

# Urban Green Space as A Climate Change Adaptation Strategy in The Tamale Metropolis, Ghana

Alhassan A. S<sup>1</sup> and LeBrasseur R.<sup>2\*</sup>

<sup>1</sup>Dream Esteem Cycle Ghana Org (DEC), Ghana

<sup>2</sup>Department of Plant, Food and Environmental Sciences, Faculty of Agriculture, Dalhousie University, Truro, NS B3H 4R2, Canada

\*Corresponding Author

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## ABSTRACT

The study assessed Urban Green Space as a Climate Change Adaptation Strategy in Tamale Metropolis, Ghana. The study used a mixed-method research design. The purpose of the qualitative methods was to explore and gain an in-depth understanding of the perceptions and experiences of people regarding urban green spaces and climate change adaptation. The quantitative methods complemented the qualitative findings and provided statistical evidence to support the conclusions drawn from the qualitative phase. Regarding the population size, the study considered that the number of residential households in the metropolis was 8718, out of this, the sample size of the study was 99 household heads. Data was collected using the questionnaire method of data collection. The study found that the factors that account for the depletion of green space in the Tamale Metropolis indicate that rapid urbanization is the primary driver, with 32.76% of respondents identifying it as a factor. This is followed by agricultural expansion (22.57%), industrialization (15.52%), and a combination of causes (17.24%). The data also emphasize the complexity of the factors driving green space depletion, requiring a multi-faceted approach. The data on recommended measures to make green spaces more accessible in the Tamale Metropolis emphasize the importance of improved transportation and signage. The majority of respondents identified these two measures as crucial for enhancing accessibility to green spaces. Improving transportation systems by providing more reliable and affordable public transportation options can facilitate access to green spaces for individuals who do not have private vehicles. This measure can encourage a broader range of people to visit and enjoy these spaces, promoting inclusivity.

**Keywords:** Urban green space, urbanization, climate change, depletion, measures, Planning, Management, impact, emerging city, extreme temperature, Housing, Infrastructure and Development.

## INTRODUCTION

Globally, Climate change is a topic that resonates with professionals, politicians, cities, and the general public. According to Cheng et al. (2021) climate change ranks among the top five most serious problems of our times (Cheng et al., 2021). Climate change is widely recognized as one of the most pressing issues of our time, ranking among the top five most serious problems. The consensus among scientific experts and the abundance of evidence supports this claim (IPCC, retrieved 2023). Climate change has far-reaching impacts on various aspects of human life and the environment, including agriculture, water resources, biodiversity,

and human health (IPCC; United Nations, retrieved 2023). Although global warming is still an issue of discussion, there are no longer any doubts regarding its progress individual scenarios only differ in the value of temperature increase (1.5 to 4.0 °C on average). Temperature increases are more related to weather extremes, uneven rainfall levels, more frequent windstorms and floods, soil degradation, and a higher frequency of forest fires, etc. (Carter, 2018).

In Africa, climate change brings a wide range of problems to both natural and human systems. Moreover, the state of the environment may deteriorate, which could be associated with the increase in human population, especially in cities, and the increasing demand for natural resources: water, food, and land (Mabon & Shih, 2021). Already, over 400 cities worldwide have declared a “climate emergency” state (Regier & Regier, 2021). Therefore, the implementation of solutions for enhancing the current state of the climate-impacted environment is required. In this regard, successive governments in Africa are trying to find a suitable method of mitigating climate change consequences, typically about green space infrastructure (GI).

According to (Regier & Regier, 2021), for liveability and quality of life in cities, parks, street trees, urban nature preserves, and other urban green areas are crucial. In reality, urban green spaces are increasingly seen as crucial “green infrastructure” because they offer a variety of ecosystem services that have positive socioeconomic and environmental effects, such as lowering urban heat islands and bridging health disparities (Mabon & Shih, 2021). Urban green spaces are an emerging method for boosting climate change resilience in urban areas. Examples include urban forests, and dense street tree canopies, (Cheng et al., 2021). Several scholars have suggested urban parks as one of the best options for reducing urban heat island impacts since they are proven to have cooler air temperatures than the nearby built environment, frequently producing a spillover cooling effect (Regier & Regier, 2021)

In Ghana, the main premise of adaption to climate change is that the climate is already changing due to historic emissions originating in the mid-nineteenth century (Mabon & Shih, 2021). These emissions result in increased temperatures across the country with varying impacts on humans and other species (Asamoah et al., 2017). Direct impacts of climate change are environmental and physical with clear and strong repercussions on social and economic dimensions. Some of these impacts include increased heat temperatures (resulting in increased intense heat human mortalities and species migration), flooding due to extreme precipitation events (resulting in flooding with building and infrastructural damage as well as related mortalities), rising sea levels (inundation of large tracts of developed coastal urban land resulting in lost property) and extreme variability of local and micro-climates (McEvoy et al. 2006). Accordingly, the magnitude of exposure and risk to these events vary the extent of vulnerability of communities.

## 1.2 Problem statement

The adaptive capacity of cities and urban areas, which relates to their ability to anticipate, moderate, and manage climate change impacts, is influenced by the features and characteristics of their landscapes. The urban land cover also affects climate change impacts. For example, urbanization influences hydrological processes and in turn, affects the frequency and intensity of flooding events.

In Ghana, the communities in the northern regions especially Tamale are very vulnerable to climate change events. In recent times, (Carter, 2018) found that urban areas in Tamale are hotter than the rest of the country, with an average temperature of 28.6 degrees Celsius in the Sudan Savannah Zone and 27.5 degrees Celsius in the Guinea Savannah Zone (based on data from 1961-2015). This area also has the greatest seasonal variations in temperature, ranging from 22-25 degrees Celsius in the July-September season to 27-32 degrees in the hot, dry season from February to May. (Asamoah et al., 2017) also found that even though tamale has one rainy season as a result of climate change vulnerability, which typically occurs from May to November, a single rainfall can last for about six hours, causing damage to an unspecified number of

properties, while several cars, tricycles, and m, motorbikes are swept away as sections of roads are mostly completely taken over by the flood water.

In addition to that, (Asamoah et al., 2017) found that despite the heavy downpours causing floods in Tamale, the average annual rainfall between 1961 and 2015 was 992 mm in the Sudan Savannah and 1115 mm in the Guinea Savannah, compared to over 2000 mm in the evergreen forest zone further south. The combined effects of high levels of poverty, heavy reliance on rain-fed agriculture, and poor access to resources and services create a situation of high vulnerability to climate change in Ghana's northern regions specifically the northern region of Ghana.

Hence, the findings from this research can contribute to the development of effective strategies and policies to enhance adaptive capacity and resilience in urban areas facing climate change challenges. Understanding the specific landscape characteristics, land cover patterns, and their effects on climate change impacts can inform urban planning, infrastructure development, and disaster management efforts in vulnerable regions globally.

### **1.3 Research objectives**

#### **1.3.1 General research objective**

1. To examine how urban green spaces, provide climate change adaptation benefits in the Ghanaian city of Tamale

#### **1.3.2 Specific Research Objectives**

1. To examine the factors that account for the depletion of green space in the tamale metropolis
2. To find ways in which green space infrastructure plans can effectively be implemented in the Tamale metropolis

#### **1.3.3 Significance of the study**

The study will identify and assess the activities that hinder the sustainability of green space in the Tamale metropolis. The study will also serve as a tool to advocate for green space sustainability by educating the general public on the dangers associated with climate change. Secondly, the study will help highlight the challenges associated with operationalizing green space infrastructure plans in the Tamale metropolis. This in the long run will serve as a reference point and guideline to the policy makers to formulate appropriate policies in other urbanizing regions globally. Lastly, this study will serve as a contribution to academic knowledge and support further research into this topic.

## **LITERATURE REVIEW**

This chapter of the study is based on a review of the literature in line with the research topic. The review of the literature was based on thematic areas in line with the objectives of the study.

### **2.1 Definition of concepts**

#### **2.1.1 Urban green space**

Urban green space refers to the presence of vegetation, trees, or grass in urban areas. It includes parks, gardens, green belts, street trees, green roofs, and other natural or semi-natural areas that provide ecological, social, and aesthetic benefits to urban residents. Urban green spaces can be found in various forms and sizes, ranging from small pocket parks to large-scale urban forests (Kabisch et al., 2016).

Urban green spaces are important for several reasons. First, they have been shown to provide numerous ecological benefits. For example, they can help mitigate the urban heat island effect by reducing surface temperatures and increasing evapotranspiration rates (Escobedo et al., 2019). They can also improve air quality by absorbing pollutants and producing oxygen (Gómez-Baggethun et al., 2013). In addition, urban green spaces can provide habitats for wildlife and promote biodiversity in urban areas (Kowarik, 2011).

Second, urban green spaces offer social benefits. They can provide recreational opportunities for urban residents, which can promote physical activity and enhance mental health and well-being (Coley et al., 2017). They also provide spaces for social interaction, community events, and cultural activities, which can help strengthen social ties and foster a sense of community (Millennium Ecosystem Assessment, 2005).

Finally, urban green spaces can have economic benefits. They can increase property values, attract businesses, and provide employment opportunities in landscaping, horticulture, and other related fields (Wolf, 2008).

In summary, urban green space is an important concept that refers to the presence of vegetation, trees, or grass in urban areas. It provides numerous ecological, social, and economic benefits, and has been recognized as an essential component of sustainable urban development (Kowarik, 2011).

## **2.2 The Factors That Account for the Depletion of Green Space**

Green spaces are defined as areas of land covered by vegetation, such as parks, gardens, and forests. They play a vital role in promoting the health and well-being of urban residents, providing opportunities for recreation, social interaction, and relaxation. Despite the numerous benefits of green spaces, many cities worldwide are experiencing the depletion of these essential resources. Below are the factors that account for the depletion of green space in urban areas.

### **2.2.1 Urbanization**

Urbanization is a significant factor that accounts for the depletion of green space in urban areas. As cities grow and expand, they often encroach on natural areas, leading to the conversion of green spaces into residential or commercial areas (Frimpong et al., 2019). The process of urbanization has accelerated in recent years due to factors such as population growth, migration, and industrialization (Seto et al., 2014). The rapid pace of urbanization has resulted in the depletion of green space in many cities worldwide, causing negative impacts on the environment and the well-being of urban residents.

### **2.2.2 Inadequate planning and management**

Another factor that contributes to the depletion of green space in urban areas is inadequate planning and management. The lack of effective planning and management of green spaces often results in their degradation and loss of vegetation cover (Amoatey et al., 2018). In many cases, green spaces are left unmanaged, leading to the invasion of exotic plant species, which outcompete native vegetation (Lonsdale, 1999). Additionally, the lack of adequate funding and resources for the maintenance of green spaces can also contribute to their depletion (Frimpong et al., 2019).

### **2.2.3 Demand for land**

The high demand for land for agriculture and other economic activities is another factor that contributes to the depletion of green space in urban areas. In many cities worldwide, the conversion of green spaces into agricultural land has increased in response to the growing demand for food (Boadi et al., 2020). Additionally, the expansion of urban areas often leads to the conversion of agricultural land into residential or commercial areas, resulting in the depletion of green space (Seto et al., 2014).

#### **2.2.4 Climate change**

Climate change is also a significant factor that accounts for the depletion of green space in urban areas. The impacts of climate change, such as increased temperatures, drought, and extreme weather events, can have adverse effects on vegetation cover (Boadi et al., 2020). These impacts can lead to the loss of vegetation cover and the degradation of green spaces. Additionally, climate change can also lead to the invasion of exotic plant species, which can out-compete native vegetation and lead to the depletion of green space (Lonsdale, 1999).

#### **2.3 How Urban Green Space Improve Climate Change Resiliency, Improve Climate Change**

Urban Green Spaces (UGS) play a crucial role in improving climate change resiliency and mitigating its effects. The benefits of UGS include:

1. **Heat reduction:** UGS can help reduce the urban heat island effect by providing shade and evaporative cooling, thereby mitigating the impacts of heat waves and reducing the need for energy-intensive air conditioning.
2. **Carbon sequestration:** UGS can help absorb carbon dioxide (CO<sub>2</sub>) from the atmosphere through photosynthesis, which can help mitigate the greenhouse gas effect and slow down climate change.
3. **Water management:** UGS can help manage stormwater runoff, reducing the risk of floods and improving water quality by filtering pollutants.
4. **Biodiversity conservation:** UGS can provide habitats for a variety of plant and animal species, which can improve ecosystem resilience and support biodiversity.

Several studies have highlighted the importance of UGS in improving climate change resiliency. For example, a study by Sánchez-Rodríguez et al. (2021) found that the presence of UGS in urban areas can significantly reduce the impacts of heat waves on public health, particularly for vulnerable populations such as the elderly and children. Another study by Liu et al. (2021) demonstrated that UGS can help reduce urban CO<sub>2</sub> emissions and improve air quality, which can help mitigate the impacts of climate change.

#### **2.4 The ways by which green space infrastructure plans can effectively be implemented**

Green spaces are critical components of urban infrastructure, providing numerous environmental, social, and economic benefits to urban residents. The creation and maintenance of green spaces require careful planning and management to ensure their sustainability and effectiveness. In recent years, there has been an increasing focus on the development of green space infrastructure plans as a means of effectively implementing green space initiatives. This section of the literature review aims to explore ways in which green space infrastructure plans can be effectively implemented in urban areas.

##### **2.4.1 Community engagement**

Effective implementation of green space infrastructure plans requires active community engagement. Community participation is essential in developing green space plans that are responsive to the needs and preferences of residents (Arnberger et al., 2017). Community engagement should involve all stakeholders, including residents, local businesses, and government agencies, to ensure that the green space infrastructure plan is inclusive and widely supported.

##### **2.4.2 Policy and Governance**

Effective implementation of green space infrastructure plans requires appropriate policies and governance structures. Policies should be developed to guide the development and management of green spaces, ensuring their sustainability and effectiveness (Amoatey et al., 2018). Additionally, governance structures

should be put in place to ensure that green spaces are adequately managed and maintained. Effective governance structures should be inclusive and involve all stakeholders, including residents and government agencies.

### **2.4.3 Funding and Resources**

Adequate funding and resources are essential for the effective implementation of green space infrastructure plans. Green space initiatives require significant financial investments to establish and maintain green spaces (Thwaites et al., 2016). Therefore, governments and other stakeholders should allocate sufficient resources to ensure that green spaces are adequately funded and maintained. Additionally, partnerships with private sector organizations and non-governmental organizations can help to mobilize additional resources for green space initiatives.

### **2.4.4 Sustainable design and management**

The sustainable design and management of green spaces are critical to their long-term effectiveness. The design of green spaces should take into account their environmental, social, and economic functions (Colding et al., 2013). Additionally, green spaces should be designed and managed in a way that minimizes their ecological footprint and enhances their resilience to climate change. The use of sustainable management practices, such as the use of native vegetation, can help to enhance the ecological integrity of green spaces.

### **2.4.5 Technology and Innovation**

Technology and innovation can play a significant role in the effective implementation of green space infrastructure plans. The use of technology, such as remote sensing and GIS mapping, can help to identify suitable locations for green spaces and monitor their ecological and social impacts (Bolund et al., 2015). Additionally, the use of innovative technologies, such as green roofs and vertical gardens, can help to maximize the use of limited urban space for green space initiatives.

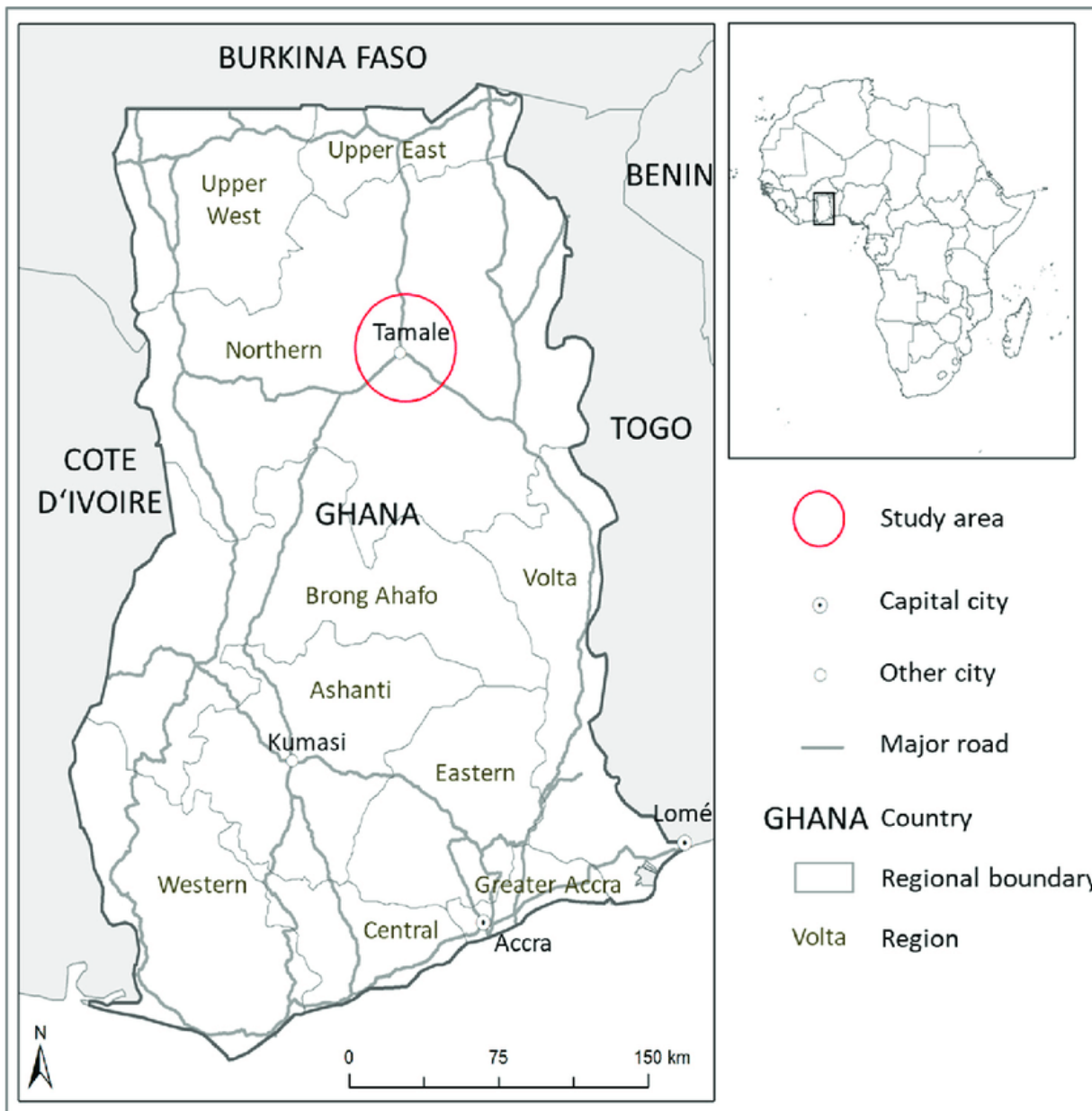
In summary, the effective implementation of green space infrastructure plans requires a comprehensive approach that involves community engagement, appropriate policies, and governance structures, adequate funding and resources, sustainable design and management, and the use of technology and innovation. Green space initiatives should be developed and managed in a way that enhances their ecological, social, and economic functions and ensures their long-term sustainability.

## **METHODOLOGY AND PROFILE OF STUDY AREA**

### **3.1.1 Location, Size, and Physical Features**

The Tamale Metropolis is one of the 26 districts in the Northern Region of Ghana. It is located in the central part of the Region and shares boundaries with the Sagnarigu District to the west and north, Mion District to the east, East Gonja to the south, and Central Gonja to the southwest. The Metropolis has a total estimated land size of 646.90180sqkm (GSS-2010). Geographically, the Metropolis lies between latitudes 9 °C 16 and 9 °C 34 North and longitudes 0 °C 36 and 0 °C 57 west. There are 115 communities in the Metropolis. Most of the rural communities have a large expanse of land for agricultural activities and serve as the food basket for the Metropolis. However, these communities still lack basic social and economic infrastructure such as good road networks, school blocks, hospitals, markets, and recreational centres, thereby hindering socio-economic development, poverty reduction, and reducing the general phenomenon of rural-urban migration. Figure 1 shows the GIS image of the Tamale metropolis.

Figure 1: Map of Ghana and Tamale Metropolis



(Ghana Statistical Service, 2020)

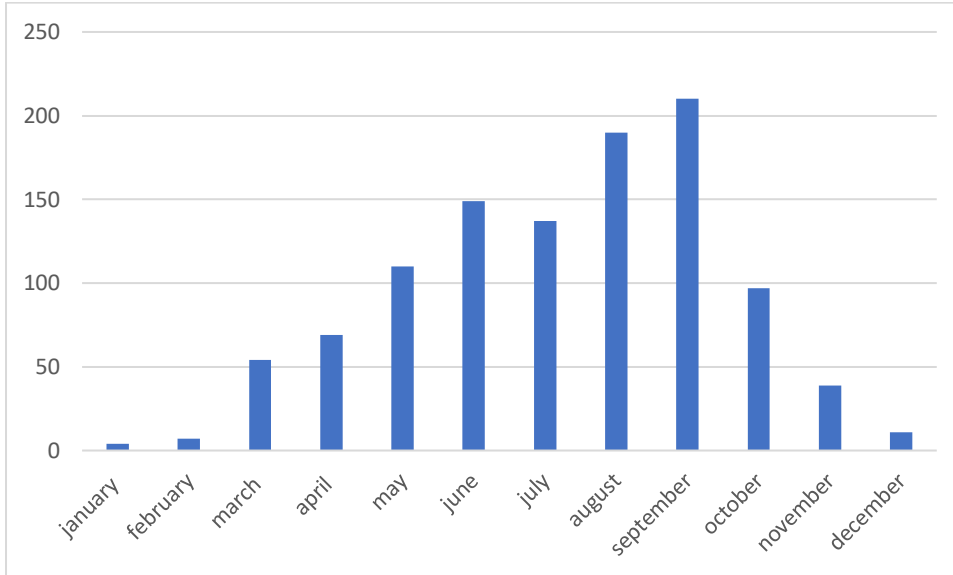
### 3.1.2 Relief and Climate

The Tamale Metropolis is about 180 meters above sea level. The land is generally undulating with a few isolated hills. The Metropolis receives only one rainfall season in a year and this has affected effective agricultural production in the area. Daily temperature in the Metropolis varies from season to season. During the rainy season, residents experience high humidity, and slight sunshine with heavy thunderstorms, compared to the dry season which is characterized by dry Harmattan winds from November-February and high sunshine from March-May.

This climatic feature offers a unique opportunity for the preservation industry in that it could use the sunshine as a natural preservative. Another untapped potential of the Metropolis is the development of artificial parks and gardens that could take advantage of the high sun rays by building swimming pools, and

parks for both children and adults to relax during the excessive sunshine period. By this, most families would be able to enjoy good family reunions during the weekends and holiday periods. The Metropolis could also derive needed revenue from the development of these potentials.

Figure 2: Rainfall and Temperature Ranges



(Joy Weather Report, 2022)

### 3.1.3 Drainage and Vegetation

The Metropolis is poorly endowed with water bodies and this has affected the regular flow of water into households within the Metropolis. The only natural water systems are a few seasonal streams which have water during the rainy season but dry up during the dry season.

The Metropolis lies within the savannah woodland zone in the country. The trees in this zone and for that matter the Metropolis are short scattered woodlots in nature. Major tree types in the Metropolis are *Dawadawa*, Nim, Acacia, Mahogany, and Baobab among others. The Metropolis is endowed with naturally grown tall grasses during the rainy season which is used to make the local mats popularly called, “Zanamat”. The making of the Zanamat by most farmers during the dry season reduces the rural-urban migration levels of the youth from rural areas to urban areas. Besides, the only economic tree is the Shear tree which has gained international recognition. The picking, processing, and marketing of the shear nuts has over the years engaged almost all households in the area. Undoubtedly these shear nut-related activities have contributed to employing the youthful population, increased household incomes, and reduced poverty. Cashew is also widely grown in the Metropolis.

The main soil types in the Metropolis are sandstone, gravel, mudstone, and shale which have weathered into different soil grades. Due to seasonal erosion, soil types emanating from this phenomenon are sand, clay, and laterite. The availability of these soil types has facilitated real estate development in the area as estate developers have resorted to using these materials in the building industry.

## 3.2 Methodology

### 3.2.1 Research design

The study employed a mixed-method research design. Both qualitative and quantitative data were used for



the study. The most suitable mixed-method research design for the research topic “Urban green space as a climate change adaptation strategy in Tamale Metropolis” was Sequential Exploratory Design.

In this design, the research started with qualitative data collection and analysis, followed by quantitative data collection and analysis. The purpose of the qualitative phase was to explore and gain an in-depth understanding of the perceptions and experiences of people regarding urban green spaces and climate change adaptation. This meant that, through the qualitative methods, data on how individuals perceived UGS as beneficial in mitigating climate change impacts were collected. The quantitative phase complemented the qualitative findings and provided statistical evidence to support the conclusions drawn from the qualitative phase.

### 3.2.2 Target population

The target population for the study included the residents/households of Tamale Metropolis. Specifically, the target population consisted of individuals and communities who lived and worked within or near urban green spaces in the Tamale Metropolis. The target population also potentially included policymakers who were involved in the planning, development, and management of urban green spaces in the Tamale Metropolis.

### 3.3.3 Sample size and sampling techniques

Regarding the population size, the study considered that the number of residential households in the metropolis was 8718. Considering the representative sample size for the study Yamane formulae was the basis for determining the sample size for the study. The Yamane formula is mathematically defined as

$$n = \frac{N}{1 + N(e)^2}$$

Where  $n$  = sample frame/target population

$e$  = margin of error

$$n = \frac{8718}{1 + 8718(0.1)^2}$$

Therefore,  $n = 98.8$

The total number of respondents for the study amounted to 99 households/residents. With nearly 100 respondents, the study can gather sufficient data to analyze trends and patterns within the population of residential households in the metropolis. Additionally, this sample size allows for statistical analyses to be conducted with a reasonable degree of confidence, providing meaningful insights into the research objectives. Therefore, the chosen sample size is appropriate for achieving the study’s objectives within the constraints of available resources and time.

To ensure equal representation of the target population, the respondents were selected from three major communities. Hence, 33 residents were selected from these communities. The respondents were obtained using Systematic and purposive sampling techniques. Firstly, The Systematic sampling method is a type of probability sampling method in which sample members from a larger population are selected according to a random starting point but with a fixed, periodic interval Ho et al. (2006). This interval was calculated as  $N/n$ . This method was targeted toward households to select household heads to take part in the study. As such the intervals for the selection of the households were obtained by  $\frac{8718}{99}$ . From the results of the equation, every household positioned 3<sup>rd</sup> from the count of 1 qualified for inclusion in the study. 99 represented the total sample size and 33 represented the number of household heads to be selected from each of the selected communities.

Out of the sample size, policymakers involved in the planning, development, and management of urban green spaces in the Tamale Metropolis were selected purposefully using purposive or judgmental sampling techniques.

### 3.3.4 Tools for data collection

Data was collected directly using questionnaires. This comprised mainly coded and open-ended questions to be able to collect both quantitative and qualitative data.

### 3.3.5 Method of Data Analysis.

Qualitative and quantitative methods were used to analyse the gathered data. Qualitative data collected from open-ended questions were recorded after which were analysed using the thematic analysis. Systematically, the responses to open-ended questions were first organized to help familiarize myself with the data collected, after which initial codes were generated serving as the building blocks of the analysis. Secondly, the identification of recurring themes was initiated to capture the themes important to the data about the research question and establish some level of patterned response or meaning within the data set. Hence analysing the data thematically. To analyse the quantitative data, responses were entered once a system was developed using the Statistical Package for Social Scientists (SPSS) version 20. Using the SPSS, patterns that exist in the data collected were analysed. After the analysis presentation of findings also proceeded.

## RESULTS AND DISCUSSIONS

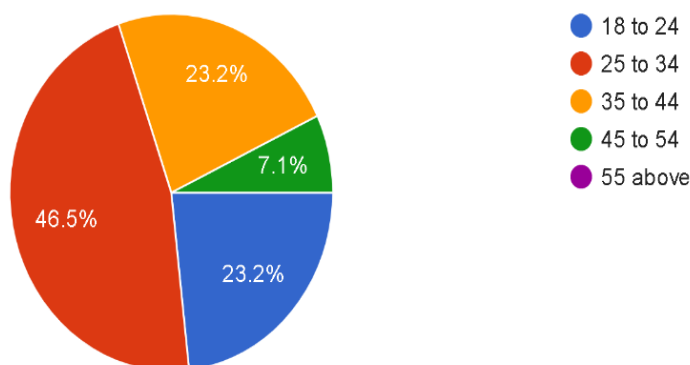
### 4.1 Introduction

This chapter of the study presents and discusses the data collected from the field of the study

### 4.2 Age of respondents

This section of the chapter presents data on the ages of the respondents. Data on the age of participants is presented in Figure 3.

Figure 3: Age of respondents



(Field survey, 2023)

According to the chart, the largest age group was 25 to 34, with 35 respondents (46.5%). The second-largest group was 35 to 44, and 25 to 34 with equal respondents of (23.2%) each. The youngest age group was 18 to

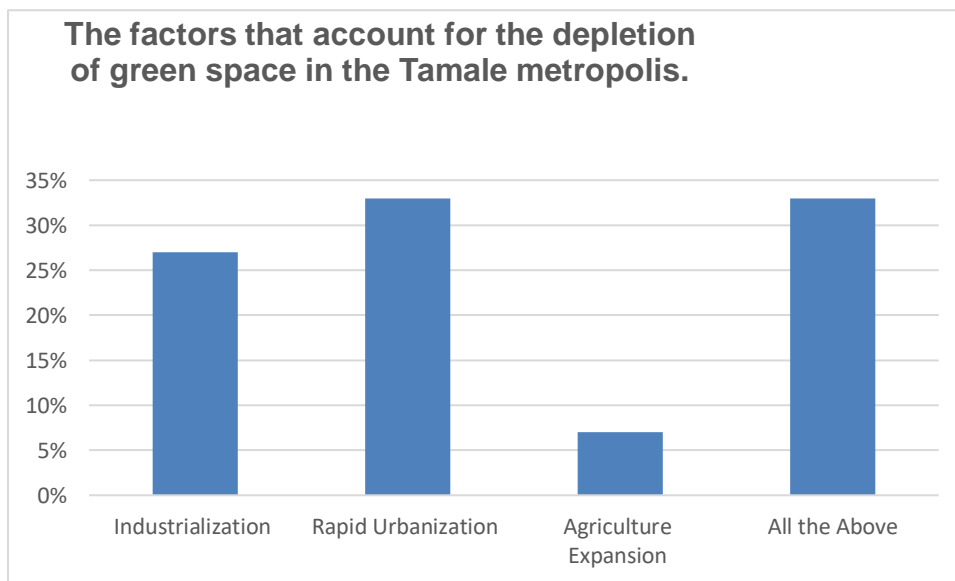
24, with (23.2%). The smallest age group recorded was 45 to 54, with only 4 respondents representing (7.1%). The data suggest that the study had a relatively young sample, with the majority of respondents being under 35 years old. This may be because younger people are more likely to be interested in environmental issues and climate change adaptation strategies. It may also reflect the fact that the study was conducted in an urban area, where younger people tend to be more concentrated.

Research has shown that urban green spaces can play an important role in mitigating the impacts of climate change by reducing the urban heat island effect, improving air quality, and reducing stormwater runoff (Gómez-Baggethun et al., 2018). In addition, green spaces can provide social and psychological benefits, such as improved mental health and social cohesion (Shanahan et al., 2015).

### 4.3 The factors that account for the depletion of green space in the tamale metropolis.

Green spaces, such as parks, gardens, and natural areas, are invaluable assets for urban environments, contributing to the overall well-being, health, and sustainability of cities. Unfortunately, rapid urbanization and development often lead to the depletion and degradation of green spaces, posing significant challenges to the quality of life for residents. Understanding the factors that account for the depletion of green space in the Tamale Metropolis is essential for developing effective strategies to mitigate this issue and ensure the preservation and expansion of these valuable natural resources. The figure below presents data on the factors that account for the depletion of green space in the Tamale metropolis.

Figure 4: Factors that account for the depletion of green space in the Tamale metropolis



(Field survey, 2023)

The figure shows the percentage distribution of causes of green space depletion in the Tamale Metropolis. According to the figure, the most frequently cited cause of green space depletion was rapid urbanization and industrialization with 33% of respondents identifying this as a factor. This was followed by a combination of causes, including industrialization (27%), agriculture expansion (7%) and all the above causes (33%). These results suggest that urbanization is the most significant factor contributing to the loss of green spaces in the Tamale Metropolis. This is consistent with previous research that has found that rapid urbanization and population growth are major drivers of environmental degradation in urban areas (Akinbode, 2017).

The combination of causes identified in the study, including urbanization, agricultural expansion, and industrialization, suggests that multiple factors may be contributing to the loss of green spaces in the Tamale

Metropolis. This is consistent with the literature, which indicates that the loss of green spaces in urban areas is often the result of a complex interplay of social, economic, and environmental factors (Dahiya, 2018).

The data on the causes of green space depletion in the Tamale Metropolis provide valuable insights into the factors driving environmental degradation in rapidly urbanizing cities in Ghana. The implications of the data are significant for policymakers, urban planners, and environmentalists seeking to mitigate the negative impacts of urbanization on the environment and human well-being. This essay will discuss the implications of the data and the measures that can be taken to address the challenges of green space depletion in the Tamale Metropolis.

One of the most significant implications of the data is the dominant role of rapid urbanization in driving green space depletion in the city. As the data show, rapid urbanization is identified as the cause of green space depletion by 32.76% of respondents. This finding is consistent with previous studies that have reported urbanization as a major driver of environmental degradation in urban areas. The conversion of green spaces to accommodate the expanding urban population is a significant concern, as green spaces provide numerous environmental and social benefits, including air quality improvement, reducing the urban heat island effect, and promoting physical and mental health. Therefore, it is essential to address the root causes of rapid urbanization, including inadequate urban planning, inadequate enforcement of land-use regulations, and population growth. One way to address the issue of green space depletion is by developing sustainable urbanization strategies that balance economic development with environmental conservation.

Another implication of the data is the importance of agricultural expansion as a contributing factor to green space depletion. Agricultural expansion is cited as a factor by only 6.90% of respondents, suggesting that its impact on green space depletion may not be as significant as that of other causes, such as rapid urbanization and industrialization. Nevertheless, agricultural expansion can still have a significant impact on the environment, particularly in regions with high population density and limited arable land. As a result, it is necessary to develop policies that promote sustainable agriculture and land-use practices, such as agroforestry, that can help reduce the pressure on green spaces and conserve biodiversity.

The data also reveal the complexity of the factors driving green space depletion in the Tamale Metropolis. A combination of causes, including rapid urbanization, agricultural expansion, and industrialization, were identified by 34.27% of respondents, while all the above causes were cited by 17.24% of respondents. This suggests that multiple factors are contributing to the loss of green spaces in the city, and addressing them will require a multi-faceted approach. Some of the measures that can be taken include developing green infrastructure, promoting sustainable urban design, and implementing policies that regulate land use and protect biodiversity.

Developing green infrastructure is one way to address the issue of green space depletion in urban areas. Green infrastructure refers to the interconnected network of green spaces, such as parks, gardens, and urban forests, which provide ecosystem services and improve the quality of life for urban residents. By creating a green infrastructure network, cities can increase the availability of green spaces, reduce the negative impacts of urbanization on the environment and human health, and promote biodiversity conservation. Furthermore, green infrastructure can also help to mitigate the effects of climate change by reducing the urban heat island effect and providing carbon sequestration services.

Promoting sustainable urban design is another measure that can help to address the issue of green space depletion. Sustainable urban design refers to the planning and design of urban spaces that prioritize the conservation of natural resources, promote energy efficiency, and reduce carbon emissions. This can be achieved through the integration of green spaces into urban design, the use of sustainable building materials, and the development of public transportation systems that reduce the reliance on private cars. Sustainable urban design can help to mitigate the negative impacts of urbanization on the environment and human well-

being while promoting economic development.

By promoting the use of green infrastructure, it is possible to create new green spaces in urban areas while also providing multiple benefits such as storm-water management and air pollution reduction. This can be achieved through partnerships between government agencies, private sector actors, and local communities, as well as through policies and incentives that encourage the adoption of green infrastructure practices.

Another strategy for addressing green space depletion in the Tamale Metropolis is to promote the sustainable use of existing green spaces. This can be achieved through the development of green space management plans that prioritize the conservation of biodiversity and the provision of ecosystem services. Such plans can also incorporate strategies for engaging local communities in the conservation and management of green spaces, thereby fostering a sense of ownership and stewardship among residents.

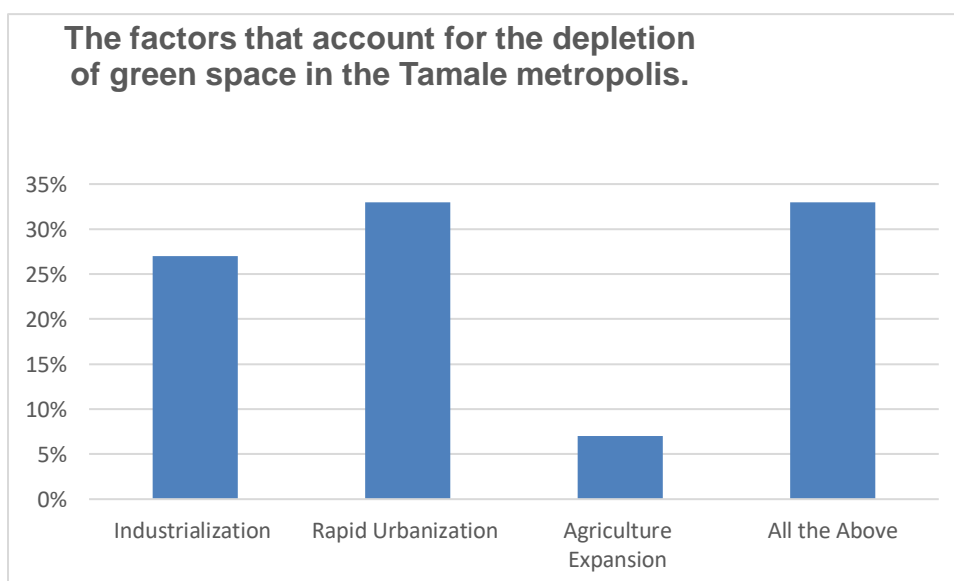
#### 4.4 Perception of respondents on the current availability of green space in Tamale Metropolis

The perception of individuals regarding the availability of green spaces in urban areas has gained significant attention in recent years due to the growing recognition of the environmental, social, and health benefits associated with these spaces. Green spaces, such as parks, gardens, and open recreational areas, contribute to the overall well-being and quality of life of urban residents. They offer opportunities for relaxation, physical activity, social interaction, and connection with nature, which are essential elements for sustainable and liveable cities.

In the context of this discussion, data on the perception of respondents on the current availability of green spaces in the Tamale Metropolis is presented and discussed. Tamale, the capital city of the Northern Region in Ghana, has experienced rapid urbanization and population growth, resulting in increased demands for infrastructure and urban development. As cities expand, the provision and preservation of green spaces become critical for maintaining a healthy and sustainable urban environment.

The perception of respondents regarding the availability of green spaces can provide valuable insights into the current state of green infrastructure in the Tamale Metropolis. Understanding how residents perceive the accessibility, quality, and distribution of green spaces can inform urban planning, policy-making, and the implementation of initiatives aimed at improving the urban environment. Figure 5 below presents the data.

Figure 5:



(Field survey, 2023)

The data on the perception of respondents on the current availability of green space in Tamale Metropolis provides valuable insights into how residents of the city perceive the state of green spaces in their environment. The fact that (54.9%) of respondents rated the availability of green space as poor indicates that there is a significant concern among residents about the state of green spaces in the city. This is consistent with the findings of previous studies that have highlighted the need to improve the availability and accessibility of green spaces in urban environments (e.g., James et al., 2015; Kabisch et al., 2017).

One possible explanation for the poor rating of green space availability in the Tamale Metropolis is the rapid urbanization and industrialization that the city has experienced in recent years. As the city has grown, natural areas and green spaces have been converted to other uses, leading to a reduction in the availability of green spaces for residents (Nakamura et al., 2019). This has been further compounded by factors such as climate change and increasing population pressures, which have further reduced the availability of green spaces (Colding & Barthel, 2017).

The fact that a significant percentage of respondents (26.5%) rated the availability of green space as fair suggests that there is a recognition that some efforts have been made to improve the state of green spaces in the city. This is consistent with the findings of previous studies that have highlighted the benefits of investing in green infrastructure and other nature-based solutions for urban areas (United Nations, 2015; Kabisch et al., 2017). However, there is still a long way to go in terms of improving the availability and accessibility of green spaces for all residents.

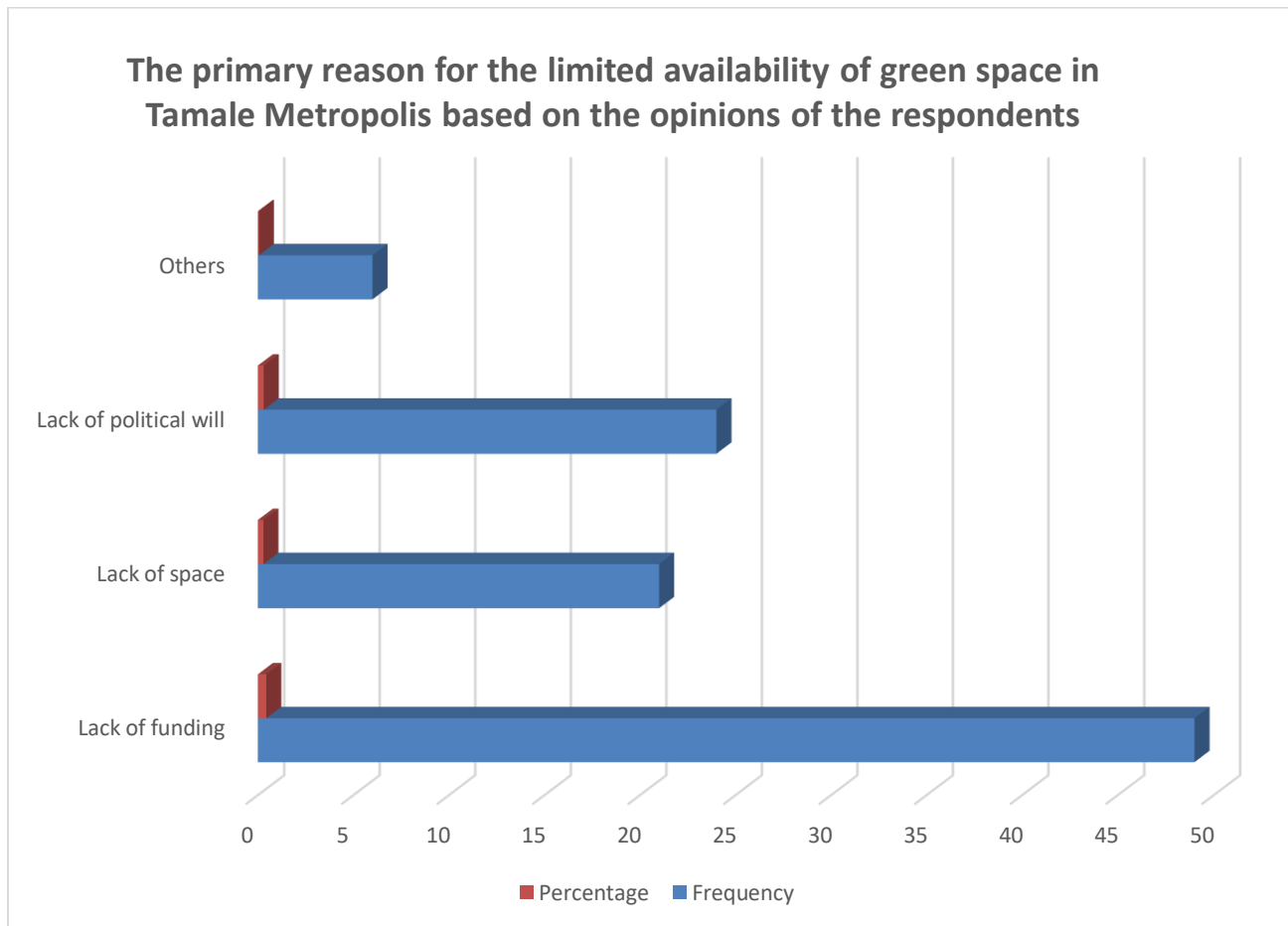
The low ratings of good (15.7%) and excellent (3.9%) indicate that there is still a lot of work to be done to improve the state of green spaces in Tamale Metropolis. This highlights the need for continued investment in green infrastructure and other nature-based solutions, as well as the development of policies and strategies that prioritize the conservation and management of green spaces in urban areas (Kabisch et al., 2017). It also underscores the importance of engaging local communities in the conservation and management of green spaces, as this can foster a sense of ownership and stewardship among residents and lead to more sustainable and equitable outcomes (Colding & Barthel, 2017).

In conclusion, the data on the perception of respondents on the current availability of green space in Tamale Metropolis highlights the urgent need to take action to improve the state of green spaces in the city. Addressing this challenge will require a multifaceted approach that involves promoting the use of green infrastructure, engaging local communities in the conservation and management of green spaces, and developing policies and strategies that prioritize the conservation and management of green spaces in urban areas. By taking action now, it is possible to ensure that Tamale Metropolis remains a healthy, vibrant, and sustainable city for generations to come.

#### **4.5 The primary reason for the limited availability of green space in Tamale Metropolis based on the opinions of the respondents**

The limited availability of green space in urban areas poses significant challenges to the well-being and sustainability of cities. Green spaces, including parks, gardens, and other natural areas, play a crucial role in enhancing urban liveability, promoting biodiversity, and improving the overall quality of life for residents. However, rapid urbanization and population growth often result in the encroachment and reduction of green spaces, leading to the need for a deeper understanding of the primary reasons behind their limited availability. In this section of this chapter, data on the opinions of respondents regarding the primary reasons for the limited availability of green space in the Tamale Metropolis is presented.

Figure 6:



(Field survey, 2023)

The data on the primary reasons for the limited availability of green space in the Tamale Metropolis reveals that the most common reason cited by the respondents is the lack of funding (44.14%). This suggests that there is a need for increased investment in the development and maintenance of green spaces in the city. This finding is consistent with other studies that have highlighted the importance of funding for the provision and maintenance of green spaces (Chiesura, 2004; Kabisch et al., 2016).

The second most common reason cited by the respondents is the lack of political will (30.63%). This finding highlights the importance of political leadership in driving the development and maintenance of green spaces in urban areas. It suggests that there is a need for policymakers to prioritize the provision of green spaces in urban planning and development, and to ensure that there are adequate resources allocated for this purpose (Kabisch et al., 2016).

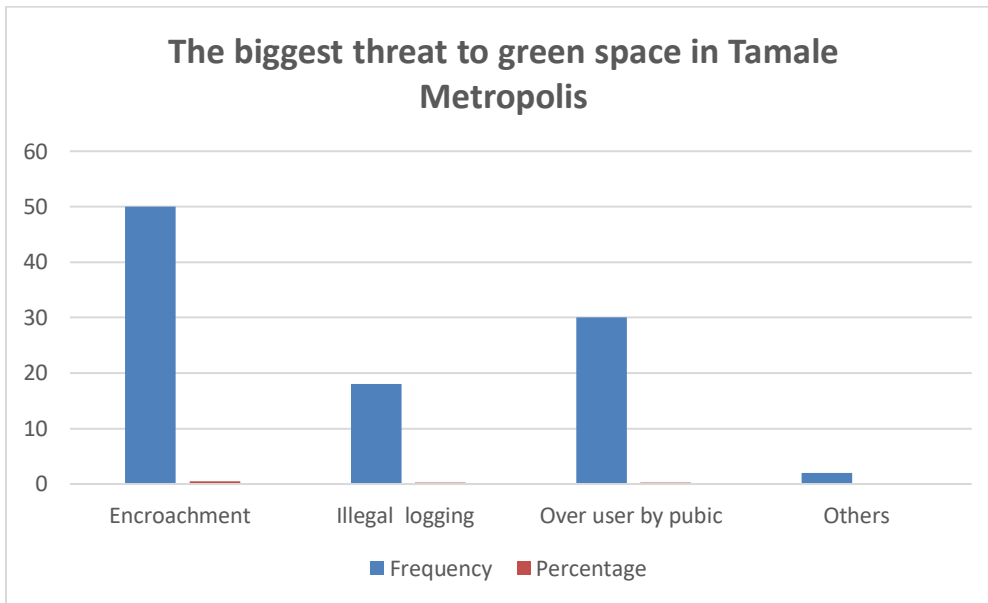
The third most common reason cited by the respondents is the lack of space (28.83%). This finding highlights the challenge of balancing the competing demands for land in urban areas, particularly in rapidly growing cities such as Tamale Metropolis. It suggests that there is a need for innovative solutions to create green spaces in areas where space is limited, such as through the use of vertical gardens, green roofs, and other forms of urban agriculture (Hoornweg et al., 2017).

#### 4.6 The biggest threat to green space in Tamale Metropolis

Green spaces in urban areas are vital for the well-being of residents and the overall sustainability of cities.

They provide numerous benefits, such as improving air quality, mitigating urban heat island effects, supporting biodiversity, and enhancing the overall quality of life. However, green spaces often face various threats due to urban development, land use changes, and competing interests. In the context of the Tamale Metropolis, it is crucial to identify and understand the biggest threats to green space to effectively address these challenges and preserve these valuable resources. The figure below presents data on the biggest threat to green space in the Tamale Metropolis.

Figure 7: The biggest threat to green space in Tamale Metropolis



(Field survey, 2023)

The data on the biggest threat to green space in the Tamale Metropolis shows that illegal logging is perceived to be the most significant threat, with 39.53% of respondents indicating this as the primary threat. Encroachment by developers was also a major concern, with 31.82% of respondents indicating this as a threat. Overuse by the public was the least concern, with only 28.68% of respondents indicating this as a threat.

The high percentage of respondents who indicated illegal logging as a significant threat to green space in the Tamale Metropolis is consistent with findings from other studies. A study by Acheampong and Boakye (2017) in Ghana found that illegal logging was one of the main threats to forest reserves in the country. The study noted that illegal logging was driven by high demand for timber and other forest products, firewood and charcoal burning, inadequate enforcement of regulations, and weak governance.

Encroachment by developers is also a significant threat to green space, with many developers seeking to convert green spaces into commercial or residential properties. This is a common phenomenon in many urban areas, with developers taking advantage of the high demand for land and the limited availability of space. The impact of encroachment on green spaces can be severe, as it can result in the loss of important habitats, reduced air quality, and increased surface temperatures (Liu et al., 2018).

Overuse by the public was the least concern, with only 28.68% of respondents indicating this as a threat. However, it is important to note that overuse can have a significant impact on the quality and sustainability of green spaces. Overuse can lead to soil compaction, erosion, and damage to vegetation, which can reduce the effectiveness of green spaces in mitigating climate change and providing other benefits (Cao et al.,



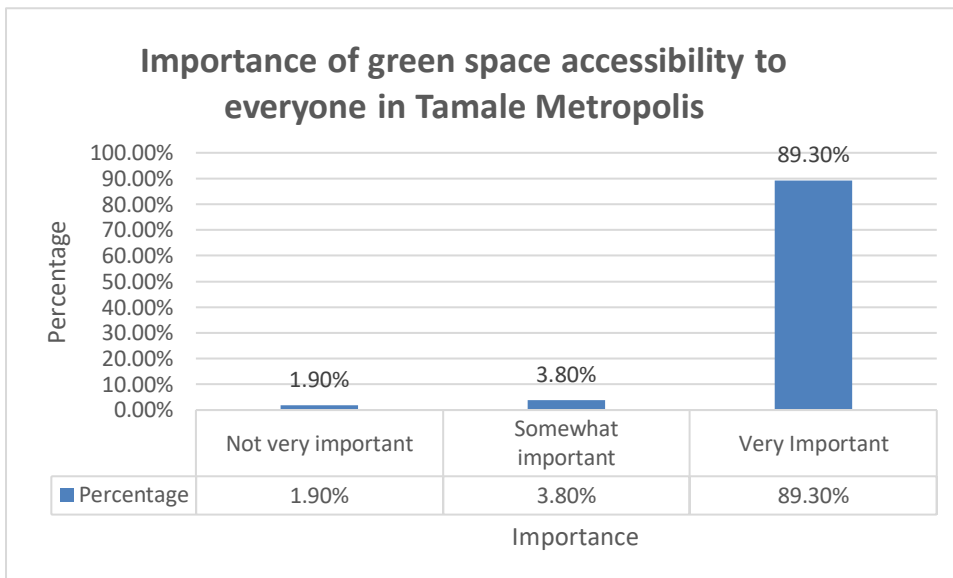
2021).

**Ways in which green space infrastructure plans can effectively be implemented in Tamale metropolis**

Implementing green space infrastructure plans is crucial for enhancing the quality of urban environments and promoting sustainable development. Green spaces, such as parks, gardens, and natural areas, provide numerous benefits to urban residents, including improved air quality, enhanced mental and physical well-being, and opportunities for recreation and social interaction. However, effective implementation of green space infrastructure plans requires careful consideration of various factors to ensure their success and long-term viability.

In the context of the Tamale Metropolis, this section of the chapter presents data on how green space infrastructure plans can effectively be implemented in the Tamale Metropolis. In doing so, data on the Importance of green space accessibility to everyone in Tamale Metropolis is presented in the table below

Figure 8: Importance of green space accessibility to everyone in Tamale Metropolis



(Field survey, 2023)

The data shows that an overwhelming majority of respondents (89.3%) perceive green space accessibility to be very important in Tamale Metropolis. This suggests that there is a high demand for green spaces among the residents of the city and that green spaces are considered an essential part of the urban environment.

The importance of green space accessibility to everyone in Tamale Metropolis can be explained by several factors. Firstly, green spaces provide numerous environmental benefits, such as carbon sequestration, air purification, and temperature regulation, which are particularly important in urban areas where these benefits are often limited. Secondly, green spaces provide opportunities for recreation, relaxation, and social interaction, which can improve the physical and mental well-being of urban residents. Finally, green spaces can contribute to urban biodiversity, providing habitats for a range of plant and animal species, and supporting ecological processes such as pollination.

Several studies have highlighted the importance of green spaces in urban areas, particularly in the context of climate change and urbanization. For example, a study by (Li et al.,2020) found that urban green spaces can help mitigate the urban heat island effect, reduce air pollution, and enhance urban biodiversity. Similarly, a study by (Shan et al, 2021) found that urban green spaces can improve the mental health and well-being of

urban residents.

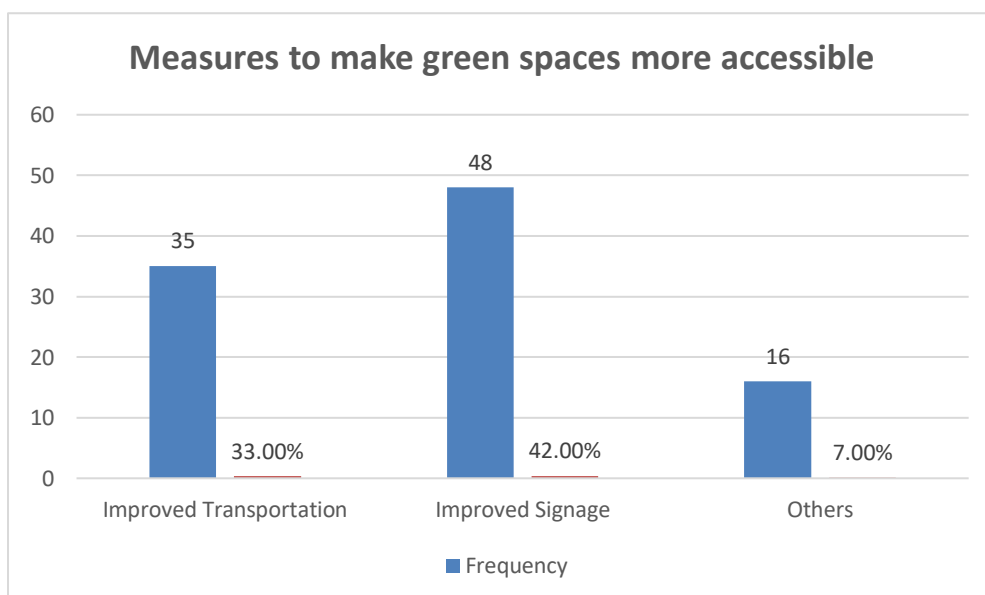
However, despite the perceived importance of green space accessibility in Tamale Metropolis, the city faces several challenges in providing and maintaining green spaces. As discussed in the previous section, limited funding, lack of space, and lack of political will are among the primary reasons for the limited availability of green spaces in the city. In addition, the threat of encroachment by developers and illegal logging poses a significant challenge to the preservation of existing green spaces.

Therefore, city planners and policymakers need to recognize the importance of green space accessibility and take proactive steps to address the challenges facing the provision and maintenance of green spaces in the Tamale Metropolis. This may involve adopting innovative approaches to green space management, such as community involvement in green space planning and management, public-private partnerships, and the use of new technologies to monitor and maintain green spaces. It may also involve addressing the underlying factors that contribute to the limited availability of green spaces, such as funding constraints and political will, and promoting the value of green spaces as essential components of a healthy and sustainable urban environment.

#### 4.7 Recommended ways that could be implemented to make green spaces in the Tamale Metropolis more accessible to everyone.

Ensuring equitable access to green spaces is a crucial aspect of urban planning and development. Green spaces, such as parks, gardens, and recreational areas, play a significant role in enhancing the quality of life for urban residents, promoting physical and mental well-being, and fostering community cohesion. However, it is essential to address barriers and implement strategies that make green spaces in the Tamale Metropolis more accessible to everyone, regardless of their socioeconomic status, age, or physical abilities. In this section, data on recommended ways to make green spaces in the Tamale Metropolis more accessible to everyone is presented.

Figure 9: Measures to make green spaces more accessible



(Field survey, 2023)

The data on the measures recommended to make green spaces more accessible to everyone in Tamale Metropolis reveals that the majority of respondents identified improved transportation as the most important measure. 56.25% of respondents identified it as a priority, followed closely by improved signage, which was

identified by 54.46% of respondents. Additionally, 44.64% of respondents identified both improved transportation and improved signage as priority measures. The data also reveals that only a small percentage of respondents identified other measures, indicating that improved transportation and signage are seen as the most effective measures.

Improved transportation is a critical factor in making green spaces more accessible to everyone in Tamale Metropolis. This could be achieved by improving the public transportation system, providing more frequent and reliable services that cover a wider area, and making the system more affordable for everyone. Improving transportation links to green spaces could encourage more people to use them, particularly those who may not have a car or other means of transport.

Improved signage is also an important measure as it can help direct people to green spaces and make them more visible. Signage can also help people to navigate and explore green spaces, making them more enjoyable and accessible. Clear and informative signage could be used to highlight the location and features of green spaces, as well as provide information on any activities or events taking place within them.

Other measures that could be considered to make green spaces more accessible include providing more seating areas, lighting, and public amenities such as toilets and water fountains. These measures can help to make green spaces more comfortable and welcoming, particularly for older people, families with young children, and those with disabilities.

## CONCLUSIONS

In conclusion, the findings presented in this summary shed light on the challenges and potential solutions regarding the depletion of green spaces, the perception of green space availability, and the accessibility of green spaces in the Tamale Metropolis. The data highlight the pressing need to address these issues to create a sustainable, liveable, and equitable urban environment.

The factors that contribute to the depletion of green spaces in the Tamale Metropolis, as identified by the survey respondents, primarily include rapid urbanization, industrialization, and agricultural expansion. These factors underscore the importance of implementing effective urban planning strategies that balance economic development with environmental conservation and the preservation of green spaces.

The perception of residents regarding the availability of green spaces indicates that there is significant concern and room for improvement. A majority of respondents rated the availability of green space as poor, highlighting the need for increased efforts to enhance the quantity and quality of green spaces in the city. This emphasizes the importance of investing in green infrastructure, engaging local communities, and implementing policies that prioritize the conservation and management of green spaces.

The data on the factors contributing to green space depletion in the Tamale Metropolis highlight the urgent need for sustainable urban planning and development. Rapid urbanization emerges as the primary driver of green space depletion, followed by agricultural expansion and industrialization.

## RECOMMENDATIONS

Based on the findings regarding the availability and accessibility of green spaces in the Tamale Metropolis, here are five recommendations to address the challenges and improve the state of green spaces:

1. The government should enhance green space infrastructure: Increase the development and expansion of green spaces, such as parks, gardens, and urban forests, within the Tamale Metropolis. This can be achieved through strategic urban planning that prioritizes the allocation of land for green spaces and

- the integration of green infrastructure into urban design.
2. The Ministry of Road and High Way should improve transportation access: Enhance transportation options to make green spaces more accessible to all residents. This can involve improving public transportation services, increasing the frequency and coverage of routes that connect to green spaces, and ensuring affordability for all socioeconomic groups.
  3. Enhance signage and wayfinding: Improve signage and wayfinding systems to help residents and visitors navigate and locate green spaces more easily. Clear and informative signage can provide directions, highlight points of interest, and increase awareness of the presence and accessibility of green spaces within the city.
  4. The town and country planners should engage local communities: Involve local communities in the conservation, management, and maintenance of green spaces. Encourage community participation through initiatives such as community gardens, volunteer programs, and educational activities that promote a sense of ownership, stewardship, and appreciation for green spaces.
  5. Urban planners prioritize sustainable urban planning: Integrate sustainability principles into urban planning and development processes. This includes implementing policies and regulations that prioritize the preservation and conservation of green spaces, encouraging sustainable building practices, and promoting green infrastructure and nature-based solutions in urban design.

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