinders the development of high-quality and appealing green areas in the study area. Insufficient manpower, expertise, and financial resources within the municipality create significant barriers to successful GI implementation in the study area.

In general, Dukem Sub-city's inadequate GI stems from a combination of planning flaws, management shortcomings, and a lack of community engagement. Addressing these challenges requires a comprehensive approach that integrates improved planning practices, enhanced municipal capacity, and increased public awareness. Future research can explore potential solutions and their effectiveness in promoting sustainable GI development in Dukem Sub-city.

5.2. Recommendation

This analysis highlights key strategies for enhancing Dukem Sub-city's urban green infrastructure (UGI) development.

Planning and Legislation:

- Expert Consultation: Address limited internal resources by outsourcing expertise to create a comprehensive UGI management plan.
- Land Allocation and Protection: Collaborate with authorities to prioritize land allocation for UGI during development planning and implement regulations preventing land conversion.
- Phased Implementation: Implement the UGI plan progressively, strengthening stakeholder involvement at each stage.
- Equitable Distribution: Ensure equitable distribution of green spaces throughout the town to maximize accessibility for all residents.
- Public-Private Partnerships: Encourage public and private sector participation in UGI management to address current shortcomings.
- Monitoring and Evaluation: Implement a well-managed plan with continuous follow-up for effective execution.

Community Engagement and Awareness:

- Educational Initiatives: Develop educational programs to equip residents with knowledge on environmental, social, and economic benefits of UGI, emphasizing resident roles in protection and maintenance.
- Demonstration Project: Create a model green space showcasing UGI's functionalities and aesthetics to spark public interest and encourage advocacy.

Inclusive Stakeholder Engagement:

- Public Sector: Involve government agencies responsible for urban planning, environment, and infrastructure development.
- NGOs: Partner with NGOs with expertise in environmental conservation and community development.

- Businesses: Engage private companies, particularly those focused on sustainability, to contribute resources and expertise.
- Local Residents: Integrate the community to understand local needs, provide design input, and foster ownership of green spaces.
- Volunteer Groups: Leverage volunteer labor and advocacy efforts from individuals and environmental organizations.

Funding and Skills:

- Funding Strategies: Secure sufficient budget through public funding options for green infrastructure initiatives.
- Capacity Building: Train existing staff to effectively manage green spaces.

Sustainable Practices:

- Green Space Protection: Implement fencing and proper maintenance for existing green spaces.
- Strategic Planting: Prioritize drought-resistant native plants, considering water availability and landscaping design.
- Natural Resource Conservation: Focus on protecting river buffers and urban forests with appropriate vegetation.

REFERENCE

AfDB Annual Report. (2016). African Development Bank

Ashley Lowe; Steve Winkelman. (2011). Learned on local climate adaptation from the urban leaders adaptation initiative the center for clean air policy February 2011.

Benedict and McMahon. (2002). Green infrastructure: smart conservation for the 21st century

Benedict, M. A., & McMahon, E. T. (2006). Green infrastructure: Linking landscapes and communities. Island Press.

Biazen. (2015). Participatory evaluation of herbage composition, biomass yield, and management practices of natural grazing lands in Sidama highlands of southern Ethiopia.

Chiesura, A. (2004). The role of urban parks for the sustainable city. Landscape and Urban Planning, 68(1), 129-138.

CLUVA. (2013). Climate change and Urban Vulnerability in Africa

Dee Merriam. (2010). Urban Green Infrastructure: A Study of Implementation Strategies

Dubbale et al. (2010). Urban environmental challenges in developing cities: The case of Ethiopian capital Addis Ababa

Eisenman, T.S. (2013). Frederick Law Olmsted, green infrastructure, and the evolving city, 12(4).

Erickson. (2006). Timothy Dennis Young Quist, 2009Erickson, Donna. MetroGreen: Connecting open space in North American cities. Washington, DC.: Island Press.

Fisseha Asmelash. (2013). Soil physicochemical property and arbuscular mycorrhizal fungi resilience to degradation and deforestation of a dry evergreen Afromontane Forest in central Ethiopia

Gascon, M., Triguero-Mas, M., Martínez, D., Dadvand, P., Rojas-Rueda, D., Plasència, A., & Nieuwenhuijsen, M. (2015). Residential green spaces and mortality: A systematic review. Environment International, 86, 60-67.

Gill, S. E., Handley, J. F., Ennos, A. R., & Pauleit, S. (2007). Adapting cities for climate change: The role of the green infrastructure. Built Environment, 33(1), 115-133.

Harrison et al. (1995). Harrison et al 2019 Diversity-Stability Dynamics. Higher Education: A Literature Review and Research Directions. Arizona

Lafortezza, R., Carrus, G., Sanesi, G., & Davies, C. (2013). Benefits and well-being perceived by people visiting green spaces in periods of heat stress. Urban Forestry & Urban Greening, 12(2), 267-275.

Li. (2014). Impact of urbanization level on urban air quality

Maas, J., Verheij, R. A., Groenewegen, P. P., de Vries, S., & Spreeuwenberg, P. (2006). Green space, urbanity, and health: How strong is the relation? Journal of Epidemiology & Community Health, 60(7), 587-592.

McDonald. (2005). McDonald, Leigh Anne and William L. III and Benedict, Mark A. and OConner, Keith. 2005.“Green infrastructure evaluation frameworks in the Journal of Conservation Planning.

Mell. (2008). I.C. Mell Green infrastructure: Concepts and planning

Mell. (2013).. Green infrastructure: reflections on past, present and future praxis

Mougeot (2000). Urban agriculture: definition, presence, potentials and risks, and policy challenges

Rosenzweig, R., Solecki, W., Parshall, L., Gaffin, S., Lynn, B., Goldberg, R., Cox, J.,

& Hodges, S. (2006). Mitigating New York City's heat island with urban forestry, living roofs, and light surfaces. In Proceedings of the National Academy of Sciences,103(4), 1259-1265.

Tsegaye Ginbo and Dawit W. Mulatu. (2017). Coupling socio-economic factors and eco-hydrological processes using a cascade-modeling approach.

Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kazmierczak, A., Niemela, J., & James, P. (2007). Promoting ecosystem and human health in urban areas using Green Infrastructure: A literature review. Landscape and urban planning, 81(3), 167-178.

UNDESA. (2014). World Urbanization Prospects. United Nations, Department of Economic and Social Affairs, Population Division.

Van den Bosch, M., & Sang, Å. O. (2017). Urban natural environments as nature-based solutions for improved public health – A systematic review

World Bank. (2015). Annual Report.

Budgets

S.N	Cost of Data collection	Unit	Total time/Quantity (days)	Unit Cost /Birr/	Total Cost/Birr/
1	Printing	page	500	2	1000
2	Binding	pes	5	600	3000
3	Perd diem for researcher / Bihoftu to Adama/ 649birr/day	days	10	649	6490
4	Transportation		12	340	4080
5	Transportation	trips	20	200	400
6	Transportation/ Bishoftu to Dukem	days	15	40	600
7	Payment for data collections / a person	days	5	600	3000
	sum				18,570

ASTU sponsored students (their salary scale) who go to Bishoftu for data collection

- Others should consult ASTU finance or their corresponding organization for details on per diem rates.

APPENDEX

Household Survey Questionnaire: Challenges of Urban Green Infrastructure Planning and Implementation in Dukem Sub-city

Introduction

Thank you for participating in this Household survey questionnaire. This questionnaire aims to understand the **challenges faced in planning and implementing UGI** in **Dukem Sub-city**. Your honest responses will be crucial in identifying these challenges and informing future UGI development strategies.

Part 1: Background Information

1. Demographic informations

□ Age

□ Gender

□ Education

□ Income

2. What is your role?

□ Resident

□ Government Official

□ Urban Planner

□ NGO Representative

□ Business Owner

□ Others

3. How long have you lived/worked in Dukem Sub-city?

□ Less than 1 year

□ 1-5 years

□ 6-10 years

□ More than 10 years

Part 2: Awareness and Perception of Urban Green Infrastructure (UGI)

1. In your opinion, how important are green spaces in Dukem Sub-city?

□ Very Important

□ Somewhat Important

□ Neutral

□ Somewhat Unimportant

□ Not Important

2. Which of the following types of UGI you have observed in Dukem Sub-city?

□ Parks

□ Street Trees

□ Green Roofs

□ Recreational areas

□ Green corridors

□ Community Gardens

□ Riparian buffers

□ Others

3. Do you believe the current amount of UGI in Dukem Sub-city is sufficient?

□ Yes □ No □ Unsure

4. How satisfied are you with the quality and accessibility of existing UGI in Dukem Sub-city?

□ Very Satisfied
□ Somewhat Satisfied
□ Neutral
□ Somewhat Dissatisfied
□ Very Dissatisfied

Part 3: Challenges in UGI Planning and Implementation

3.1. Planning

1. Are you aware of any plans for developing UGI in Dukem Sub-city?

□ Yes □ No □ Unsure

2. If yes, have you been involved in the planning process for UGI development?

□ Yes □ No

3. If you were involved, how inclusive and participatory was the planning process?

□ Very Inclusive
□ Somewhat Inclusive
□ Neutral
□ Somewhat Exclusive
□ Very Exclusive

4. In your opinion, what are the biggest challenges in planning UGI for Dukem Sub-city?

□ Lack of funding
□ Limited land availability
□ Competing priorities for land use

- Difficulty in integrating UGI into existing urban fabric
- Lack of public participation in planning
- Lack of data and information on UGI benefits
- Other (Please Specify)

3.2. Implementation

5. Have you observed any challenges in implementing UGI projects in Dukem Sub-city?

 Yes No Unsure

6. If yes, what are the biggest challenges in implementing UGI projects?

- Lack of maintenance and management resources
- Damage to UGI by residents or businesses
- Lack of enforcement of regulations related to UGI
- Insufficient technical expertise for UGI construction and maintenance
- Difficulties in acquiring land for UGI development
- Other (Please Specify)

Part 4: Recommendations

1. What suggestions do you have for overcoming the challenges faced in UGI planning and implementation in Dukem Sub-city?
2. How can residents be better involved in the planning and management of UGI in Dukem Sub-city?

Thank you for your time and valuable input!