

UNIVERSITY OF CAPE COAST

EFFECTS OF URBAN EXPANSION ON ENVIRONMENTAL
SUSTAINABILITY: ANALYSIS OF LAND USE/COVER CHANGES IN
KASOA

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URBAN EXPANSION AND ENVIRONMENTAL SUSTAINABILITY:
ANALYSIS OF LAND USE/COVER CHANGES IN KASOA, GHANA

BY

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Regional Planning

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original, research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature..... Date.....

Name:

Supervisor's Declaration

I hereby declare that the preparation and presentation of this thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Supervisor's Signature Date

Name:

ABSTRACT

The Environmental costs of rapid urbanization in African urban cities have gained great attention. Due to this, stakeholders and policymakers have placed much emphasis on the need to protect the environment. This study sought to assess the urban expansion of Kasoa and its effects on environmental sustainability. Using a mixed method approach and explanatory sequential design, the study used satellite data from 1985 to 2021. This was supplemented with qualitative data obtained from in-depth interviews conducted for key informants and focus group discussions for unit committee members. The findings showed that Kasoa has experienced high urbanization resulting in significant changes in the land use/land cover making the area vulnerable to high temperature and poor environmental stress. The study shows a tremendous change in all land use/ land cover classes studied and also a change in the average temperature. Though there are community-based initiatives to manage the pressures emanating from urbanization, however, implementation of these initiatives by land management institutions are often challenged by cultural and institutional bottlenecks. It is therefore recommended that traditional authorities of Kasoa in collaboration with various land management institutions should take steps to effectively coordinate, develop and implement appropriate by-laws and policies to strictly protect natural environment due to the rapid growing population and the accelerated rate of urbanization in Ghana.

KEYWORDS

Environmental sustainability

Ghana

Kasoa

Land use/ land use

Urbanization

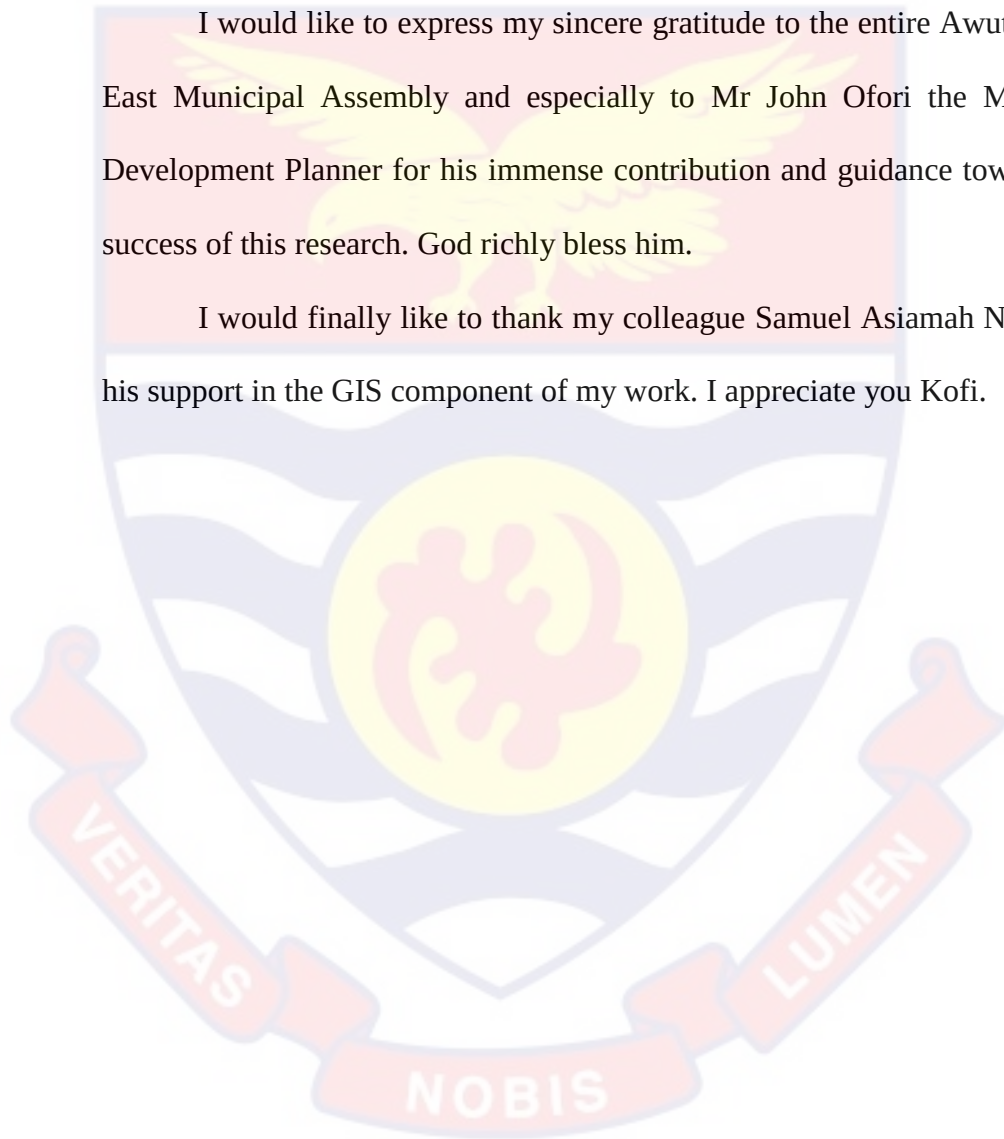


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DEDICATION

To my mother Phyllis Ekua Mensah.



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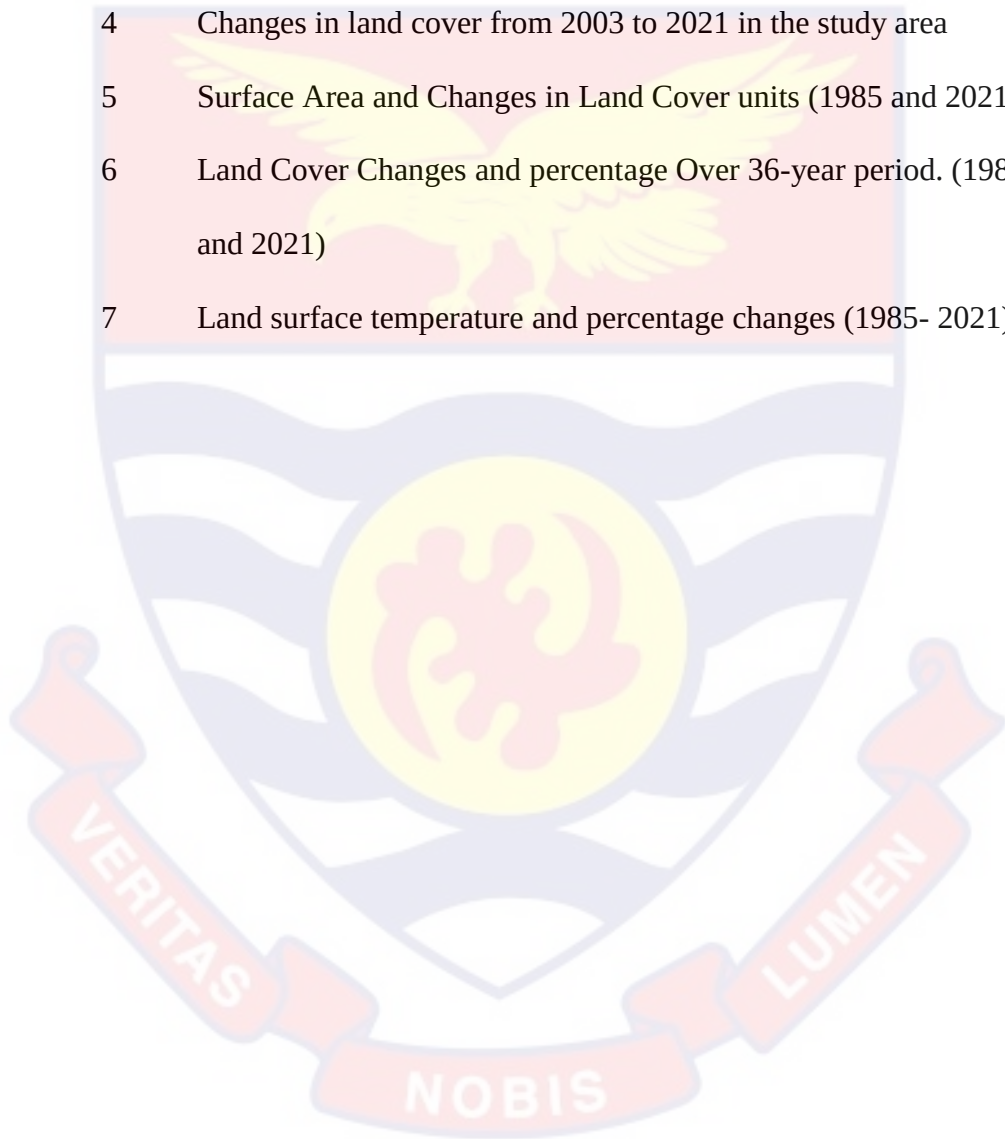
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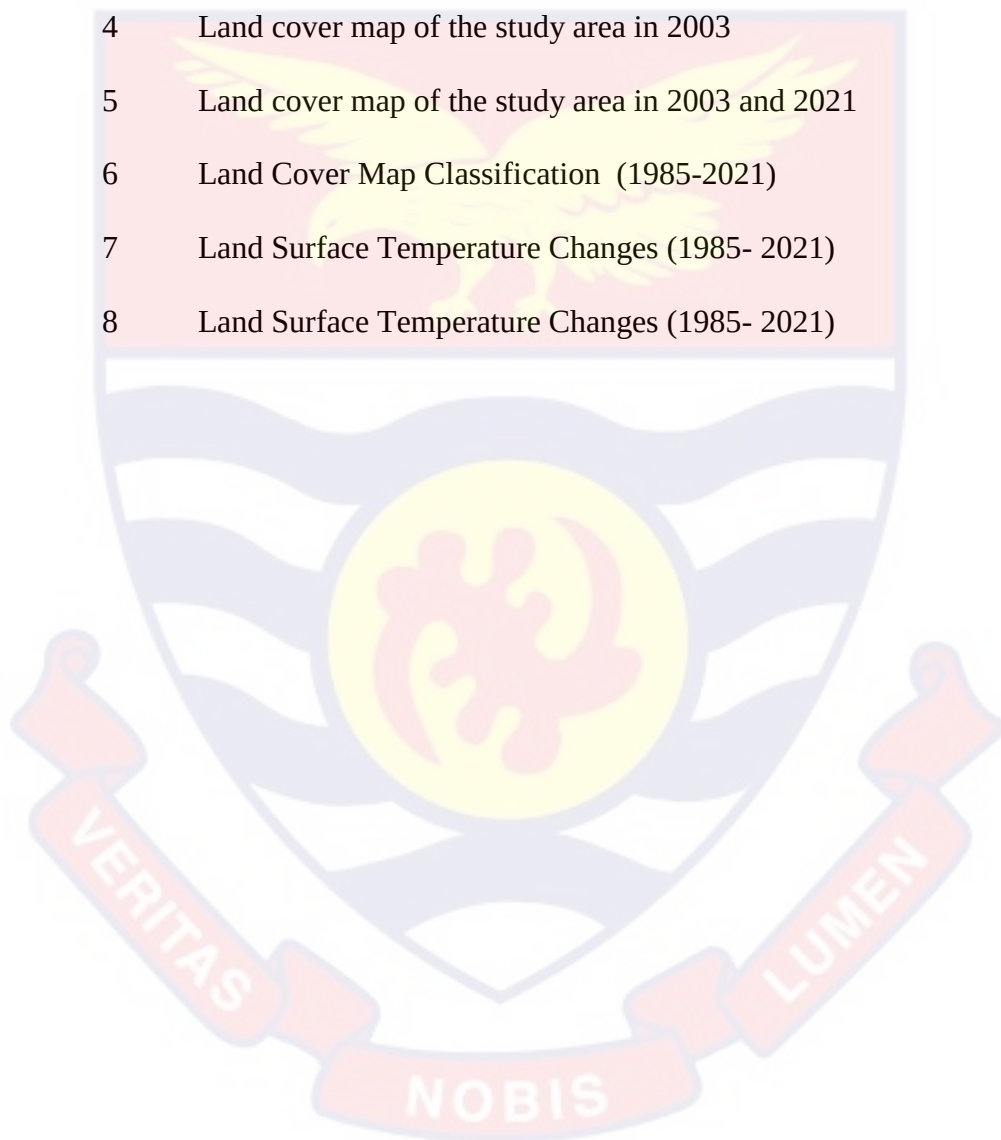
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LIST OF ACRONYMS



ASEMA	-	Awutu Senya East Municipal Assembly
DPSIR	-	Driving Forces, Pressure, State, Impact, and Response
EPA	-	Environmental Protection Agency
FAO	-	Food and Agriculture Organization
FGD	-	Focus Group Discussion
GSS	-	Ghana Statistical Service
LCLU	-	Land Change Land Cover
LCLUC	-	Land Cover Land Use Change
LGAF	-	Land Governance Assessment Framework
LUSPA	-	Land Use and Special Planning Authority
MDGs	-	Millennium Development Goals
MMDAs	-	Metropolitan, Municipal and District Assemblies
NGOs	-	Non-Governmental organisation
OECD	-	Organisation for Economic Co-operation and Development
SDG	-	Sustainable Development Goal
UHIs	-	Urban Heat Islands
UN	-	United Nation
UNCED	-	United Nations Conference on Environment and Development
UNDESSA	-	United Nations Department of Economic and Social Affairs
UTM	-	Universal Transverse Mercator
WCED	-	World Commission on Environment and Development

CHAPTER ONE

INTRODUCTION

Background of the Study

Urban population is projected to reach 68% of the world population of about 9.8 billion by 2050, an increase from 54% in 2016. Few countries are expected to have more rural shares higher than that of urban shares. These include some countries in the sub-Saharan Africa, Asia, and Latin America (UN, 2018). However, more than half of the population has increased expected to happen in 2050 is expected to occur in Africa, with a large proportion of world population growth expected to take place in urban centers town. In 2014, the population living in urban cities in Africa was estimated at 40%, this proportion is expected to increase to around 60% by 2050 (UN, 2018).

In contrast, most of the world's population now lives in urban areas until the beginning of the nineteenth century. Among developing countries, Africa have the highest rates of urban growth with an urban growth of about 5%, double of Asia, with Latin America anticipated to remain around 3.5% per year. The evidence then shows that Africa has and is still experiencing a rapid level of urbanisation. These Phenomena can in part, be attributed to the overall levels of rapid population growth across the continent, and the increasing concentration of population in major cities or rural-urban migration (UN-DESA-PD, 2012).

The expectation of the world population increase shows that urban growth will continue at a high rate, particular in megacities of developing countries (United Nations, 2018). This has brought much attention to how urban expansion can be achieved sustainably. The discussion of the

environmental costs of rapid urban expansion in the megacities of developing countries is gaining traction among scholars and policymakers in order to ensure environmental sustainability in the megacities of developing countries, as it is a crucial element in achieving the Sustainable Development Goals (Arku & Marais, 2021; P. Zhao, 2010). The problem of urban expansion and the environmental effect is on only on the quality of life of the megacities but also because environmental problem affecting these developing megacities turn to affect the rest of the world.

Urbanisation is a symbol of national development and civilisation Wang Mcgranahan & Satterthwaite (2014), defined urbanisation as a broad-based rural to urban transition involving population, land use, economic activity and culture. Urbanisation is widely used to describe the changes in land-use for certain areas, typically the peripheral of urban concentrations. Once land is 'urbanised' it is either sold to a private individual or seized by the government, and developed for urban use. Urbanisation as a convectional phrase requires the transformation of a society whose economy, culture, and way of life are mostly rural into one that is primarily urban.

Generally speaking, it is the percentage of a country's population that resides in what are considered to be urban regions according to official national census data (United Nations, 2018). The statistics on urbanization in the world has been rapid and it continues to do so. The issue of urbanisation becomes a major concern in the year 2008 as the human race transitioned from being mostly a rural species to an urban one (Firdaus & Ahmad, 2011).

Globally, the rates of population growth, urbanization, and urban population growth have all been growing, but at a relatively slow rate for

decades. However, the annual growth in the number of individuals choosing to make their homes in urban regions has reached its pinnacle and is responsible for almost the entirety of the global population increase. The majority of required urban population growth will be centred in less developed regions' cities and towns. This includes Asia, which is predicted to see its urban community rise by 1.4 billion, Latin America and Africa by 0.2 billion and 0.9 billion respectively. Therefore, population expansion is becoming mostly an urban phenomena in the developing countries (Satterthwaite, 2007).

According to Saghir and Santoro (2018), Sub-Saharan Africa is widely considered as the world's fastest urbanizing region. Urban regions currently have 472 million inhabitants and will quadruple in the next 25 years. It is anticipated that by the year 2050, the proportion of Africans who live in urban areas would have increased from 11.3 percent in the year 2010 to 20.2 percent. The cities located in Sub-Saharan Africa collectively produce a gross domestic product (GDP) of \$0.5 trillion, which accounts for 50% of the region's GDP. Cities hold significant importance in combating poverty and maintaining economic progress and are frequently regarded as the key to future prosperity in developing nations. The realisation of strategic urbanisation is contingent upon the formulation of national macroeconomic policies, yet the involvement of city governments, the private sector, development practitioners, and urban planners is also indispensable in facilitating progress.

Similar to many nations in sub-Saharan Africa, Ghana has undergone a recent shift from a primarily agrarian society to an urbanised one, with a significant portion of its populace residing in cities in search of improved economic opportunities. The urbanisation of Ghana is attributed to three

factors, which align with observed patterns in Africa. The phenomenon of natural increase, rural-urban migration, and urban reclassification are significant factors in the study of urbanisation. The interrelatedness of these factors, as posited by Cobbinah et al. (2015), implies that they cannot be considered in distinct ways. A vital factor is the migration from rural to urban areas. According to (Cobbinah & Darkwah, 2017), rural-to-urban migration was the primary factor responsible for 98% of Ghana's urbanisation. A number of causes, including landlessness, rural poverty, and economic dislocations, have contributed to the recent rise in rural-urban migration in Ghana. The current trend, which has been seen in recent years, demonstrates that migrants have generally relocated from resource-poor to resource-rich areas in quest of decent living conditions, with rising concentration and densities in the capital cities, particularly Accra and Kumasi (Songsore, 2009).

The phenomenon of urbanisation, when accompanied by inadequate infrastructural planning, often results in urban sprawl. This, in turn, may lead to the transformation of vegetation into agricultural land and urban areas (Dasno-Wiredu & Sanda, 2021). The transition sequence from natural vegetation to agriculture to low density-built environment to high density, as observed in land cover and land-use change (LCLUC), has the potential to contribute to urban sprawl in major urban centres, as noted by Näschen et al. (2019). The imperative to enhance agricultural productivity in light of persistent population expansion necessitates the modernization of conventional subsistence agriculture to augment production output, wherever feasible. The outcome of this phenomenon is a reduction in the demand for rural labour, as the attainment of higher yields necessitates the use of

mechanised means rather than human labour. Human migration is a significant factor in the process of Land Cover Land Use Change, particularly in urban areas.

Numerous research works have been conducted to observe the progression and configuration of urbanisation in Ghana. According to Owusu & Yankson (2017) findings, the process of urbanisation is occurring predominantly in the peripheral regions of major cities, rather than in the conventional urban core zones. The study conducted by Stow et al. (2016) examined the correlation between population growth and land cover and land use change (LCLU) in the southern region of Ghana. The analysis was conducted at the level of census districts and covered the time period between 2000 and 2010. The study revealed a robust association between the overall population and the quantity of constructed land cover and land use (LCLU) at the onset and conclusion of the research duration. However, alterations in population and built LCLU exhibit a comparatively weaker correlation. Furthermore, it was discovered that the expansion of built land use in the peri-urban regions of Accra and Kumasi, the two principal cities in Ghana, occurred at a more rapid pace than the growth of the population.

Doan and Oduro (2011), discovered that expansion in Accra has happened in concentric circles surrounding the city centre. Around the port city of Tema and older villages, as well as along the major highways, the urban perimeter has expanded. Oduro et al.,(2014), demonstrated that between 1970 and 2010, the form and expansion of the Greater Kumasi Metropolitan Area followed a clear pattern that could be explained by the monocentric

(central business district surrounded by residential sections) city model and a ribbon development pattern of spatial growth.

Statement

Kasoa, formerly known as Odupongkpehe, is a peri-urban locality in the Awutu Senya East Municipal District of the Central Region of Ghana.

According to the 2010 Population and Housing Census, the town had a population of approximately 370,384, a significant increase from 34,719 in 2000. By 2014, Kasoa was recognized as one of the fastest-growing communities in West Africa (Awutu Senya East Municipal Assembly, 2019). Data from the 2010 census indicate that the region's population has increased more than 79-fold since 1970 (Ghana Statistical Service, 2013). This rapid growth has led to swift urbanization, driven primarily by the expanding population of the Accra-Tema metropolitan area.

Similar to many towns near major cities, Kasoa has experienced substantial population growth and urbanization due to its proximity to diverse infrastructural amenities and the capital city of Accra. Acheampong et al. (2022) found that areas like Kasoa have undergone significant expansion, becoming integral parts of the Accra metropolis. The challenges associated with overcrowded urban centres often force residents to seek nearby settlements, resulting in urban sprawl, as seen in Kasoa (Yankson & Bertrand, 2012).

The haphazard and unplanned development of the region has had noticeable consequences for the municipality of Kasoa (Yeboah, 2000). Uncontrolled housing, commercial development, and roadway expansion across vast areas, with little regard for urban planning, have led to land use and land cover

(LULC) transformations that largely ignore sustainability (Yiran, 2020). This population surge not only challenges the provision of jobs, housing, and infrastructure but also places increased demands on urban land, making sustainability a critical concern. Addressing sustainability, particularly through initiatives like Sustainable Development Goal 11, has become essential both globally and locally.

Despite the focus on socio-economic issues such as livelihood, congestion, urban sprawl, health, and infrastructural development, little attention has been given to the environmental sustainability impacts of urban expansion (Abass et al., 2018; Adjei-Mensah et al., 2019). This has resulted in a knowledge gap regarding the ecological consequences of urban growth, including effects on natural vegetation, surface temperatures, and land use governance. This study aims to bridge these gaps by assessing the land expansion of Kasoa and its impact on environmental sustainability, focusing on land use change, vegetation, and surface temperature as key indicators.

Research Questions

- a) What are the dynamics of urban expansion of Kasoa?
- b) How has the expansion of Kasoa affected surface temperature of the area?
- c) What is the nature of land use governance of Kasoa?

Main objective

The main objective of this study is to assess the urban expansion of Kasoa and its effects on environmental sustainability.

Specific objectives

- a) Analyse the extent of urban expansion in Kasoa from 1986 to 2019.

- b) Examine the surface temperature of the area of Kasoa.
- c) Assess the land use governance of Kasoa.

Significance of the Study

The Sustainable Development Goals represent a call to action, urging a shift in the policy agenda of numerous countries. Environmental sustainability is a crucial component of this policy, which necessitates comprehensive measures to enable urban areas to attain SDG11, aimed at realising sustainable objectives. The objective of this research is to address the existing gaps in knowledge by incorporating discussions on urban expansion and environmental sustainability into policy discourse. The information will be useful to the Land Use and Spatial planning authority at the assembly level and other developmental organisations (stakeholders) in terms of policy formulation and intervention on urban expansion.

This research will also provide information to the Awutu Senya East Assembly on the LULC change from 1986 to 2019 in the Metropolis to help in urban development, planning and structure. The findings of this investigation contribute to the current body of knowledge regarding urban green spaces planning and management in urban areas and may stimulate additional research in this field.

This research will also serve as a foundation for a new policy proposal on urban expansion and its implications for environmental sustainability. In light of this revelation, more studies are required, to maximize environmental sustainability and its relation to urban expansion for effective policy interventions and implementation aimed at addressing the environmental sustainability question, as it becomes imperative-the gap that this research

attempts to fill. Furthermore, the results of the research would serve as a baseline for further studies and an inspiration for other researcher in countries with similar characteristics to emulate and implement.

Organisations of the Study

This thesis is composed of five chapters. The first chapter provides an overview of the study's background, the statement of the problem, the purpose of the investigation, research questions, the significance of the study, and the structure of the study. Chapter two is devoted to the study's literature review, while chapter three describes the research methodologies, study area, and study area map. The results are presented in chapter four, while the summary, recommendations, and conclusion are presented in chapter five. Pages have also been given to the presentation of references and the Appendices at the conclusion of the thesis. At the same time, the Dedication, Content, Acknowledgement, and the Preface will occupy the front pages.

CHAPTER TWO

REVIEW OF RELEVANT LITERATURE

Introduction

This chapter critically analyses the literature pertinent to the research under investigation. The topics examined encompass urban development and expansion, land cover alterations within urban regions, ramifications of vegetation loss, temperature fluctuations, and the regulatory frameworks and governing bodies managing land use. The chapter also discusses the conceptual framework utilized in the current investigation.

The Concept of Urban Growth and Urban Expansion

From the early 1950s, the global urban population began growing at an unprecedented rate (UN-Habitat, 2020). Currently, urban areas are home to approximately 55% of the global population, a figure projected to reach 70% by 2050 (UN-DESA, 2018; UN-Habitat, 2020). This substantial migration from rural to urban areas has led to the swift expansion and growth of urban regions. The terms "urban growth" and "urban extension" are occasionally used interchangeably, despite their distinct conceptual differences. Urban growth and decline are inevitably linked to the process of urbanization.

Urban growth has been defined from various scholarly perspectives. According to Skelton (2007), urban growth pertains to the rise in the number of individuals residing in urban areas, either in relative or absolute terms. Alternatively, Viana et al. (2019) view urban growth as the expansion of urbanized land cover and propose urban extension as a potential mechanism for urban growth. The rate at which urban areas expand depends on the inherent growth of the urban populace, the influx of people from rural areas

through net rural-urban migration, and the reclassification of rural settlements into urban centers. Urban growth develops according to the demands of dwelling, industry, and business sectors (Karakayaci, 2016), indicating the trend of urban sprawl. This entails encroachment upon city peripheries and consequent human intrusion into agricultural and forested areas. Urban sprawl is characterized by uncontrolled and unplanned expansion of urban areas, often resulting from unregulated urban growth (Sudhira & Ramachandra, 2007; Zhang, 2004).

Urban expansion varies from region to region (Addae & Oppelt, 2019). Luck and Wu (2002) found that urban expansion as a spatiotemporal arrangement encompasses various urban growth patterns of differing sizes and shapes. Urban expansion contributes to landscape degradation, primarily due to patch fragmentation and ecological alterations (Dewan et al., 2012; Herold et al., 2002). A joint initiative by the Marron Institute of Urban Management and UN-Habitat in 2015 found that urban expansion on the periphery tends to be inadequately planned compared to established areas. Additionally, cities are experiencing a decline in walkability and transit accessibility.

The features of urban expansion are highly specific to the locality. Nevertheless, the extent of expansion can be managed by key factors such as economic, social, demographic, planning and policy, and natural rewards (Zhang & Su, 2016). Policymakers must comprehend these fundamental factors and opt for equilibrium. Urban planners promote concentrated development and sustainable management of urban expansion (Ahani & Dadashpoor, 2021).

Urbanization is caused by both natural and human factors (Lambin et al., 2001). Spatial heterogeneity is influenced by natural factors such as topography and soil characteristics, and anthropogenic factors such as population and economic growth, and the development of urban traffic. These variables can bring significant shifts in landscape configuration, resulting in diverse forms of urban development and expansion (Wilson et al., 2003). Several determinants of urban expansion have been identified, including topology, precipitation, and demographics, which are classified into biophysical and socioeconomic categories. However, studies overwhelmingly emphasize the socioeconomic determinants of urban expansion (Zhang & Su, 2016).

The European Environmental Agency (2006) defines urban expansion as a physical manifestation of low-density urban development primarily occurring in agricultural regions globally, subject to specific conditions. Deng et al. (2022) describe urban expansion as an uncoordinated mode of urban growth and development occurring on the city periphery. According to Salvati and Zitti (2017), urban expansion is a fundamental urban mechanism associated with both urban growth and economic development. Urban growth is found to be a precursor to urban expansion, where the former pertains to the increase in the number of individuals residing in an urban setting, leading to a corresponding escalation in developed land or habitation. Therefore, the notion of urban expansion frequently co-occurs with urban growth.

The Concept of Environmental Sustainability

The concept of sustainability has gained significant acceptance in policy-oriented research as a means of expressing the desired outcomes of public

policies. The widely accepted definition of sustainability is put forth by the UN World Commission on Environment and Development, which refers to the capacity to fulfil current requirements while ensuring that future generations can satisfy their own needs. Sustainability's definition is broad, encompassing a wide range of issues. For sustainability to be relevant and useful, countries need to adapt it to their local context. Sustainability has three dimensions—economic, social, and environmental—as outlined in the Brundtland report, although some academic works consider additional pillars such as institutional (Spangenberg et al., 2002; Turcu, 2012), cultural (Soini & Birkeland, 2014), and technological (Hill & Bowen, 1997) factors.

Goodland (1995) discusses the three dimensions of sustainability, explaining environmental sustainability as aiming to improve human lives by preventing the depletion of essential natural resources and overloading wastewater treatment facilities. Goodland's conceptualization of environmental sustainability aligns with the notion of resource constraints and involves limitations on the utilization of renewable and non-renewable resources, as well as the absorption of pollution and waste. Shayan et al. (2022) highlight the importance of implementing environmental sustainability practices to ensure that current needs are met without jeopardizing future generations' capacity to satisfy their own needs.

A balanced socioeconomic system, fundamental to human existence, is a critical issue in environmental sustainability. The basis of a responsible socioeconomic system is centred on ensuring the availability of unpolluted air, uncontaminated water, and fertile land for productive use (Morelli & Lockwood, 2011). The absence of a sustainable environment that provides a

reliable resource base for life on earth, including a sustainable flow of material, energy, and environmental resources, can lead to the failure of economic systems. Anthropogenic activities are the primary drivers of deteriorating environmental conditions (Arora et al., 2018). Human interference with the natural environment has resulted in climate change, increased pollution of air, water, and soil, land degradation, and the dominance of greenhouse gases (GHGs) in the environment.

Recognizing the threat to the environment has led to various interventions among world leaders. The United Nations (1987) discussed the cost of environmentally unsustainable development in the 'Our Common Future report,' also known as the Brundtland report, emphasizing that development is only sustainable if it meets present needs without compromising future generations' ability to meet their own needs. Among the many initiatives to ensure the planet's viability for future generations is the World Commission on Environment Development's (WCED) worldwide agenda.

The UN Conference on the Environment in Stockholm (1972) and the UN Conference on Environment and Development (UNCED) in Rio (1992) warned of the dire consequences of continuing humanity's destructive practices in the name of progress. The United Nations' Agenda 21 was also mentioned as a way to encourage sustainable development with the environment in mind. The "global partnership" was founded on these and other goals and agreements to promote international collaboration for environmental protection and global economic growth to ensure the continuation of life on Earth. This agenda has seen various revisions, with the

most recent being the 2015 Summit on Sustainable Development that birthed Agenda 2030 and its seventeen (17) sustainable development goals.

Factors Influencing Environmental Sustainability

Environmental sustainability issues are some of the major issues of interest to many governments and researchers around the globe. This has led to the designs of many sustainable models that look at how world developments and evolutions affect the environment. Prior to the formulation of the SDGs, the Millennium Development Goals (MDGs) were in place, with Goal 7 focusing on ensuring environmental sustainability through the incorporation of sustainable development principles into national policies and programmes and the restoration of depleted natural resources (United Nations, 2015).

This birthed the SDGs which was launched in 2015, with one of its fundamental pillars as environmental sustainability. As a pillar, environmental sustainability aims to achieve significant progress in areas such as creation of peace and security, innovation, climate change, elimination of poverty, and sustainable consumption. Problems like climate change, water scarcity, pollution, and rapid depletion of natural resources all have their roots in a lack of environmental sustainability as a concept. One definition of environmental sustainability is the ability to uncover and increase the worth of the environment and aspects associated to the environment, while also ensuring the long-term viability of a region's natural resources and environmental legacy (Munasinghe, 2003).

Since urban population expansion around the world has reached such massive proportions, there is a direct relationship between urbanisation and

environmental sustainability. In 1960, the city of Johannesburg in Africa was home to one million people, and London was the first metropolis in the world to achieve so since ancient Rome. An estimated 662 cities will have populations of 1 million or more by the year 2030, up from the more than 512 that existed in 2016 (United Nations, 2018). The rise in urban population and population density necessitates the construction of new buildings, transportation systems, utility infrastructure, and distribution systems to accommodate urban development.

Existing empirical research has focused on examining the relationship between population and the environment, with particular emphasis on the influence of demographic variables, including population expansion, urbanisation, rural-to-urban migration, and shifts in age and gender demographics, on environmental outcomes. Several noteworthy studies have examined the relationship between population and the environment. Research conducted over time has demonstrated that the relationship between population and the environment is reciprocal (Biney & Boakye, 2021). One of the primary concerns is the influence of demographic variables on the environment, leading to the depletion of natural resources and a surge in pollution levels. The second aspect pertains to the influence of environmental factors on the populace, specifically the adverse effects of pollution on both health and labour productivity (Ghanem, 2018).

King (2022), conducted research that concluded no human activity had a more far-reaching impact on the environment. Both the rate of production and the demand for energy are increasing in tandem with the rate of urbanisation that is taking place around the world. About two-thirds of

worldwide energy usage and over 75% of energy-related GHG emissions contribute to growing temperatures and shifting climate change (UNEP, 2018), all of which are primarily attributable to the growth of urban areas, the global population, and the global building stock. A study by Yıldız et al. (2018), pointed out factors that affect environmental sustainability are how cities are made, how many people live in them, and how quickly they grow. Their findings suggest that using energy from alternate sources can dramatically reduce harm to human health and the bad impact on the environment.

Africa is the least continent to contribute to the process of global warming in the world. Globally, building construction and the act of converting agricultural lands to built-up are responsible for 39% of all carbon emissions in Africa (World Green Building Council, 2020). Furthermore, the commercial and residential building industry in the United States accounts for 38% of annual CO₂ emissions. As a result, sustainability in general, and energy efficiency in particular, have emerged as the primary indicators of building performance (Motawa & Carter, 2013). In order to lessen people's reliance on primary sources of power, numerous strategies for economising energy and improving architectural design have been created over the course of several decades. In addition to water and energy, the land itself is an important natural resource, and the alarming rate at which it is being converted from its natural state into agricultural land is a major concern. The use of land as a resource is competitive to local, regional, and international levels since it is a limited resource.

As cities grow and expand, one of the main features that changes is the land, either on or below the surface. It is now normal to utilize existing agricultural or forestland for the building of additional housing areas as cities grow. Large areas of soil being sealed off and paved over alter the natural drainage patterns and may result in issues like land erosion. Regional shifts in land use from forestry and agricultural to built-up or landfill regions may contaminate freshwater supplies as well as the soil (Langemeyer et al., 2021). There will be undoubtedly more competition between various land uses as the world's population rises. The land is required for various objectives including food production and biodiversity preservation in addition to being needed for newly constructed areas to accommodate the expanding urban population.

Factors Influencing Urban Expansion

Rapid, unplanned urban development, fuelled by rapid economic growth, has occurred in a variety of forms in cities throughout the world. This phenomenon has been condemned as a primary source of massive green lands loss, social inequality, and environmental damage in many cities (Hammar et al., 2013). Recent decades have seen a tremendous acceleration of urbanization, with city populations frequently doubling in size every decade. According to the UN Department of Economics and Social Welfare (2014), it is projected that urbanisation may result in the addition of approximately 2.5 billion urban inhabitants by the year 2050, with a significant proportion of the increase anticipated to take place in Asia and Africa, accounting for nearly 90% of the total increase. The remarkable surge in urban populace has the potential to present multifarious difficulties, not only in terms of job creation, housing provision, and infrastructure development, but also in relation to

urban land management, spatial parity, and sustainable progress at large (Wei & Ewing, 2018).

However, the driving forces behind these global urbanization trends vary greatly by country's level of development and, in particular, by its social structure (Guangdong Li, & Chuanglin Fang, 2018). The most essential part of urbanization has been determined to be urban expansion as a factor of urban growth. The land is a crucial but finite resource in many large places where the population is becoming more and more crowded. One of the major difficulties around the world is the equitable and sustainable development of land in urban areas to meet the requirements of this expanding urban population (UN Habitat, 2015; Wei et al., 2017).

Africa is recognised as the second most rapidly urbanising region in the world, boasting an average annual urban population growth rate of 4.13% between 2010 and 2020 on a global scale (UN Habitat, 2015). The trend of urbanisation has identified urban expansion as a prominent factor that drives the conversion of agricultural lands in developing nations (Azadi et al., 2011). The expansion of urban areas has resulted in various outcomes for peri-urban regions, including the endangerment of biodiversity due to the loss and fragmentation of habitats, as well as the degradation of soils, decline in water quality, air pollution, inconsistent water supply, traffic congestion, and sanitation issues, among other factors (Ahoobim et al., 2013; Elmqvist et al., 2015; Oertli & Parris, 2019). The agricultural lands situated in urban and peri-urban regions of African cities hold significant importance in catering to the food requirements of the urban populace. Additionally, they serve as a source of income and entrepreneurial opportunities, thereby supporting the urban

population predominantly engaged in informal economic activities. Contrary to the OECD/ FAO (2016) and Smit et al. (2001), smallholder farming constitutes over 60% of the total population in sub-Saharan Africa. Pauleit et al. (2019), assert that the escalating cost of living in various African nations has led to dependence by impoverished individuals on urban and peri-urban agriculture as a means of addressing insufficient and sporadic food accessibility.

Historically, urbanization has been the subject of a number of studies, which have examined the variables that have driven this process (Amoateng et al., 2013; Yiran, 2020). According to Karakayaci (2016), these factors could be categorized under seven main factors thus macroeconomic factors: that is economic growth, globalisation and countries integration. Microeconomics factors: which include rising standard of living, increasing price of land and the availability of agricultural lands. Demographic factors which also include population growth, resulting in increase in households. Which in turn result in housing preferences as another factor thus more space per person according to housing preferences, this result in also other factor thus intercity problems because of poor air quality, environmental stress and many other social problems. Other two factors are transportation, and regulatory frameworks, which results from increase in private car ownership, availability of roads and lastly, lack of effective planning for the use of land and a sloppy approach to enforcing existing plans. Guangdong Li, and Chuanglin Fang, (2018) believes the factors are driving forces by global means and people need to migrate from one region to another. This then fuels population increase, causing an increase in the cost of living triggering all the other factors mentioned. Hence, the

implementation of strategic planning is imperative to steer expected progress and enable judicious and well-informed decision-making in the present, with the objective of fulfilling the requirements of the present generation while safeguarding the interests of future generations (Missimer, 2015).

Dynamics of Urban Expansion

Dynamics of urban expansion: Global perspective

Regardless of occupying a relatively minor portion of the global land surface, urban regions have undergone swift expansion, resulting in substantial alterations to the terrain and the emergence of significant environmental and societal consequences. The preceding impacts hold significant importance, particularly in swiftly evolving regions such as urban agglomerations worldwide, particularly in emerging nations. In recent decades, numerous scholarly investigations have been devoted to the subject of urban expansion. Nevertheless, the consequences of this expeditious growth of urban areas have not been adequately scrutinised, thus posing significant obstacles in this realm of research. The insufficiency of geospatial data sets in developing countries poses a significant challenge, despite the availability of comprehensive land cover information in most developed nations.

Furthermore, the examination of urban expansion is hindered by a widespread deficiency in comprehension and awareness of physical and socioeconomic elements. Many scholars such as Heidarinejad, (2017); Nor et al., (2017); Weng et al., (2021) tried to fill this void in the scientific literature by exploring urban expansion and its effects on various multi factors such as green spaces, wetlands, surface temperature, spatial and socioeconomic patterns among other all around the world. Their findings indicated that cities

around the world are constantly characterized by significant rapid urban expansion, which have several effects. In areas where expansion was dictated, it was accompanied by a rapid increase in surface temperature at an uncontrolled level. Their study results demonstrated a clear pattern of correlation between the increase in temperature and patterns of urban expansions. This, therefore, suggests a true pattern, particularly in areas where vegetation was converted into major road networks or built-up areas, especially in industrial areas. Uneven urban growth was generally detected (Weng et al., 2021).

In many areas around the world where urban expansion has been studied in relation to green space, it has been found that in cities where expansion in terms of increase in built-up was not planned according to policies and sustainable planning, the effect on green spaces is often drastic. This affects human survival and the natural vegetation. However, the literature shows that, in the area where urban expansion is well-planned, and managed by national policies, the recorded rate of harm to the environment is minimal and does not cause many effects to the environment. As a result, urbanization is one of the primary factors that contributes to the transformation and fragmentation of green space (Nor et al., 2017).

In contrast, a study by Heidarinejad (2017), on urban expansion had a significant positive effect in terms of population growth. The findings demonstrated that the growth of urban areas led to a reduction in the population density as well as an increase in employment opportunities, hence making cities a more desirable place to live. The study found that one of the main strategies implemented that triggered this significant effect is a national

policy on expansion taking into consideration the environment now and in the future. These policies give utmost importance to preserving a healthy equilibrium between the growth of urban areas and the safeguarding of natural areas and resources.

Available studies indicates that numerous countries across the globe have encountered significant socioeconomic and environmental difficulties in recent years as a result of the pressures of urbanisation (Cao et al., 2014; Rana & Parves, 2011; Subasinghe, 2017). According to Subasinghe (2017) research, the primary driving force behind recent global migrations is the availability of administrative services and socio-economic prospects, which have contributed significantly to the limited spread of urbanisation in the region. The phenomenon of new migrants relocating to urban centres in search of improved services and subsequently occupying non-urban areas surrounding these centres has become increasingly prevalent among the current generation. Scholarly investigations have suggested a decrease in recent migration towards the core area, with a growing trend of migrants being attracted to the fringe and outside regions, particularly in suburban areas (Bijker & Haartsen, 2012; Subasinghe, 2017). Research has indicated that the prevalence of attraction towards urban areas is primarily driven by the availability of urban amenities and the escalating cost of land in central regions, rather than by urban planning endeavours in suburban locales.

Planned city expansions are the only places where the simultaneous pursuit of global goals for poverty reduction, social cohesion, sustainable economic growth, environmental responsiveness, and climate change adaptation is possible. Global leaders need to prepare rising cities all around

the world including Asia, Africa, and South America for their inevitable expansion at the same time that we retrofit, renovate, or green existing mature cities (Rosenzweig et al., 2018). Growing urban areas can aid in the eradication of poverty and the reduction of inequality through sound governance and productive partnerships. Their task is to serve as catalysts for change for better social justice and environmental sustainability as well as engines of economic prosperity. The choices we make today will determine whether we succeed or fail in the future (Walker et al., 2001).

Dynamics of urban expansion: African perspective

Since 2010, Africa has been experiencing an exceptional urbanisation phenomenon. The annual increase in the urban population of Africa is estimated to be around 21 million. In the year 2015, Kenya's urban population surpassed the total urban population of the entire African continent in the year 1950 (Heinrigs, 2020). As of 2020, approximately 67% of South Africa's total population resided in urban areas, where the pace of urbanisation has been comparatively rapid within the African continent (Kaba, 2020). In comparison to some Countries, especially those in East Africa, approximately 25 percent of Africa's population resides in cities and other urban centres.

The sub-Saharan African region is home to approximately 472 million individuals who reside in urban areas, making it widely recognised as the world's most rapidly expanding region with respect to urbanisation. According to Saghir (2018) findings, North and West Africa are followed by Central Africa, which has experienced significant growth in recent years. Africa's urbanisation has been primarily driven by robust demographic growth since the 1990s. According to the United Nations (2019), the population of the

continent has experienced a growth rate of over 100% since 1990, resulting in a current population of 1.3 billion individuals as of 2020. Furthermore, projections indicate that this figure is expected to double once more by the year 2050. The dynamics of urbanisation are subject to a multitude of factors that exhibit varying impacts contingent upon the national context. These factors include but are not limited to climate and geography, income levels of individuals, public institutions and policies, economic cycles, and conflicts. The complexities involved in comprehensively understanding the urbanisation dynamics of Africa are numerous, as noted by Moriconi-Ebrard et al. (2008). The absence of a standardised definition for urban areas in Africa, in contrast to other regions of the world, coupled with the infrequent updating and unreliability of demographic data, as noted by Heinrigs (2020), poses a challenge to accurate analysis and interpretation of urbanisation trends in the region. International statistical data often exhibits a bias towards larger urban areas, and the challenge of distinguishing between formal and informal settlements within these areas highlights the necessity of adopting a spatial perspective.

In accordance to the Ghana Statistical Service in 2021, the urban population in Ghana accounted for approximately 57.3% of the total population, amounting to approximately 17.8 million individuals. The phenomenon of contemporary urban transformations has been extensively examined by numerous scholars, revealing its widespread reach across the globe. This process is characterised by the emergence of concentrated, extended, and varied urban structures. The feasibility of capturing these processes through conventional urban analyses has been subject to scrutiny

(Derickson, 2016). Delgado-Viñas & Gómez-Moreno (2022) contend that urban living has become a ubiquitous phenomenon, and advocate for the elimination of an analytical differentiation between rural and urban. Some scholars highlight the significance of comprehending urban centres as unique locations for their inhabitants. The inference drawn from this statement is that the phenomenon of urbanisation warrants examination in specific geographical areas with respect to the inhabitants' attachment to their locality (Schindler, 2017), as well as the historical circumstances that have shaped it (Pieterse, 2011). The concept of the 'urban' is examined and conceptualised in its diverse forms, and from perspectives beyond the metropolitan areas, as evidenced by the works of Christiansen et al. (2016), Lacour & Puissant (2007), and Skytt-Larsen & Winther (2015).

According to a report by the United Nations, the global population growth will require the creation of more than 470 million jobs, with a significant proportion of these jobs being necessary in developing nations. Ghana, being a developing country, is expected to be among the nations that will require a substantial number of these jobs. The swift pace of urbanisation highlights the numerous challenges linked to this phenomenon. Globally, there is about 75 million unemployed youth worldwide, while the working-age population is underused (inactive or underemployed).

In Ghana, about 12 percent of the youth are unemployed, and more than 50 percent of the population are underemployed (World Bank, 2020). Due to poor infrastructure and limited access to resources, many people in rural areas commute long distances to cities in search of work. Young people are especially drawn to urban areas due to the greater availability of

opportunities for modernization, productivity, entrepreneurship, and technology (Skytt-Larsen & Winther, 2015). Over 75% of all jobs in developing countries are unofficial, and Ghana is no exception to this rule (World Bank, 2020). Despite earning more on average, city workers had to fork out a higher portion of their pay to cover non-work-related housing, transportation, food, and general living expenses (Christiansen et al., 2016).

Available literature indicates that one of the main causes of most of the challenges associated with urbanization, and it accompanied challenges is linked to government's inability to mobilize enough revenues, and other necessary domestic resources required for urbanization to take place effectively. Without the necessary domestic and international resources and prospects for the future, government-funded urbanization initiatives and strategies will continue to be ineffective. City development and plans must become incubators for employment growth to be able to deal with the growing challenges (Acheampong, 2018).

The growth of cities in terms of population, economy, and overall importance may all be measured by their rate of urbanisation, which is a spatially dynamic process in and of itself. For urban spatial research and future urban planning, it is essential to use current and historical data in urbanisation analysis. In many of Ghana's rapidly growing urban districts, urbanisation is viewed as the primary spatial factor in land-use shift. Consequently, it is crucial to have a thorough familiarity with the dynamics of land-use land-cover change and urban expansion at various spatial scales. In order to better understand the land-use planning and spatial development, Addae and Oppelt (2019) conducted a study which revealed that the pace and scale of urban

growth in the peripheral districts is significant. The study posited that the trajectory of Ghana's future will be significantly influenced by the patterns of urban expansion at the district level. Akubia and Bruns (2019), suggested that in order to effectively address the challenges associated with urban expansion, it is crucial to conduct a comprehensive analysis and assessment of the phenomenon at both macro and micro levels. This approach enables the identification of diverse expansion patterns and directions. Furthermore, the literature asserts that it is essential to design effective methods and plans for sustainable urban densification and regional spatial planning and development.

In Ghana, drivers of urban expansion have been categorized into two; human activities and natural forces (Ampim et al., 2021). The human activities can be moderated and regulated by initiatives such as education and policies. For examples, a change in national, regional, and local policies can affect human activities. Sule and Odekunle (2016), confirmed this by indicating that institutional policies and laws can control human population growth and other human-induced activities that can affect urban expansion.

In terms of natural factors as a driver for urban expansion, available literature shows that demographic and environmental factors are often the main forces, however, the complex interactions between several factors such as economic, political, and demographic are by far considered the most important (Ampim et al., 2021; McNicoll, 1995). Since the finding of major commercial quantities of oil in Ghana in 2017, urban regions like Takoradi in the west, have seen tremendous expansion. As a result of a wave of growth in the region, these studies have demonstrated how changes in the land use and land cover of the region have brought about large infrastructural changes

(Amim et al., 2021; Cobbinah & Darkwah, 2017). The extant literature suggests that these phenomena are primarily linked to economic and political factors and their interplay, such as globalisation, economic growth, commercialization, industrialization, and rural-urban migration (Langemeyer et al., 2021). The expansion of the Greater Accra Metropolitan Area can be attributed to the microeconomic policies implemented by the National Government, which have facilitated the growth of the capital and the Tema Port City. The burgeoning of numerous urban regions in Ghana is ascribed to the escalating migration from rural to urban areas in several central cities and their outskirts, owing to the amplification of commercial and industrial development (Kleemann et al., 2017).

It is crucial to consider the adverse impacts of expansion, including deforestation, a decline in biodiversity, a decrease in the capacity of urban land to provide ecosystem services, and the depletion of agricultural land, given that Ghana's economy heavily relies on agriculture and natural resources. Hence, it is imperative to consistently oversee and control the growth of urban areas to identify any potential issues and requisite interventions (Braimoh, 2004).

Urban expansion and Vegetation Greenness

Biodiversity, encompassing the variety of life from genes to ecosystems, plays a critical role in maintaining ecosystem services such as water and air purification, as well as providing aesthetic and recreational value (Bolund & Hunhammar, 1999; Lazarow et al., 2008). Urban biodiversity is essential for educating city dwellers about the importance of nature conservation (Miller & Hobbs, 2002). However, urban expansion significantly impacts biodiversity,

altering species composition and vegetation richness in ecosystems. Rapid urban growth worldwide has severely affected urban forests, reducing ecological services for both humans and wildlife (Nguyen et al., 2020).

Impact of Urbanisation on Biodiversity

Urbanisation, a major driver of land use changes, poses a significant threat to biodiversity (Mustard et al., 2004). The conversion of rural land to urban areas often leads to a reduction and fragmentation of habitats, contributing to species loss (McKinney, 2002). Urban areas typically have impervious surfaces covering over 80% of the land, with vegetated areas making up less than 20% (Blair & Launer, 1997). This leads to a simplified vegetation structure and reduced biodiversity (Marzluff & Ewing, 2008).

Studies have shown that moderate urban development can lead to higher species richness due to the proliferation of common, urban-adapted species (Deutschewitz et al., 2003; Concepción et al., 2016). However, extreme urbanisation often results in decreased species richness due to habitat loss and fragmentation (McKinney, 2002). Urban planning should consider habitat connectivity and the conservation of small habitat fragments outside major reserves (Kim, 2016; Nguyen et al., 2020).

Urbanisation and Vegetation Cover

Urbanisation has dramatically reduced vegetation cover globally, significantly affecting ecosystem services such as CO₂ absorption, rainwater storage, and soil preservation (Yao et al., 2019; Kane et al., 2021; Wang et al., 2020). Studies across various regions have documented declines in urban green spaces and vegetation cover due to urban expansion. For instance, Dallimer et al. (2011) noted a decrease in green spaces in several English cities from 2000

to 2008, while Yang et al. (2014) observed significant vegetation loss in over half of the 32 Chinese cities studied between 2000 and 2012.

In Africa, urbanisation has also led to significant reductions in vegetation cover. The continent's rapid urban growth, driven primarily by migration, has resulted in extensive vegetation loss in cities like Cairo, Kumasi, and Accra (Yao et al., 2019; Coulter et al., 2016; Ampim et al., 2021). Studies indicate that coordinated efforts by government and non-governmental institutions are necessary to mitigate the impact of urbanisation on vegetation cover and promote sustainable urban development.

Urban biodiversity and vegetation cover are crucial for maintaining ecosystem services and ensuring sustainable urban development. While moderate urban development can increase species richness, unplanned and rapid urbanisation typically leads to habitat loss and biodiversity decline. Effective urban planning and conservation strategies that consider habitat connectivity and the preservation of green spaces are essential for mitigating the adverse effects of urbanisation on biodiversity and vegetation cover.

Surface Temperature Changes

More over half of the world's population lives in cities (Grimm et al., 2008). As many metropolitan areas continue to grow fast, significant land cover and land-use changes occur as a result of urbanisation. Furthermore, rising urbanisation reduces people's ability to observe and enjoy nature, as does the capacity for vegetation to thrive, as vegetation is frequently degraded to adapt changes in the land surface (Troy et al., 2007). As a result, there is a need to comprehend how urbanisation affects the environment, namely

temperature, local and regional climate, air and water quality, vegetation, and drainage.

The process of urbanisation has emerged as a significant human endeavour that alters the Earth's land surfaces and environment. The most conspicuous outcome of urbanisation or urban expansion is the augmentation of built-up areas and land cover, leading to a transformation in land cover. The phenomenon of urbanisation and its impact on the thermal environment of cities has garnered significant attention from scholars across the globe (Peres et al., 2018). The phenomenon of urbanisation has resulted in a significant surge in population, leading to the expansion of built-up areas. This, in turn, has caused a substantial reduction in green spaces and a corresponding increase in impervious surfaces. The consequence of this phenomenon is that the central region of the urban area experiences higher temperatures relative to its outskirts. This is due to the expansion of constructed spaces, which leads to the removal of natural greenery and the replacement of land surfaces with concrete (Guo et al., 2016).

Greater thermal capacity and conductivity as well as greater solar radiation absorption characterise urban environments, allowing for the daytime storage and subsequent release of heat (Saleh, 2010). Consequently, urban regions exhibit a comparatively elevated temperature in contrast to the adjacent rural regions. The thermal contrast, coupled with the loss of residual heat from urban dwellings, transportation, and industrial activities within urban regions, fosters the emergence of urban heat islands (Coseo & Larsen, 2014).

The accelerated expansion of urban centres since the last century has resulted in a fundamental change in land use and land cover patterns in many regions worldwide. Urban expansion has rapidly increased on a global scale, leading to significant environmental strain. This phenomenon is especially evident in urban areas where vast expanses of agricultural land are progressively vanishing each year, being repurposed for urban or associated purposes. Assessing the extent and configuration of global urban expansion is a pressing imperative. Furthermore, due to inadequate land use planning and insufficient measures for sustainable development, uncontrolled urban expansion has resulted in significant environmental repercussions (Hegazy & Kaloop, 2015).

Numerous academic pursuits have ignited interest in demonstrating the combined utilisation of remote sensing and GIS to assess urban expansion patterns within urban areas and to scrutinise the effects of such expansion on surface temperature. Using remote sensing technology, Saleh (2010) examined the impact of urbanisation on surface temperature in Baghdad and discovered that between 2003 and 2017, the city's urban area had grown by around 77%. In addition, the rise in land surface temperature contributes to the occurrence of regional heating as a result of Bhubaneswar's growing urbanisation. From 2003 to 2017, the airport area's land surface temperature was found to have increased by around 0.25 °C every year. The Urban Heating Island effect in Bhubaneswar was further reinforced and intensified by the disparity in temperature rises between urban and nonurban areas. Overall, the study concluded that Bhubaneswar's seasonal Land Surface Temperature trends indicate the city's climate is moving towards an extreme scenario.

Land use-land cover changes related with land surface temperature are widely documented in Sub-Saharan Africa, and their impact cannot be overstated. However, knowledge about the effects of land change on land surface temperature in urbanising African drylands is quite sparse (Akinyemi et al., 2019). Especially in urbanising areas that are undergoing rapid development, land use-land cover change as a driver of environmental change plays an essential role in regulating the local microclimate, including the temperature of the land surface (Deng et al., 2018). Across these various regions, there is a growing trend of replacing natural and semi-natural land covers, which are predominantly found in rural landscapes, with concrete and other construction materials. This is primarily driven by the desire to construct buildings for residential, recreational, industrial, commercial, and other land use purposes.

The forecast indicating that 70% of the global population will reside in urban areas by 2050 underscores the significance of cities and metropolitan regions in realising a sustainable future for the planet. Various stakeholders, including non-governmental organisations, individuals, governments at different levels, and civil society organisations, are collaboratively working towards achieving ambitious goals aimed at enhancing the sustainability, competitiveness, safety, resource efficiency, resilience, and inclusivity of urban areas. The attainment of sustainable development necessitates addressing crucial areas of need. The development of Goal 11 is focused on enhancing the inclusivity, safety, resilience, and sustainability of cities and human settlements. By looking into developing suitable capacity and delivery capabilities across stakeholder groups, as well as securing funding, innovative

designs, and delivery models and projects for integrated city infrastructure, this sought to discover and agree upon the most sustainable approaches to meet the targets. The scope of urban development encompasses a range of essential services such as buildings, energy, mobility, telecommunications, water, sanitation, and waste management. It is imperative to establish effective procedures for multi-stakeholder engagement throughout all stages of urban development that foster agreement, inclusivity, adaptability, and sustainability (UNDESA, 2015).

The urbanisation level of Ghana is highest in the Greater Accra region. In the past ten years, the area has experienced a swift demographic transition and expansion of urban development. This surge in population has subsequently led to a rise in traffic congestion, prompting individuals to relocate to adjacent outskirts. The anthropogenic alteration of the local environment has resulted in the emergence and intensification of Urban Heat Island phenomenon (Wemegah et al., 2020).

Several studies conducted in the realm of urban planning and environmental development within Ghana have confirmed the notion that urbanisation is causally linked to the degradation of Ghana's natural environment. These works of literature illustrate how urban growth leads to the loss of vegetation that is caused by urbanisation and how urban development was preceded by a wave of land conversion, often from forest to agricultural areas. The literature also highlights how urban development was preceded by a wave of land conversion (Jorge et al., 2020; Stow et al., 2016). During the study period, urban land cover replaced urbanisation, resulting in a reduction in natural vegetation cover (consisting of 'agriculture land,' mixed

woody vegetation, and primary 'forest') in some major urban centres in Ghana, a significantly lower proportion of natural vegetation. The expansion and development of urban areas comes at the expense of altering the natural vegetation cover, thereby endangering the biodiversity of the natural environment.

Several studies have indicated that there exists a substantial rate of temperature change in specific urban centres within the country, and the impact of urbanisation notably amplifies these trends in major metropolitan areas located in the capital (Wemegah et al., 2020)

Land use governance

Asia and Africa are projected to experience the highest rates of urbanization over the next decade. Rapid population growth in several South Asian countries has led to accelerated urbanization, prompting urban planners to implement various spatial strategies. However, these strategies have not achieved their intended outcomes, as urban areas have expanded by more than 20% over the past two decades, leading policymakers to seek new, pragmatic spatial planning approaches to manage this growth effectively (Abdul & Yu, 2020).

Urbanization entails extending urban territories, which involves developing the physical environment to accommodate growing populations and activities. This expansion affects natural habitats, biogeochemistry, hydrology, land cover, and surface energy balance (Grimm et al., 2008). Seto et al. (2011) found that urban land is expanding at a higher rate than urban populations. While urban populations are expected to double in the next decade, urban areas may triple between 2000 and 2030 (Seto et al., 2012).

Managing land use is complex due to the intricate nature of land-use systems, characterized by multiple drivers interacting dynamically (Meyfroidt et al., 2018). Urban planners face challenges in governing land use to achieve sustainable outcomes, as changes in one location can impact land use elsewhere. In the United States, for example, urban land use can be residential, industrial, transportation, recreation, or unoccupied, and effective land conservation and planning are crucial for sustainable urban growth (Schwarz et al., 2014; McQueen & McMahon, 2003).

Effective national land policies are needed to meet the rising global demand for land, safeguard rights, and support development. The Land Governance Assessment Framework (LGAF) aids in addressing land conflicts at national and regional levels by evaluating legal frameworks, land use planning, management, public land information, and dispute resolution (Deininger et al., 2012). Africa's urban population is projected to grow significantly, leading to crowded cities and increased land commercialization (Fazal et al., 2015; Napier & Berrisford, 2013). This urban growth has transformed environmental landscapes, with high demand for peri-urban space leading to informal settlements and trade activities (Bloch, 2015; UN-Habitat, 2010).

In Ghana, land use planning is based on the British Town and Country Planning Act of 1947. Between 1992 and 1994, Ghana reformed its urban and land use planning system, decentralizing power to district levels to improve rural incomes and well-being (Botchie, 2000). However, with 78% of Ghanaian territory under customary ownership, regulating land usage is challenging (Kasanga & Kotey, 2001). The Land Registry Act of 1962

requires formal land registration, but the lack of documentation for customary land leads to conflicts and insecurity of tenure (Twerefou et al., 2011). This situation affects the country's development, resulting in uneven, dispersed growth and challenges in managing land cover changes (Romanowicz et al., 2007).

Urbanization in Asia and Africa presents significant challenges for land use and governance. Effective planning and management strategies are essential to balance urban growth with environmental sustainability. Ensuring secure land tenure, promoting coordinated efforts among various governance levels, and adopting innovative spatial planning approaches will be crucial in addressing these challenges and supporting sustainable urban development.

Legislative framework on land use management in Ghana

In Ghana, the great majority of land is owned by customary authorities, such as stools, clans, and households. Approximately 78 percent of Ghana's land area is controlled by customary landowners. Approximately 20 percent of the entire land area is owned by the state, while a partnership between the state and a customary authority holds the other 2 percent (Larbi, 2008). In Ghana, the land tenure system is a pluralistic system in which customary and legal systems managing land overlap. Although the majority of land is customarily owned and controlled under the informal system, the government has established a fair and efficient process for land registration, building institutional capacity, and coordinating statutory and customary law while resolving the land dispute in Ghana through various laws and policies (Larbi, 2008).

Ghana as a country has a peculiar structure of land tenure. It is intricate and represents the distinctive traditional political structures, sociocultural distinctions, and characteristics of the numerous tribes, clans, and families who obtained land ownership through wars, conquests, and early settlement to acquire ownerships of lands. Through this type of ownership about 80 percent of the lands, are owned by stool, clans, and family heads. These lands are considered assets and are held in trust by the leader of the community, clan, or family for the benefit of future generations.

Since colonial times, the legal system governing land management in Ghana has evolved and continues to evolve in response to specific concerns of interest or political orders. These laws work together with Ghana's customary laws, which sometimes causes overlaps and conflicts (Larbi, 2008). The 1992 Constitution article 267(1) makes provision that the stool in ownership of the lands is entrusted with all management decisions relating to the right to own, sell, management and decides who is allocated a part with all conditions relating to the land including price. Article 267 (2) of the Constitution of 1992 also set up the office of the administrator of stool lands. This office is in charge of collecting and distributing all stool land income, such as rents, dues, royalties, and any other income or payment for land management. This includes rents, dues, royalties, and any other income or payment that comes in the form of income or capital. The responsibility of the office is to ensure that all payment negotiations and contracts agreed by landowners and their partners are followed through to prevent illegal payments to non-landowners claiming to be landowners.

The 1992 Constitution, article 267 (3) also provides that there shall not be any development or deposition on any stool lands without certification from the Lands Commission. The Lands Commission is a government agency entrusted with approving land development in accordance with the development plan drafted and approved by the planning authority of the region in which the land is located. This means that in any situation where the lands commission is unable to give certification for a development work to commerce any depositions on land can be considered invalid and illegal.

The challenge poses by this framework however are that Ghana does not have a system of database where land ownership can be stored to prevent general disputes in the land market. According to Larbi (2008), the lack of a database for the ownership of the land has led to many menaces such as land encroachment, multiple sales of parcels of land, and unapproved developments leading to many environmental challenges such as congestions, floods among others.

Literature suggests that the absence of consultation between customary landowners and state land management authorities during the decision-making process for land allocation or development plans has resulted in the unregulated utilisation and management of numerous land areas for unauthorised developments. This has consequently contributed to the various environmental issues that we are currently encountering (Kuusaana & Eledi, 2015).

Institutional framework for land use Management in Ghana

The institutional framework for land use management in Ghana is contributed to by both the public and private sectors. Public provisions refer to

the legal frameworks that require public land management institutions to work together to oversee and regulate all lands acquired by the state, including customary lands, and to enforce relevant laws and regulations governing their administration. The public agencies under the Ministry of Lands and Natural Resources and Ministry of Environment, Sciences, Technology, and Innovation share the institutional arrangement. The aforementioned entities comprise the Lands Commission, Office of the Administrator of Stool Lands, the Survey Department, Land Evaluation, and Land Use and Spatial Planning Authorities.

The Environmental Mandate of the Ministry of Lands and Forestry states that many different tasks fall under the umbrella of land management. In order to guarantee the growth and development of standardized urban settlements, it is necessary to take measures such as issuing permits, creating planning laws, regulations, and guidelines, writing instruction manuals, drawing up spatial plans, collecting data, monitoring progress, and putting plans into action. These activities are carried out by agencies under the ministry. In the case of this study, the following agencies were of great importance.

- The Lands Commission is mandated under the ministry to manage all public lands, impose obligations on stools, clans, and families, and ensure effective management through the established customary land secretariat.
- The Land Use and Spatial Planning Authority: under the ministry are mandated to provide sustainable means of development of land and

human settlement through a decentralized planning system by creating efficient land use.

- The Office of the Administrator of Stool Lands: under the ministry is mandated for the establishment and managing stool land revenues. Its establishment requires consultation with stool and traditional authorities on issues relating to the administration and development of public lands.
- The private institutions, on the other hand, are customary landowners and individuals who pose land ranging in all sizes including non-governmental organizations (NGOs). In the management of private lands, the authorized landowners or representatives of families or clan heads are responsible for managing land use of the land in accordance with the law.

Literature, however, shows that a number of challenges hinder these agencies from effective administration and implementation of mandates according to the law. According to a number of studies, environmental issues were caused by a combination of factors, including a high rate of land invasion, the sale of several parcels of land, unapproved development schemes, and uncontrolled development in sanctioned areas, among other things. These problems include land disputes, litigation, undefined boundaries of customary lands, the slow disposal of land cases by the court and weak land administration system among others are some of the challenges facing these institutions and agencies of government from ensuring that sustainability as a mandate of these agencies is achieved (Kuusaana & Eledi, 2015; Larbi, 2008).

Conceptual framework

The DPSIR Framework (Driving Forces, Pressure, State, Impact, and Response) offers a structured approach to analyzing the complex interactions between human activities and the environment. Originally employed by the European Environmental Agency in 2010, the framework was instrumental in assessing urbanization and its environmental impacts, highlighting key indicators that illustrate these dynamics. In 2019, Ragas utilized DPSIR to address social concerns like environmental pollution and stress, demonstrating its effectiveness as a communication tool. By systematically breaking down environmental issues, the DPSIR Framework facilitates clearer understanding and effective policy responses, promoting sustainable development and environmental stewardship.

The strength of the DPSIR Framework lies in its ability to integrate various aspects of environmental issues into a cohesive model. It allows for the identification of underlying driving forces behind environmental changes, the pressures these forces exert on ecosystems, the resultant state of the environment, and the subsequent impacts on both natural and human systems. This comprehensive approach not only aids in diagnosing environmental problems but also guides the development of targeted responses. By fostering a clear understanding of these complex interactions, the DPSIR Framework supports the creation of effective strategies for mitigating adverse effects and advancing sustainable development goals.



are shown by state indicators. Impact indicators pertain to the ecological functions of the natural environment, encompassing the provision of suitable conditions for human health, availability of resources, and preservation of biodiversity. Response indicators are responses by various groups in society, as well as government activities, to avert harmful environmental effects while improving environmental conditions or adapting to changes in the state of the environment. Research shows that population growth drives urbanization worldwide (Hamdy, 2017; Matamanda & Chinozvina, 2020). As the population grows, so will the demand for housing and food, resulting in an increase in economic activity and productivity activities such as commercial operations. With increased production comes increased demand for land for various land uses. The modification of natural vegetation, particularly owing to anthropogenic activities, has disastrous repercussions (Maitima et al., 2010; Mensah et al., 2019)

Despite the fact that various policies and legal institutions are mostly put in charge to help curb the increasing anthropogenic influence on the natural environment and ensure development occurs in a planned manner, the lack of coordination and clear-cut role of each of these institutions makes their task of managing the ecosystem difficult. In the field of environmental protection, there is sometimes a clash between national and traditional regulations. A coordinated effort by individual stakeholders, as well as proper enforcement of laws and policies by these stakeholders, is critical to the planned development, proper management, and protection of our natural environment.

The use of the adopted framework, along with its variables, facilitated the identification of solutions to address the research gaps that are being targeted. The utilisation of the variable "Drivers" facilitated the identification of solutions to the initial objectives of the research, which sought to elucidate the underlying factors driving the swift alterations in land use and land cover in the Kasoa region. These changes are primarily attributed to the human desire for expansion, which has resulted in a multitude of pressures that have significant environmental implications. The initial aim of the study was to document the environmental modifications that transpired between 1985 and 2021. The investigation of the nature of land governance and its impact on changes in the natural environment was facilitated by analysing the interconnections among policy, legal, and institutional frameworks and the stakeholders' approach to land management governance, thereby fulfilling the third objective.

Ragas (2019), highlighted that the DPSIR framework is essentially a cause-and-effect chain that seeks to capture the main processes involved in an environmental issue; from its inception to the changes, it causes in the environment. He subsequently classified these processes into five broad categories.

- The human needs underpinning the human actions that result in negative consequences. Human demand for a new environment, culminating in the conversion of forested land to human settlements, is one example.
- The actions taken by humans to satisfy their wants, which result in changes to the physical environment and, as a result, ultimately lead to

consequences on the environment that are viewed as undesirable, either now or in the future.

- The condition of the physical environment as a direct result of activities carried out by humans. It is common practice to quantify the state of the environment by referring to observable shifts in the environment, such as variations in the cover of vegetation or the quality of the air.
- The impact of the perceived changes in the physical environment or the consequence of the environmental pressures. An example is the human health effects of poor air quality`.
- The initiatives developed by society's stakeholders to solve the issue. These can range from the collection of data through the formulation of policy plans and the implementation of mitigation actions.

The DPSIR framework has been subject to criticism due to the fact that it attempts to capture all processes in cause-and-effect relations. Some people believe that this results in a bias towards the physical aspect of environmental stresses, such as human activities, physical effects, and the controlling measures. The sociocultural dimension, which includes the development of information, the resources needed to implement measures, awareness and society knowledge of the problem it needs to generate for the environment, and a number of other factors, is less easily captured, according to the argument of some academics (Svarstad et al., 2008). However, in some studies the framework has been modified to accommodate some of these aspects. It should be acknowledged that though it has its limitations it was found to best fit this study by capturing all the concepts of the study (Elliott et al., 2018;

Gari et al., 2015). This therefore made the usage of this framework a useful tool in contextualizing the problem underpinning the study and address it accordingly.

Summary of Chapter

To summarise, this section of the thesis has examined matters pertaining to urban expansion, including its categorization and the impact it has on alterations in temperature and the depletion of vegetation. In order to address the research inquiries that were guiding the investigation, an empirical examination was conducted on the alterations in land use and land cover in urbanised regions, as well as the changes in temperature. The review of empirical evidence culminated in an examination of the regulatory frameworks and legal statutes that govern land use, as well as the institutions tasked with managing land use in Ghana. Ultimately, the chapter delves into the employed conceptual framework utilised within the study.

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

This chapter focuses on the methodology that was employed in the study. It explains how various data were gathered and analysed to address the objectives of the study. The issues discussed here cover the study area, research philosophy guiding the study, the research design, data and sources, study population, sample size and sampling techniques. The chapter ends with discussions on research instruments, data collection exercises (fieldwork), ethical issues, and data analysis.

Research Design

The present study employed an explanatory sequential design comprising two distinct stages, namely quantitative and qualitative, in accordance with the research problem and study objectives (Creswell et al., 2003). The explanatory sequential design involves an initial focus on the collection and analysis of quantitative data. Subsequently, in the sequential process, qualitative data is gathered and scrutinised to provide clarification or expansion on the quantitative findings acquired in the initial phase. The present study employed an exploratory sequential design as a framework. The findings obtained through the employment of a quantitative methodology were subsequently integrated into the qualitative facet of the investigation. This enabled the researcher to pose pertinent inquiries encompassing open-ended, close-ended, and scale-based questions, tailored to the study's focal point. The researcher relied on what was already known from existing satellite image data, which was the secondary data for the early stages of this investigation, to

use explanatory sequential for this. The qualitative phase of the data collecting stage's second stage involved conducting interviews based on the findings of the quantitative data technique. The justification for this method is that the quantitative data and its subsequent analysis offer a broad grasp of the research problem. Creswell et al. (2003) argue that the analysis of qualitative data can enhance and elucidate statistical findings by delving deeper into the perspectives of study participants. This is particularly useful in understanding contradictions between quantitative results and qualitative findings as it enables this researcher to compare quantitative and qualitative data needed for this study. The explanatory sequential design further provides rich, comprehensive information about a phenomenon, which gives a clear understanding of nature and how such phenomenon came into being (Ritchie, 2003).

Research Philosophy

The positivist and interpretivism philosophies are combined in the pragmatism research philosophy, which serves as the foundation for this study. A single viewpoint is rarely able to capture the full picture since there may be several realities, according to pragmatics, which is an approach to reasoning and analysis (Saunders et al., 2019). The positivist paradigm, which is part of the objectivism epistemology, is a methodological philosophy in quantitative research. According to this philosophy, the techniques used in the natural sciences are employed in order to find the field of social science (Crotty, 1998). Thus, an understanding of phenomena, in reality, must be measured or quantified and supported by evidence (Hammersley, 2013). To give an example, when employing the positivist research approach to analyse

phenomena, causal inferences will be used to determine the relationship between an independent variable and one or more dependent variables. In order to completely determine the outcomes of experimental designs, researchers must maximise the influence of the independent variable on the dependent variable and events (Cohen et al., 2011).

As opposed to a truth that can be ascertained through a process of measurement, the interpretivist research philosophy uses a relativist ontological approach, in which a single phenomenon may have numerous interpretations. Instead of attempting to generalise the basis of understanding for the entire population, researchers tend to get a deeper grasp of the phenomena and its complexity in its specific context by adopting an interpretivist stance (Creswell, 2007). In the same way, Hammersley (2013), emphasis interpretive researchers should try to understand "the diverse ways of seeing and experiencing the world through different contexts and cultures" and try to avoid bias when studying the events and people with their interpretations. This is because multiple interpretations develop among human relationships.

The pragmatic research philosophy incorporates a variety of research techniques into its investigation, including qualitative, quantitative, and action research techniques. The influence of philosophical presumptions on the conduct of research tends to be less with a pragmatic approach. By this, researchers are less constrained in terms of how they can carry out research. Onwuegbuzie et al. (2009), assert that pragmatism prioritises practicality in addressing research inquiries, as opposed to selecting between the positivist and constructivist philosophical approaches. The pragmatic philosophy was

employed within the framework of this investigation. In order to gain a comprehensive understanding of the phenomenon being investigated, it was necessary to conduct a thorough analysis and objective assessment of the situation. This approach facilitated the development of a holistic analysis that effectively addressed the study's objectives

The Study Area

The settlement of Kasoa, originally known as Odupongkepe, is located in the Central area of Ghana's Awutu Senya East Municipal District. Kasoa separates Ghana into its Central and Greater Accra regions and is also the district capital of Awutu Senya East. Gomoa and Awutu, two Akan tribes, have called Ghana's Central area home for generations (Asante & Attom, 2022). Its latitude Coordinates are 05.31.12N and 00.28.48W, while its latitude and longitude are 5.5220 and -0.4800 respectively. Kasoa is situated along the Accra-Cape Coast Road and roughly 36 kilometres (22 miles) by road west of Kotoka International Airport. Its average height is 75 meters above sea level (Ghana Statistical Service, 2014).

The focus of the study was to explore the various urban expansion and its effect on environmental sustainability. Kasoa was the preferred study area for the study because in 2010 the Ghana Statistical Service reported that the population of the area has multiplied by 79 times since 1970 (Ghana Statistical Service, 2014). The GSS in its 2014 report indicated that Kasoa as of 1980 was regarded as a rural community but due to the continued growth the area is experiencing Kasoa was categorized as an urban centre. Figure 2 shows the map of the study area.

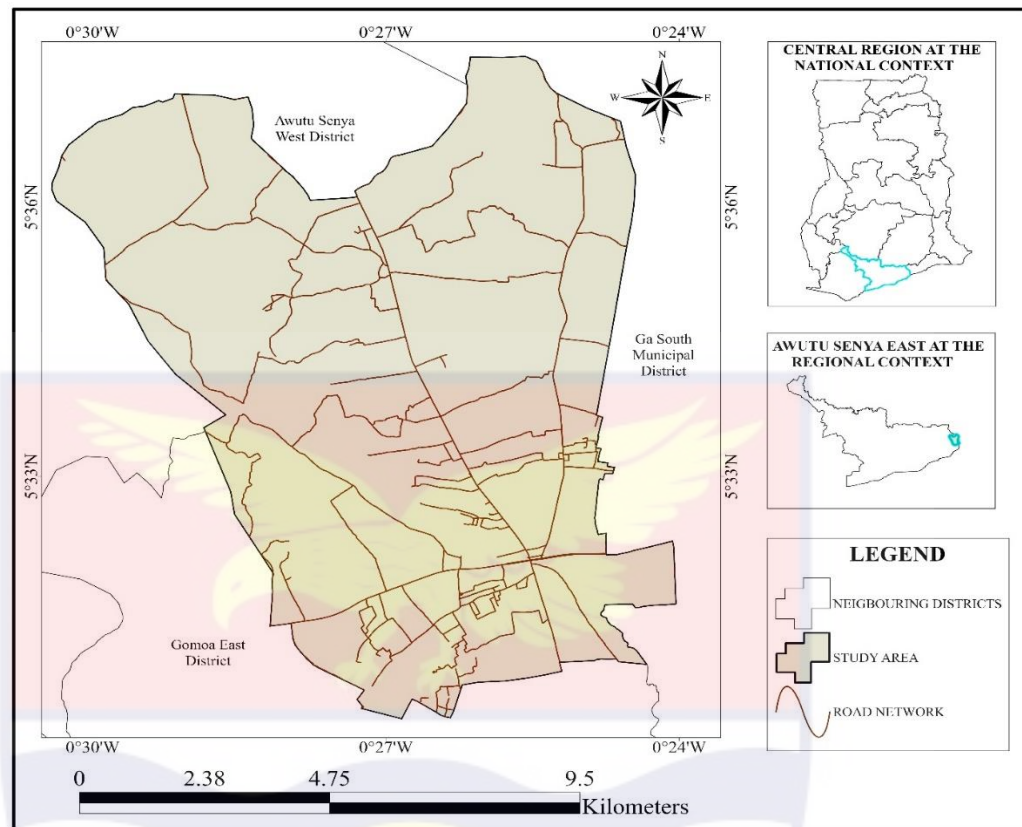


Figure 2: Map of the study area in national and local context

Source: Author contract (2021)

Climate and Vegetation

Kasoa experiences two seasons as any region in Ghana, a five-month dry season lasting from November through March. During the dry season, the northeast trade winds are prominent. The dry season is followed by a seven-month rainy season that lasts from April through October. During this rainy season, the southwest monsoon winds are most common. The rainy season is usually characterized by flooding, low crop yield, and financial strain for a large portion of City's population which is just one of the many problems that plague a sizable percentage of the population (Kyei-Mensah et al., 2019).

Population

Odupongkpehe/Kasoa is the home of Awutu Ofaakor and hosts a diverse range of ethnic communities, including the Hausa, Ga, Akan, Ewe,

Wala/Dagarti, Moshie, Basare, and several smaller ethnic groups. The projected population of Odupongkpehe/Kasoa in 2010 was 370,384. The rapid population growth in Ghana over the past three decades has directly impacted Odupongkpehe/Kasoa and other peri-urban areas. Reports indicate that Kasoa is one of West Africa's fastest-growing settlements (Ghana Statistical Service, 2014). The population, which stood at 2,597 in 1984, surged to 34,719 in 2000 and 69,384 in 2010. According to Meimuna (2019), the current population of Kasoa is estimated at around 400,639. Between 1970 and 2010, the net population growth was 68,521, signifying that over the past 40 years, the population of Kasoa has increased more than 79-fold compared to its 1970 figures. These statistics highlight Kasoa as one of the most rapidly urbanizing areas in West Africa (Ghana Statistical Service, 2014)

Study population

The target population for the study consisted of the following demographic groups.

- Officials of land management institutions
- Landowners
- Opinion leaders

The individuals under investigation were not chosen randomly, but rather in accordance with the objectives of the research. Initially, with regards to the personnel of land management organisations, purposive sampling was employed to engage heads of institutions such as the Environmental Protection Agency, Land Use and Spatial Planning Authority, Lands Commission, Development Planning Department, Parks and Gardens Unit, and unit committee members in the Awutu Senya East Municipality Assembly

(ASEMA) for the purposes of the study. The selection of these stakeholders for the study was purposeful, as they are responsible for the fundamental duties of land management and planning within the designated study region. The stakeholders in question are crucial actors in the context of land use and land cover change within the study area, given their central responsibilities.

The study incorporated the participation of traditional authorities, including queen mothers and chiefs, in consideration of the landowners within the study area. This can be attributed to the fact that they hold the role of land custodians and bear the responsibility of overseeing the proper maintenance of the land for the betterment of the inhabitants within the study region. Moreover, it is noteworthy that in Ghana, a significant proportion of land is under the ownership and control of traditional authorities. This fact renders their participation in the study particularly valuable in terms of gaining insights into their experiences with land expansion and land management practises. In addition, selected individuals who hold influential positions and possess a decade-long residency within the research locale were also enlisted for participation.

Sampling size and technique

The study used two sets of data (qualitative and quantitative data) as already indicated above, the quantitative data employed were satellite images, which did not require the application of sampling techniques. However, some sampling techniques were used to select some individuals to obtain primary data for the qualitative aspect of the study. The sampling technique used was purposive sampling technique which is a non-probability sampling technique focus on selecting specific people who served the purpose of a given study

Participants for this study were sampled based on the needs of the study. In context, the study interest was based on the needs of the institutions and individuals who have the responsibility in relation to land management or governance.

For in depths interviews, five (5) representatives from five land management institutions listed in the previous paragraphs were sampled for the first set of interviews. After that two representatives from the Zonal Council were also sampled for the study. Two opinion leaders who fit the criteria as stated in the previous paragraphs were also engaged in the study. Three-assembly members were also sampled for the in depths interview based on their locality.

Finally, unit committee members were the focus of the FGDs. At least six participants attended each of the two FGD sessions. Participants for the FGDs were selected from the municipality's six Zonal Councils. In total, 10 respondents participated in in-depth interviews and 12 individuals participated in two FGD sessions.

Research Instruments

In the case of this study, the secondary data did not require any set of instruments for its collection as they were Landsat satellite images retrieved from the United State Geological Survey website using a well-connected internet.

The primary data however was collected using interview guides for both the in-depth interviews and the FGDs sessions. The interview guide was structured into three forms with the aim of seeking answers to fill the identified gap the study seeks to address. The interview guide was mainly

grouped into three (see Appendix). This is because the study target population (representatives or officials of land management institutions) were grouped into three categories that is: the public institutions, the local authority including opinion leaders, and the target group for the FGDs. These three categories made it easy for the researcher to be able to engage and seek information from respondents based on each institution and their role in land management in Ghana specifically the study area.

The procedure for interviews was organised into four distinct sections, which were aligned with the research objectives of the investigation. The initial segment of the interview guide aimed to elicit demographic data from participants while simultaneously safeguarding their anonymity. The reason for this is that the study's respondents' demographic provided the researcher with a wider understanding of the target group and their professional experience, which was crucial for the study's focus. The second segment of the interview guide was designed to gather data pertaining to the mechanisms driving urban expansion within the study area. The third segment of the guide aimed to elicit information regarding the impact of urban expansion on the vegetation cover of the study area. The fourth segment of the interview guide was designed to elicit insights from participants regarding the characteristics of land utilisation and its administration within the research local.

These four structures were the nature of the interview guide for both the FGD sessions and the interview guide because the researcher took into account the various roles played by each of the target populations (officials of land management institutions) and their role in the land management process per the interest of this research. This structure of the interview guide was

necessary as it helped the research asked objective and relevant questions in relation to the topic under study.

Data Sources

This study employed both primary and secondary data sources. The secondary data employed consisted primarily of satellite imagery. The present images were obtained from a pre-existing source, namely the US Geological Survey, and were employed in the examination of alterations in land use and land cover (LULC). The study utilised primary data obtained from in-depth interviews and focus group discussions conducted in the field. The utilisation of both primary and secondary data in this investigation facilitated the verification of the analysed data. The supplementary information provided by the secondary data collection corroborated the primary data gathered in the field.

Data analysis and processing

Primary data acquisition and processing

Adherence to standard procedures was deemed important during the information gathering phase from the respondents. To secure consent from the target demographic, the researchers presented a letter from the Department of Geography and Regional Planning at the University of Cape Coast to the participants. The data collection period spanned from October 28th to November 22nd, 2021. Two forms were utilised to obtain the primary data for the study: the utilisation of in-depth interviews and focus group discussions (FGDs). Each session was conducted in a distinct manner, adhering to the structured interview guides.

Based on the goals of the study, in-depth interviews were used to get information from the heads of the land management institutions, local authorities, and opinion leaders. The first step in collecting data was a "recognizance survey." This was needed to choose the people who would be interviewed and to let the people interviewed know what information would be needed from them for the study. It also made it possible for the respondents to make time for the interviewer on the scheduled date and time. The recognizance survey was necessary as it aided the smooth path for the main interview to be conducted. On the day of the interview, at an agreed time, date and venue per the respondents' schedule, the researcher through the interview guide was able to solicit information needed for the study. All in-depth interviews for the study were conducted at different times and days within one month. Each in-depth interview session took a maximum of one hour and was recorded using tape-recorded and a notebook with the permission of the respondents.

There was two FGD session for the study. These sessions took place at different times of the day. Each session consisted of six respondents and through the interview guide; the moderator for the discussion was able to engage respondents on the various issues outlined in the interview guide. On each topic, the moderator was able to allow for much deliberation and discussions without respondents deviating from the topic of interest. Each discussion session took a maximum of two hours and was recorded using a tape recorder and a notebook with the permission of the respondents.

The primary data was later transcribed using MAXQDA 2020 software, which allows researchers to listen back, record interviews, and be

able to transcribe the information that had been recorded. Using the MAXQDA software allowed the recorded interviews from both the in-depth interview and the FGD sessions to be transcribed for easy analysis. Later, the transcribed data were put into themes based on the nature and structure of the interview guide. This meant that all responses that were related to the structure were put into the theme that was related to that structure. This was done for all four of the interview guide's structures. These themed responses were then used in the discussions of the study in the next chapters of the study.

Acquisition and Processing of Secondary Data

The study used secondary data consisting of spatial data obtained from Landsat satellite images during the specific time frames outlined in the research objectives. This study utilised Landsat satellite images from the years 1985, 2003, and 2021, which were obtained from the United States Geological Survey website (USGS Earth Explorer 2019). Table 1 presents the specifics of the Landsat satellite imagery. The satellite images' discrete bands (1-5) underwent a stacking process and were subsequently projected onto Ghana's reference system, the Universal Transverse Mercator (UTM) WGS 1984 zone 30N, which is commonly used by the War Office. The utilisation of bands 1 through 5 in the satellite imagery was deemed sufficient in order to accurately depict the true colour of each respective image. The process of classifying the satellite images involved the utilisation of Supervised Classification with Maximum Likelihood Classification technique, which was executed through the ArcGIS 10.5 software. Radiometric and atmospheric corrections were performed on the downloaded images during the pre-processing stage due to the presence of clouds and other atmospheric interferences.

Table 1: Study Landsat Images

Satellite	Sensor	Path/Raw	Acquisition date
Landsat	TM	193/056	1985/12/22
Landsat	OLI/TIRS	193/056	2003/12/26
Landsat	OLI/TIRS	193/056	2021/12/00

Source: Authors construct (2021)

Accuracy assessment

The process of evaluating the correctness and precision of remote sensing data is commonly referred to as accuracy assessment. The utilisation and dissemination of remotely sensed data analysis outcomes constitute a crucial phase. The evaluation of accuracy holds significant value in classification projects, as it involves the comparison of the classified image with ground truth data that is deemed precise. During the accuracy assessment process, the land cover maps were subjected to the generation of random points. The utilisation of assessment is imperative in this study, given the inherent presence of inaccuracies in land cover maps that are obtained through remote sensing data. The process of accuracy assessment aids in the determination of the precision of land cover data with respect to thematic categories. This enables the evaluation of whether the product satisfies the prerequisites of the intended application for the study. Table 1 presents the overall accuracy metrics and Kappa Statistics for the classified image. The determination of the overall accuracy involves the computation of the ratio between the number of accurately classified observations and the total number of observations, resulting in a percentage value that represents the proportion of correctly categorised pixels. The aforementioned indices have satisfied the threshold criteria as recommended by Jessen and Venderwel (1994), and thus have been deemed suitable for subsequent analysis.

Table 2: Accuracy Assessment for the Land Cover Map for the Study

Land cover map	Overall Accuracy (%)	Kappa Statistic
2003	90.2	0.89
2021	90.8	0.93

Source: Field survey (2021)

Study Limitation

The research aimed to utilise a decade-long sequence of satellite imagery spanning from 1985 to 2021. However, certain satellite images that were accessible for download did not satisfy the necessary criteria, as they were obstructed by cloud cover, rendering them challenging to analyse. Consequently, the study resorted to an 18-year time frame. The temporal span of 18 years did not have a detrimental impact on the study; instead, it provided a more comprehensive perspective of the alterations that have transpired in the research location over an extended duration.

Summary of Chapter

This chapter of the study emphasizes the methods employed in this study. The study area, location, and other characteristics such as vegetation and climate were discussed. The study's research philosophy design has been highlighted in this chapter. The data sources for both primary and secondary data used in the study were also thoroughly examined. The chapter concluded with examining data gathering tools, data acquisition and processing, and satellite images, as well as the accuracy assessment for satellite data. The chapter concludes with the study constraint encountered during the study period.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter of the thesis summarizes the study's findings in relation to the study's specific objectives. It examines the results of photographs processed for the land cover map between 1985 and 2021. The discussion of the various interviews with selected heads of institutions from the Land Use and Spatial Planning Authority, Environmental Protection Agency (EPA), Development Planning Department of ASEMA, Land Commission, and some selected members of Traditional Authority, Municipal Assembly Members, and Unit Committee members is emphasized further.

The State of Land Cover/ Land Use

The section examined Landsat Satellite Images from 1985 to 2021, with an interval of 18 years between the time points used for the study, which were 1985, 2003, and 2021. Thus, five land cover groups were employed to lead the analysis across the years under study: Built-Up, Vegetation, Water, Agriculture, and Bare Land.

The analysis of the satellite imagery from 1985 indicated that a significant portion of the land, specifically 46.31 sq./km or 48.27% of the total area, was covered by vegetation. In contrast, the cultivated land area, which was primarily used for agriculture, encompassed 47.73 sq./km or 49.76% of the total land size of 95.03 sq./km, as illustrated in Figure 3. In 1985, the collective presence of these factors resulted in green spaces encompassing 98.03% of the overall land area of Kasoa. In contrast, the settlement area, also known as the built-up area, encompasses 0.355 square kilometres (0.37% of

the total land area). Conversely, the bare land category occupies the smallest proportion of the total land area, covering only 0.0100 square kilometres, as depicted in Figure 3.

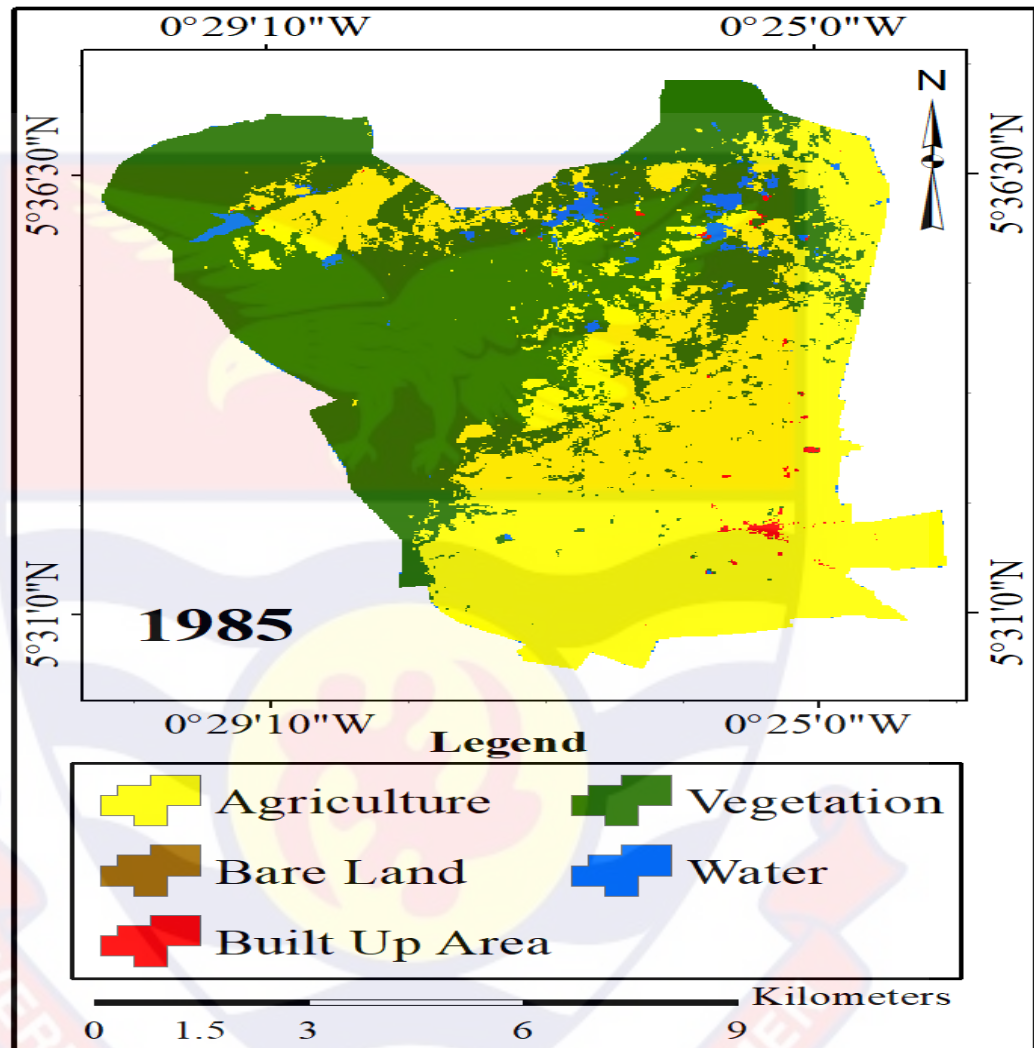


Figure 3: Land cover map of the study area in 1985

Source: Author's Construct (2022)

However, comparing the 1985 satellite image categorization to that of 2003 across the same 18-year period revealed considerable changes in land cover within the study area, as illustrated in Figures 3 and 4. Figure 4 indicates a considerable increase in the red and yellow colours representing built-up and

agricultural area, respectively, and a rather significant drop in vegetation and desolate fields.

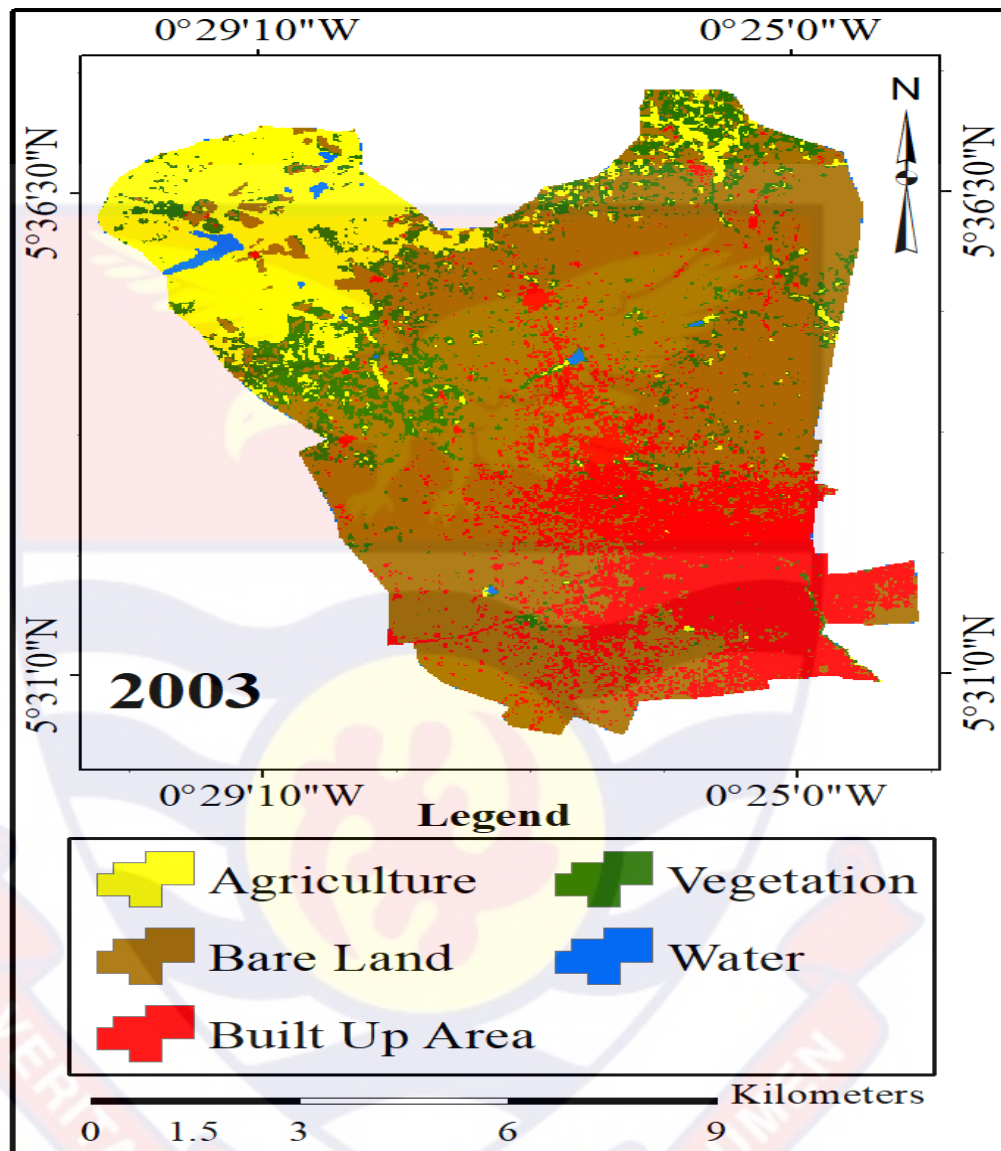


Figure 4: Land cover map of the study area in 2003

Source: Author's Construct (2022)

Table 3 presents a numerical analysis indicating that the land area covered by vegetation underwent a decrease from 46.314 sq. km in 1985 to 9.6516 sq. km in 2003, as revealed by the image analysis conducted in the same year. This represents a significant decrease of 79.5 percent. In contrast,

the urbanised region experienced a substantial rise from 0.355 square kilometres in 1985 to 19.4481 square kilometres in 2003, indicating a percentage increase of 5343.3% over the 18-year timeframe, as shown in Table 3. The agricultural land area experienced a significant reduction from 47.737 square kilometres in 1985 to 14.472 square kilometres, indicating a percentage decrease of 69.6 percent. The observed swift alteration in land cover across all categories may be ascribed to the swift expansion of built-up areas, which is a consequence of the rise in population and subsequent urbanisation.

The observed phenomenon can be attributed to the conversion of a significant portion of green spaces, including agricultural land and vegetation, into built-up areas. This conversion is primarily a result of human activities, such as unregulated urbanisation for human habitation and the construction of residential and commercial buildings, leading to the rapid expansion of concrete surfaces. Furthermore, it can be observed from Table 3 that the Landover water class experienced a decline from 1.524 sq. km in 1985 to 0.664 sq. km in 2003, resulting in a reduction of 56.4 percent. This indicates that approximately 54 percent of the water coverage was lost during the period under consideration. Finally, it is worth noting that bare land, the land classification with the smallest recorded size in the base year, experienced a remarkable expansion from 0.0100 sq. km in 1985 to 51.7032 sq. km in 2003, indicating a percentage increase of 5070.3% over a period of 18 years (as shown in Table 4).

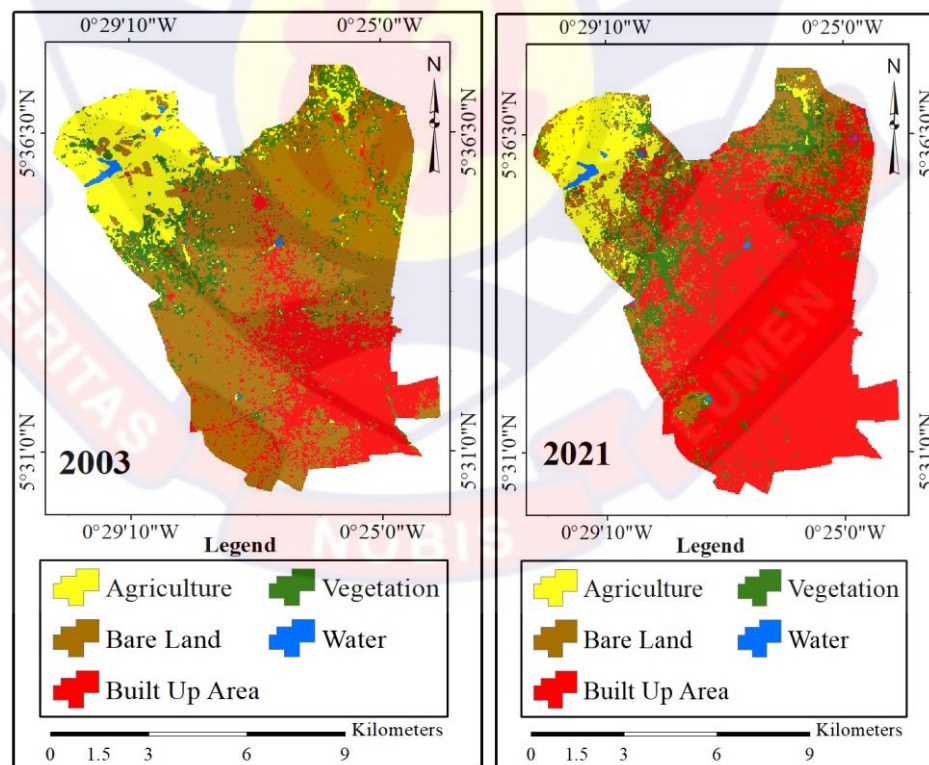
Table 3: Changes in land cover from 1985 to 2003 in the study area

Land cover classes	Area in 1985 (sq.km)	Area in 2003 (sq.km)	Percentage change % (1985-2003)
Built up	0.3555	19.4481	5343
vegetation	45.314	9.6516	79.5
Water	1.524	0.6640	56.4
Agriculture	47.737	14.472	69.6
Bare land	0.0100	51.7032	5070.3
Total Land size 95.03			

Source: Field Survey 2021

Changes in land cover from 2003 to 2021

The trend in the changes analysis of the land cover classes from 2003 to 2021, which sums up the 18 years interval (Figure 4), was not much different from that of 1985 to 2003 (Figure 3) as there continue to be some rapid changes in some of the land cover classes.

*Figure 5: Land cover map of the study area in 2003 and 2021*

Source: Author's Construct (2022)

The comparison between the satellite images of 2003 and 2021 for the five land classes previously mentioned is presented in Figure 5. The findings indicate that the Built-up area experienced a significant increase from 19.4481 sq. km to 59.6286 sq. km, representing a percentage change of approximately 206.6 percent. Nevertheless, the expansion of vegetation coverage over land exhibited a sluggish rate of growth, as depicted in Figure 5. Table 4 highlights the increase in vegetation area from 9.6516 sq. km in 2003 to 11.6442 sq. km over an 18-year period. Conversely, Figure 4 illustrates a decrease in agricultural land size from 14.472 sq. km in 2003 to 9.4824 sq. km in 2021, indicating a percentage change of 34.5 percent. The data reveals a 20.6 percent increase in vegetation land. In addition to the significant increase observed in built-up areas, the study also noted a substantial decrease in bare land, amounting to approximately 72%. This finding indicates that a considerable portion of the previously bare land has been converted to other land uses, including built-up areas. Finally, the study area exhibited a decrease in the land area submerged by water, as indicated in Table 4.

Table 4: Changes in land cover from 2003 to 2021 in the study area

Land cover classes	Area in 2003 (sq.km)	Area in 2021 (sq.km)	Percentage change % (2003-2021)
Built up	19.4481	59.6286	206.6
Vegetation	9.6516	11.6442	20.6
Water	0.664	0.6336	4.6
Agriculture	14.472	9.4824	34.5
Bare land	51.7032	14.5503	72
Total Land size 95.03			

Source: Author's construct (2022)

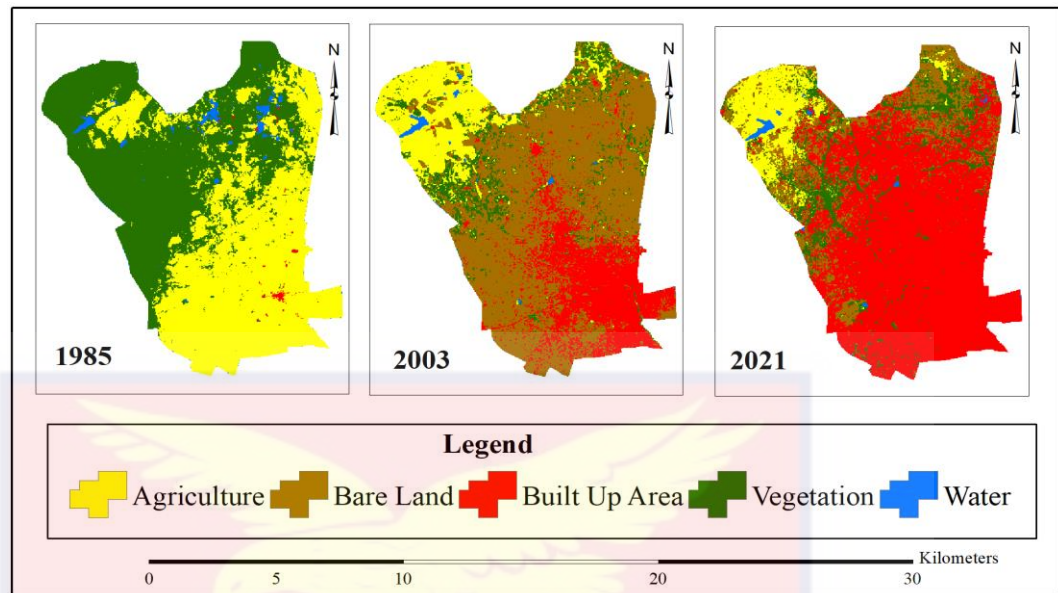


Figure 6: Land Cover Map Classification (1985-2021)

Source: Author's Construct (2022)

Table 5: Surface Area and Changes in Land Cover units (1985 and 2021)

Land cover class	Area in 1985 (sq.km)	Area in 2021 (sq.km)	Percentage change % (2003-2021)
Built-up	0.355	59.6286	16696.8
Vegetation	46.3185	11.6442	74.9
Water	1.524	0.6336	58.4
Agriculture	47.737	9.4824	79.8
Bare land	0.010	14.5503	13127.5
Total land size 95.03			

Source: Author's Construct (2022)

When examining the trend analyses depicted in Figure 6 on a larger scope, it becomes apparent that there is a noteworthy shift across all five land cover categories utilised in the classification, as evidenced by the comparison of 18-year intervals spanning from 1985 to 2021. The alterations in land cover classes between 1985 and 2021 were notable, and were attributed to various factors, including population growth, urbanisation, technological advancements, cultural practises, and other human activities, as noted by Aspinall and Hill (2007). The findings of the analysis indicate a reduction in the sizes of all area covers, with the exception of built-up areas, which

exhibited a steady and significant upward trend, leading to the displacement of other land cover categories. As the population of the area continues to grow, an increasing number of individuals are constructing residential dwellings, resulting in the conversion of other land covers.

Table 6: Land Cover Changes and percentage Over 36-year period. (1985 and 2021)

Land cover classes	Area in 1985 (sq.km)	Area in 2003 (sq.km)	Percentage Change % (1985-2003)	Area in 2021 (sq.km)	Percentage change % (2003-2021)	Percentage change % (1985-2021)
Built-up	0.355	19.4481	5343	59.6286	206.6	16696.8
Vegetation	46.3185	9.6516	79.2	11.6442	20.6	75.0
Water	1.524	0.664	56.4	0.6336	4.6	58.4
Agriculture	47.737	14.472	69.7	9.4824	34.5	80.1
Bare land	0.010	51.7032	5070.3	14.5503	72	145403
Total land size 95.03						

Source: Author's Construct (2022)

Discussion of Findings on Changes in Land Use Land Cover Classes from 1985 to 2021

The primary aim of this research was to evaluate the urban growth of Kasoa and its impact on ecological sustainability in the designated region, with a focus on land use and land cover. The study utilised five distinct categories of land use in the classification procedure. The aforementioned objective was addressed through the utilisation of Landsat Satellite images, which were subjected to analysis in the study.

The findings derived from the image analyses conducted on the diverse land cover categories spanning from 1985 to 2021 have demonstrated that the investigated region has undergone substantial transformations in relation to its land cover and land utilisation patterns throughout the 36-year period (as

depicted in Figure 6). There have been notable alterations in different land uses, with certain land cover categories exhibiting persistent growth over time, while others have experienced a substantial reduction in their land area. A significant discovery of the research indicates that the land cover category that exhibited the most substantial alteration (upward trend) is the developed region. The land cover size of the built-up area within the study area exhibited a notable increase over a period of 36 years. Specifically, the size expanded from 0.355 sq. /km in 1985, which accounted for a fraction of the total land size of 95.03, to 19.448 sq. /km in 2003, and ultimately to 59.629 sq. /km in 2021. Table 6 indicates a cumulative percentage shift of 206.604% throughout the duration of the study. Figure 6, highlights that alterations in built-up areas constitute the most substantial proportion of modifications in the examined region between 1985 and 2021.

A further interview with of the key informants selected for the study supported the above finding of very high increase of the built-up areas due to rapid population. The key informant remarked as follows:

We have seen Kasoa grow over the years. For the last 30 or 40 years our town has seen rapid population growth forcing people to build many buildings here as their place of abode and for several socio-economic activities. Now I see Kasoa as one of the fastest-growing communities in the central region. (A middle-aged Queen mother)

This confirms the conclusions of the Ghana Statistical Service's statistics report, which stated that the population of the area had expanded dramatically

from only 836 individuals in 1970 to around 400,639 in 2021. The preceding is similar to numerous investigations done in developing nations on land use and land cover changes in metropolitan areas (Adjei-Mensah et al., 2019; Harraz, 2016). Most of these studies found many urban areas in developing countries to be undergoing tremendous changes due to increasing urbanization and increase in human population causing conversion of other land uses to especially built-up areas.

The significant increase in human population in the study area, primarily through migration from other parts of Ghana and beyond, was identified as the principal factor causing the rapid growth of built-up areas. Kasoa, for example, had a population of 863 in 1970 before increasing to 2597 in 1984, 34,719 in 2000, 69,384 in 2010, and 400,639 in 2021 (Ghana Statistical Service, 2020). As the population grew, so did the demand for land, leading in the conversion of various land types such as agricultural land, vegetation, and bare ground to meet housing and other infrastructural needs. Although these other land uses have, essential benefits to the ecosystem (provision, culture, etc.), these benefits are ignored for the sake of diverse human needs, which have started having several repercussions on the environment and humanity as several water bodies and wetlands have been destroyed. For example, in Kasoa, the land cover size for water in the year 1985 was 1.524sq. Km but this size reduced to less than half of its original size to 0.6336 sq. Km in 2021, indicating a loss of 4.57831% (Table 6). It was found out that some portions of the water body have been covered or filled with sand to make way for built-up areas. The Assembly Member for the Jei River Electoral Area stated that:

We have two river bodies here, but they are all shrinking. The Jei River for example has some of its parts and banks covered with sand to make way for people to build their houses. Although the main river is still there, people have built all around it, which is causing flooding around the area every time it rains.

Apart from the land size for water that witnessed a reduction in its coverage, agriculture and vegetation land cover also suffered a high reduction in land size. Table 6 shows that agricultural and vegetative areas are two of the land cover classifications that have seen a significant decline in land size. Land sizes for agriculture and vegetation in 1985 were 47.737 sq. km and 46.314sq.km respectively, but under the study period of 36 years thus 1985 to 2021 these land use classes recorded a decrease in size thus 9.4824sq.km for agriculture and 11.644sq.km for vegetation representing a decrease (negative) percentage change of 34.5 % and 20.6 % respectively. This shows that both land cover classes experienced about 98% decreased land cover size together. Similar results were seen in a number of the assessed papers, suggesting a general tendency toward the contraction of agricultural and vegetative land covers and the expansion of urban areas. For instance, Biney and Boakye (2021), study on urban sprawl and its influence on land use/ land cover dynamics in Secondi Takoradi concluded on a considerable change in the land covers in which settlement and built-up had an average yearly increment over the study period. This was also the conclusion of many other scholarly works including studies by Adjei-Mensah et al., 2019; Belal and Moghanm, (2011).

The results from the field were analysed further, and the findings showed that the significant expansion of built-up areas is not merely a result of simple population growth; rather, it is mostly due to the proximity of the study region to the nation's capital city, Accra. This was discovered through further research of the results from the field. Several developers and residents have established structures in the region to capitalise on the spillover effects of the metropolitan area and to facilitate access to diverse economic opportunities available in the capital city. The research revealed that a majority of the inhabitants residing in the Kasoa study region tend to reside locally while commuting to the metropolitan city for employment opportunities. One of the primary sources of information provided the following statement.

I choose to live here because Accra is already congested with many people so some of us decided to settle here in Kasoa, which is a few minutes to Accra. I am not from here; I came from the Eastern Region of Ghana to look for a job in Accra, but I and my other friends have lived here for about 13 years but work in Accra. So, every day I commute in the morning to Accra to work and return in the evening in Kasoa (57-year-old male respondent).

The above statement highlights the importance of proximity to the capital city in the rapid population growth of Kasoa. Although Kasoa is in the Central Region of Ghana but due to its proximity to Accra, it has witnessed huge infrastructural development to serve as a home to thousands of people

from Accra. This has made Kasoa to be functionally considered part of the Greater Accra Region, which has Accra as its capital (Adugbila, 2019).

Lastly, the study also revealed that the increase in the population of the area over the decade is a result of the refugee camp that was set up in 1990 by the government to accommodate the influx of Liberians who fled to their country during the civil war. June 2010 was the official cessation of the refugee for the refugees in the settlement, settlers of the refugee were advised to move out of the camp or go back to their home country. The study revealed that most of the refugees after the cessation of the camp acquired land and moved into Kasoa. A respondent stated that most lands were sold to them around the time when everyone knew the program was coming to a halt. He said this as follows:

Even though the United Nations put an end to the refugees' program in Ghana those who already settled are still with us. Some of them are now landowners, because after the program ended most of them stayed and worked to be able to afford and acquire lands outside the camp. Now they all live with us. (57-year-old Male respondent)

The issue of many Liberian refugees still living in Kasoa is a clear attestation of foreigners taken a chunk of Kasoa's population as revealed in the literature and several reports of the area. For instance, a study by Addo (2016), on Liberia Camp (Buduburam) in Kasoa indicated that the camp is not only occupied by Liberians but also Nigerians and some other refugees including

those from Sierra Leone and that even after the cassation most refugees decided to stay since they had lost their families in their home country.

Land Surface Temperature and Urban Expansion

The rates of urbanisation across the globe are rapid, and as a result, the quality of several aspects of the physical environment, such as temperature and rainfall, is in jeopardy as a result of these rates. One of the most significant issues that arise as a consequence of increased urbanisation is the formation of urban heat islands (UHIs). According to Peng et al. (2012), at the present time, the Urban Heat Island is one of the most significant problems facing the environment in terms of the influence it has on land usage and vegetation cover. As a result, it is an essential indication of the continued viability of the environment.

In the case of this study, the analysis of land surface temperature using satellite photos for the study area provides the base year of the study. As a result, a satellite image from 1985 is compared to one from 2003, and then that of 2021 is compared to the 1985 image. The purpose of these studies is to investigate the changes in surface temperature that have occurred over the past three decades and to determine how those changes relate to shifts in land use and land cover. By calculating the temperature of the land's surface, which falls under the purview of the Umweltbundesamt (UBA), the German Government Agency for Environmental Protection, the Land Surface Temperature acts as a crucial indicator for evaluating the state of the environment. In a recent report regarding the global temperature, the agency stated that the year 2020 was the second warmest year on record and



degrees Celsius to a maximum of 30.8 degrees Celsius in the base year (1985) of the study. The results of the research (shown in Figure 7) also indicate that the temperature of the land surface in the same region ranged from a minimum of 21.00 degrees Celsius to a maximum of 30.00 degrees Celsius in the year 2003.

Figure 7 gives a detailed account of the change that has been experienced in the area for 18 years in terms of land surface temperature. The image (Figure 6) shows that within the (18) interval years the land surface temperature which, had the lowest range of temperature to be about 9.96 degrees Celsius tremendously increased to 21 degrees Celsius. However, the region in the south of the research area had an average temperature that was 30.8 degrees Celsius higher than the rest of the area during the base year (1985). In the instance of the year 2003, the analysis of the study demonstrated that the region's greatest temperature, which was thirty degrees Celsius, was not clustered as it had been in the case of the base year but was rather dispersed mostly across the entirety of the region that was the subject of the study.

The research from 1985 found that the northern portions of the study had a pattern of temperature variation that was quite stable. This is very similar to the low temperatures experienced in the northern part of the study area in 2003, which ranged from roughly 21.1 to 24.1 degrees Celsius. As indicated in Figure 7, in terms of the study area and the variations in temperature that it experienced, the portion of the study area that experienced the highest type of heat was the southern section of the study area.

Result of Land Surface Temperature Changes from 1985 to 2021

On a broader scale, one of the focuses of the study was to assess the changes in land surface temperature that had been experienced in the study region over the course of the previous 36 years. This aspect of the study was undertaken with the intention of gaining further insight into the phenomenon. The findings of this study helped establish a connection between shifting patterns of land use and land cover and the temperature of the earth's surface, which ultimately led to increased environmental sustainability. The variations in temperature that have been experienced throughout the course of the years are depicted clearly in Figure 8 of the study's findings.

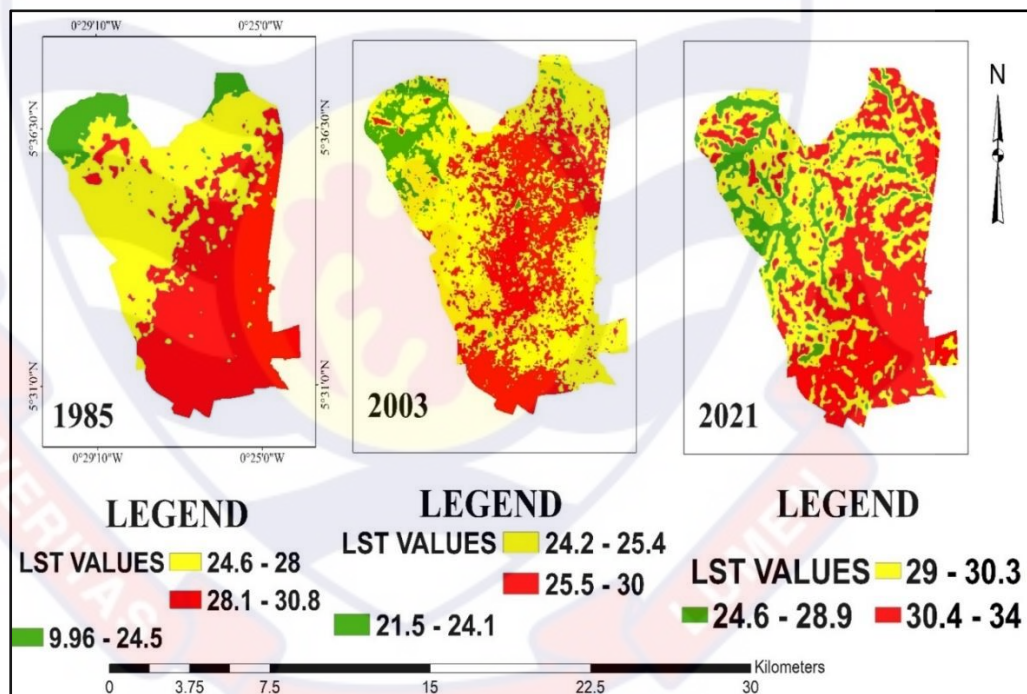


Figure 8: Land Surface Temperature Changes (1985- 2021)

Source: Author's Construct (2022)

The study aimed to analyse the changes in land surface temperature that occurred in the study region during the previous 36 years, on a more comprehensive level. The findings of this analysis facilitated the establishment

of a relationship between changes in land use and land cover and variations in surface temperature, which in turn have implications for the maintenance of ecological balance. The eighth figure in the study findings provides a comprehensive illustration of the fluctuations in temperature over time.

The base year used for the study was 1985; this showed that the land surface temperature of Kasoa ranged from the 9.96 (lowest) to 30.8 degrees Celsius (highest). The analysis for the year 2003 also shows the surface temperature in the same area ranged from 21.00 (lowest) to 30.00 (highest) degrees Celsius while the year 2021 had the land surface temperature ranging from 24 to 34 degrees Celsius. The study revealed that within the 36 years interval, the lowest temperature recorded in the study area saw a tremendous increase from 10 degrees Celsius to 24 degrees Celsius, which is about a 140 percent increase in temperature under the 36 years under study (Table 6).

Table 6 of the study indicates that the maximum temperature in the study region increased from 30.8 to 34 degrees Celsius, representing a temperature change of approximately 10.4 percent during the study period. The study area exhibited an average increase of 25 percent over the course of 36 years.

It is noteworthy that certain areas within the study region exhibited a greater degree of increase in comparison to other regions, which is consistent with the alterations observed in the classification. The study reveals that the classes pertaining to land use/land cover analysis exhibited a significant rise in built-up during the study period, and concurrently experienced a notable surge in temperature with the increase in built-up over time. The findings suggest that vegetated land areas underwent a transformation into bare land, which

was subsequently repurposed for construction purposes. As a result, the land became covered with concrete, thereby exacerbating the heating of the land surface and leading to a subsequent increase in land surface temperature. According to Näschen et al. (2019), various studies have demonstrated that the conversion of any other type of Land Use/Land Cover to cropland or built-up areas is likely to result in the most significant temperature increases.

The analysis of trends revealed that the region situated in the southern part of the study area exhibits the most elevated temperature. In the year 1985, the maximum temperature of 30.8 degrees Celsius was recorded in the southeastern region, proximal to the central eastern portion of the examined locality, as illustrated in Figure 8. In 2021, it was observed that the southeastern region of the study area, which is in proximity to the Middle Eastern portion, exhibited elevated temperatures in certain locations. The recorded temperatures were approximately 34 degrees Celsius, consistent with the land use and land cover data analysis indicating that during the year 1985, the majority of the southern region of the study area was utilised for agricultural purposes, either devoid of vegetation or sparsely vegetated. After a span of 36 years, the complete land region of the southern segment of the examined area underwent a transition into a developed area. This phenomenon can be attributed to the swift escalation in temperature that the surveyed region has undergone throughout the years.

Nevertheless, it is noteworthy that the rate of change in the southern zone, as previously discussed, does not significantly deviate from the trend observed in the remaining regions of the study area. With regards to the years under investigation, it was observed that in 1985, the minimum temperature

value of 9.96 degrees Celsius was recorded solely in the northern regions of the study area. Conversely, the southern part of the study area predominantly exhibited the highest temperature values, as depicted in Figure 8. According to the analysis conducted in 2003, there was a notable rise in surface temperature rates ranging from 9.96 to approximately 26 and 34 degrees in the majority of the northern and central regions by the year 2021. It is noteworthy that during the period under investigation, all factors that led to the rise in temperature were occurring within the study region. The majority of the verdant lands in the vicinity have been transformed into structures, serving either residential or commercial functions, as depicted in Figure 8. Overall, it was noted that the temperature in Kasoa has experienced a significant rise during the period under consideration, as evidenced by Tables 5 and 6. The study commenced in 1985, during which the minimum land surface temperature recorded was 10 degrees Celsius. After a span of 36 years, the study area experienced a significant surge in temperature, with the lowest surface temperature being recorded at 24 degrees Celsius in 2021.

Table 7: land surface temperature and percentage changes (1985- 2021)

Land Surface Temp. 1985	Land Surface Temp. 2003	Land Surface Temp. 2021	Percentage Change (1985- 2003)	Percentage Change (2003 to 2021)	Percentage change (1985- 2021)
9.96	21.50	24.6	115.863	14.186	147
24.6	24.20	29	1.62602	18.8367	18
28.1	25.50	30.4	9.2526	19.2157	8
30.8	30.00	34	2.5974	13.3333	10.3

Source: Author's Construct (2022)

Discussion on Changes in Land Surface Temperature

The study results for land surface temperature throughout the 36-year period suggested that Kasoa has suffered and continues to suffer from a high rate of temperature as a result of the world's rapid expansion in urbanisation. The study used satellite picture data at 18-year intervals, therefore it covered the 36-year span between 1985 and 2021. According to the analysis of land surface temperatures, the temperature increased by about 147 percent (Figure 5) over the course of the 36 years under consideration, from the lowest temperatures ever recorded in the base year (1985), which were 9.96 degrees Celsius, to 24.6 degrees Celsius in 2021. These findings support existing research by Cobbinah et al. (2019) and Macarthy (2012) which contends that governance and urban design are key factors in mitigating the effects of climate change.

This research came to the conclusion that urban planning is still a useful strategy for coping with climate change and its effects on attaining Sustainable Development Goal 11. One must not overlook the fact that obtaining these outcomes is essential to accomplishing the Sustainable Development Goals, especially Goals 11 and 13. The underlying goal of urban planning is to build socially inclusive, economically dynamic, and environmentally sustainable cities and communities. The research discovered a correlation between the nature of urban and spatial planning and environmental changes. This resulted from conversations with certain representatives of significant institutions covered by the study. For instance, a representative from the Environmental Protection Agency said that community planning is a major factor in the current state of the climate.

How cities and towns are built considering the change in vegetation cover influences the impact of temperature and climate change all around the world. This is because poorly planned cities are very much prone to the impact of climate change than properly planned cities.”

This corroborates a study by (Darkwah et al., 2018) the study argued that African cities and the form of urban growth are affected by local socio-economic factors, which are acknowledged by climate change and unplanned urban growth zones. The study also revealed that in 2021, the highest temperature ever recorded 10.3 percent higher than in 1985. These findings once more demonstrate that the highest surface temperature recorded in the first year (1985) was 30.8 degrees Celsius, and that it increased to 34 degrees Celsius with an increase of roughly 10%. According to 2019 NASA research on global climate change, temperatures are rising at varying rates worldwide, with warming over land where urbanisation is taking place typically being higher than in the oceans. According to the report, extreme land temperatures will likely be warmer than the world's average surface temperature, with significant regional variations. Due to this, more hot days are anticipated in most land regions, including Western and Southern Africa. According to the analysis, twice as many megacities as there are today projected to experience heat stress with increasing temperature above 1.5 degrees Celsius, potentially exposing 350 million more people to heat by 2050.

According to the study findings, the study region has seen an unusually high temperature, which is in line with the NASA report, utilising the 1.5

degrees Celsius increase as an indicator of substantial increases in temperatures. This is due to the fact that when expressed in percentage terms, the average temperature increase for the research period was roughly 47%, which is far beyond the NASA requirement.

Literature indicates that Land Surface temperatures are frequently higher in urban and barren soil regions than in regions with vegetation cover and bodies of water (Sodoudi et al., 2014; Wemegah et al., 2020). This is due to the cooling effects of evaporation, evapotranspiration, and shading generated by water and vegetation-covered areas. These studies suggest that the daily impact of rising land surface temperatures contributes to the attainment of Sustainable Development Goals, particularly Goal 11, which aims to construct sustainable cities and communities in every country by 2030.

Nature of land-use governance and loss of vegetation

Numerous studies suggest that the rapid increase in population is associated with the expansion of urbanisation, which creates an ecological imbalance in unplanned development environments (Chaurasia, 2019; Weber & Sciubba, 2019). The majority of global environmental degradation can be attributed to the expansion of croplands and cities. It has also been demonstrated that urban expansion causes the displacement of cropland, resulting in the global loss of vegetation. Between 1992 and 2015, according to a study by Van Vliet (2019), urban expansion caused the direct loss of 3.3Mha of forest and 4.6Mha of scrubland, and contributed to the loss of 24.3Mha of cropland. The study predicts an increase in the loss of natural land and cropland, necessitating the implementation of measures to guide urban development and minimise its environmental impacts.

The purpose of this study is to examine the nature of land use management in the study area and its function in the process of expansion. Land ownership in Ghana's Kasoa (study area) is governed by the customary land ownership system, wherein chiefs, rulers of family, or clans, and thus individuals, can only acquire land through grants, sales, gifts, or marriage. This indirectly affects the nature of urbanisation, as the rate at which land is leased to individuals determines the rate at which the area expands (United Nations Environment Programme, 2018)

This corroborates the results of the satellite's image analysis, which indicates a loss of more than 90 percent of the green cover over the 36-year study period (Table 4). In the local assembly system, the Development Planning Unit is primarily responsible for overseeing the implementation and evaluation of development initiatives and programmes. In a system of decentralised governance, the entity is accountable for localised growth in terms of development.

As previously discussed, the results of the image analysis indicate that the study area has lost more than 90 percent of its vegetation greenness over the past 36 years. In an attempt to find out why this is so, an official from the Development Planning Unit said this.

The population of Kasoa keeps growing; 10 years ago, when I started working here it was not like this. It keeps increasing every day and it puts pressure on the small infrastructure we have. The population growth is not only from internal growth but also from overflow from the capital city. This is because the

capital city is full and very congested so many people prefer to stay here and work in the capital city (40-year-old male).

This suggests that the inflow population contributes to the rapid loss of vegetation cover in the area as such people often clears the vegetation to make way for different infrastructural activities. He was of the view that the population of an area (Kasoa) contributes to the nature of development in the area. Consequently, as the population grows the need for land increases due to human activities. This result corroborates with the many studies that suggest that an increase in population contributes to vegetation loss. Most of the findings of such studies suggest that the rapid means of vegetation loss determines the faster rate of urbanization (Chen et al., 2022; De Carvalho & Szlafsztein, 2019). De Carvalho and Szlafsztein (2019), concluded that the rate of urbanisation can be predicted based on the rate of vegetation loss in a region. The official from the Development Planning unit further explained that the unplanned and unregulated nature of the area's development is the primary cause of vegetation loss. He said this:

The physical changes that have happened in this area have had a tremendous effect on our agricultural lands because everyone is building, most of the agricultural lands have now been turned into built-up areas, we are not planting food crops as we use to. First, we use to have the plantation farm, the Jei River farms has now been turned into an estate building for residential use. For smallholder farmers, just a few

people are doing it now even though it is those who have lands and are not ready to build that use the land for smallholder farming. About 10 years ago, 95% of the people who lived here were farmers, but this has reduced drastically (40-year-old male).

The nature of the land-use plan determines the rate of new emerging residents in an area and the conversion of various land-use land-cover into built-up areas, so land use management plays a crucial role in urban expansion. A study by Biney & Boakye (2021), revealed that the administrative function of land management determines the extent of conversion of land use/land cover. This was consistent with the findings of the present research, which determined that land management institution activities influence the rate of vegetation loss.. Owusu (2018), in his study, suggested the requirement for a change in the city's development paradigm in order to address what David Maddox refers to as the "city we want," which in his opinion must solve three key issues, including the resilience, sustainability, and liveability of the city (Maddox, 2013). The representative from the Land Use and Spatial Planning Authority remarked as follows:

In 1990, with the help of international partners, sector plans were developed by the assembly in consultations with the chiefs since they are the custodians of the lands, but these plans were not followed as the landowners did not cooperate with us the assembly. Therefore, by the time we realized, places demarcated on the sector's plans as schools

and roads were used for different land-use purposes as you can see (43-year-old male).

The study further revealed that traditional authority in the area also holds a similar view that the increase in the land demand in the area has contributed mainly to the loss of the many agricultural lands that existed in the past years. A representative of the traditional authority said this:

We used to have an internationally recognized farm here called Jei river farms, they were into the planting of pineapples but now the place is turning into built-up area because a lot of people have encroached on the farmlands. Apart from that, the individual farms are there but you should know that Kasoa is a municipal area, so we are not in serious farming unlike 30 years but now into commercial businesses thus buying and selling.

A representative of the Unit Committee of the area who said this also supported the above comment.

First Kasoa used to be a farming community although some physical developments were happening; we still had our farms like the Jei River farms. Six years ago, the farms were there but just within a year, the whole place is now covered with people's houses. If you see the place now and they tell you that a year ago, it was used as a plantation farm you will not believe it even the chief used to have a

plantain plantation but now it is no more. All those have been sold for people to build (35-year-old Male).

This confirms a study by Ziem Bonye et al., (2021) which revealed that over the past few decades, urban development has significantly encroached upon agricultural land in the peri-urban centre, resulting in a reduction of available space. According to these scholars, urbanisation is causing a competition for land that was previously utilised for agricultural purposes, resulting in the displacement of smallholder farmers to rural areas. This phenomenon is observed both globally and in Ghana (Abass et al., 2018; Kuusaana & Eledi, 2015).

Many academic works have demonstrated a clear correlation between human-nature interaction and the intricate interplay of natural and social elements, including but not limited to the fundamental challenge of population growth, finite resources, and unanticipated environmental advancements. The aforementioned studies demonstrate that Land Use/Land Cover Change, as a multifaceted system, exerts a significant influence on ecosystems across various spatial dimensions, particularly with regards to environmental sustainability. This impact is manifested through the alteration of key components such as the atmosphere, soil, plants, and hydrology (Chen et al., 2015; Kerns et al., 2018; H. Zhao et al., 2018).

However, the findings obtained from the study region are consistent with the situation observed in other global locations, in relation to the repercussions resulting from the rapid pace of growth being witnessed. An interview conducted with a group of elected assembly members in the region has corroborated that the alteration of land use and land cover has become a

source of strain on various aspects of the environment, including sanitation, flooding, temperature fluctuations, and air quality, among other factors. In their own words, these are what they said:

A few years back area use to witness some flooding, but it was not disruptive but now because that people have built-in waterways flooding is a big problem here. In places such as Shalom, the flooding situation is worse because people have to vacate their homes for some time when it rains heavily since all their homes are flooded. Areas around the Jei River have similar experiences because part of the river has been covered to make a home for the construction people's home so when it rains the river overflows its banks (37-year female).

Another assembly member representative emphasized this argument by saying:

First, we use to have deep forests and big trees around where I live now and the air at that time was good as compared to what we have now. Even where we are sitting now there were many big trees. Even the school environment the air then was different we use to sit there on weekends but now all the trees are gone so we do not have that again (40-Year-old male).

With regards to interventions, considering the rapid nature of the urbanization process the area is experiencing accompanied with many adverse

effects, one will expect that much be done to protect the environment and Ghana's commitment to achieving sustainable cities. However, it appears that the current state of affairs is disparate, as there has been a dearth of efforts to regulate the ongoing advancements. Based on the findings of multiple interviews, it is evident that the nation lacks a comprehensive legal and policy framework aimed at attaining sustainable urban areas. Personnel from the Parks and Gardens Unit of the Physical Planning Department of the area stated as follows:

We are in charge of maintenance and protection of green and open spaces in the municipalities. We also undertake horticulture training for people in the municipality and carry out tree planting of extinct greens. In addition, my department is also in charge of the annual tree planting initiative by the national government but because its implementation has been politicized, the aim of combating environmental issues of climate change is not being achieved. This is because most of the trees that are being planted are not even growing as expected because good care is not given to them (38-year-old male).

Further contact was made with the Environmental Protection Agency in the district to determine whether there are any laws or policies in place to safeguard the natural environment from the effects of urbanisation. The Environmental Protection Agency (EPA) is a public institution committed to enhancing, preserving, and advocating for the nation's environment, while

pursuing ecologically sustainable progress through effective and efficient resource administration. In a quest to find out laws or policies that protect the natural environment from the many effects of urbanization, an officer from the EPA said this:

I am not aware of any of such intervention but what I know is that the planning department is responsible for regulating some of these things but also remember that our assembly system does not have all the resources they need to enable them work effectively (32-year-old female).

The Land Use and Spatial Planning Authority in Ghana under the decentralized system are responsible for community and town planning. The Authority is required to supervise the emergence and the expansion of cities in accordance with community sector plans.

However, findings from the Land Use and Spatial Planning Authority also suggest that, although they are no specific laws or policy directly linked to achieving sustainable cities, the implementation of the assembly building permit system helps the planning and building of sustainable cities. The challenge, however, is that the government does not own many lands which makes absolute control of lands in the study area and Ghana as a whole challenging. As earlier stated, the Authority however uses its permit issuing system to control and check for unplanned growth and expansion in cities and town that are expanding contrary to their sector plans. This is no different from the study area Kasoa; this is because head of the land and spatial planning authority commented that:

I would say that lands use management is one of our most challenging works as an authority. This is because the government does not own majority of the lands in Ghana, which makes government control of these lands difficult. In the case of Kasoa, majority of the lands here in this town are customary lands just as many other places in Ghana, and so the landowners decide the uses of the land with very little control from us the authority. Even the few areas where the sector plans have been prepared in consultations with the landowners' development take place with or without permit from the authority. The most times we are forced to give permit to landowners to build residential houses in areas allocated for say a school or a recreational park in the sector plans (35-year-old male).

This conforms to studies by Ubink & Quan, (2008) and Yeboah & Obeng-Odoom, (2010) which concluded that the planning institution in an attempt to implement development plans are at the mercy of the of the landowners. Yeboah & Obeng-Odoom (2010), suggested that the main causes of these differences in implementation are rigid land tenure regimes, a deficient legal system, excessive political meddling in the planning process, a lack of human resource capacity, and inadequate money.

Discussion on nature of Land-Use Governance and Land Use /Land

Cover Changes

It is imperative to take into account the causal relationship between development and its effects when prioritising sustainability in the realm of urban development. There exists a necessity to inquire whether it is justifiable to exert pressure on landowners in order to attain sustainable development, while simultaneously utilising their land resources, and demonstrating that the advantages derived from such measures surpass the associated expenses. Frequently, land is utilised as a commodity for immediate profit without regard for the resultant harm and its enduring ecological implications.

The quick change in land use/land cover changes in the research region (Kasoa) can be directly attributed to the nature of land uses and its governance practises, as evidenced by interviews and direct observation done on the ground.

Land Use and Spatial Planning Authority and the Development Planning Department in the local district assembly, who are mandated by law to manage development in the area have very little control over land management due to the fact that it rests with the stool owners. This result confirmed a study by Alhassan (2006), which suggested that around 80% of lands in Ghana are in the custody of customary authorities and so its owners carry out its management. From the colonial days to the present, chiefs have openly protested against attempts by successive governments to take control over lands in this country (Amaoo-Otchere, 2024).

The (LUSPA) established under the Land Use and Spatial Planning Act, 2016 (No. 925 of 2016) in the local governance system have the sole

responsibility for ensuring the sustainable development of land and human settlements through a decentralized planning system being practiced in Ghana. However, from the study, contrary to the above provision was found. It was discovered that the traditional authorities (chiefs) in the study area virtually control land management, and that without consulting the Municipal Assembly of the area, they indirectly dictate the use of lands, which often goes against the layout or development plans designed for the area by the Municipal Assembly.

From the interview, the head of the Land Use and Spatial Planning Authority said that before any developmental plans are drawn the Assembly has the responsibility of engaging all stakeholders in the area including the traditional authorities and the local authorities in preparation of sector plans. These sector plans or layouts are a physical planning document that shows how the emerging communities should be built, in terms of layout and structures. When this consultation is done, and the plans are designed it makes room for all social amenities taking into consideration the sustainability of the area. However, in Kasoa, the study found that developments taken plans do not conform to the available plans. This was supported by interview with an official from the Development Planning Unit of the Municipality who had this to say.

In Kasoa, development has gone ahead of the planning layout that we have on paper, and not every part of Kasoa has layout plans. Even for those that have the plans, there has been a lot of encroachment but now we are revising all the layouts that we have to

see how we can salvage the situation here (45-year-old male).

This, therefore, shows the disparities between plans drawn on paper and what is actually on the ground. In the area of Kasoa (study area), a demarcated area assigned for use as a playground for recreational activities on paper now is being developed as a residential area with a bad road network.

The results, therefore, show a clear disparity between what is planned on paper and what is implemented on the ground.

The study also found that the area's rapidly expanding population is partly to blame for its increasingly urban landscape. Therefore, development must be accelerated to meet anticipated demand. Additional evidence in support of the aforementioned conclusion was obtained through an interview with the director of the Land Use and Spatial Planning Authority. The official said this:

Before any planning scheme can be approved, key land uses that needs to be available on the scheme to promote sustainable development are checked. These land uses include playing grounds, ceremonial grounds, however, in this area all those land uses have been encroached upon for different purposes. For instance, sanitary places are now used for people's homes, with some roads encroached upon for residential land uses. This is a major problem in not only Kasoa but also Ghana as a whole (48-year-old male).

This highlights the finding by Yeboah & Obeng-Odoom (2010), that despite the best efforts of Ghana's land management organisations, tensions between the country's traditional land owners and the country's planning authorities persist. This also buttress the arguments by Kloos et al. (2015), that experts have identified unplanned urban expansion as a national indicator of climate change risk in Northern Ghana.

In an effort to understand why landowners participate in such behaviour, the traditional area's queen mother emphasises that the quick development of Kasoa is excellent because locals have benefited from it. The spokesperson of the traditional council in the study area stated that:

Kasoa is the most densely populated place in the central region. The population here is greater than that of Cape Coast. It is the third most densely populated in the whole country, which I believe will soon become the first most populated municipality in the country because judging by the rate of population growth and the availability of lands to expand as compared to the other district assemblies. In the next 30 years some virgin areas here, that have not been allocated will all be filled with people's homes and businesses which will be good for us because people here will get jobs to do. I believe that in 30 years' time Kasoa will have a high skyscraper though it will come with challenge, but we will solve them as we develop (57-year-old male).

The study finding highlights the disregard towards the achievement of Sustainable Development Goal 11. Stakeholder for the short-term benefit or goal. From the findings, stakeholders of land management institutions can be said to be improvident with measures aimed at the achievement of short-term benefits that result in long-term stress on the environment rather than measure with long-term benefit to the now and future generation. This confirms studies by Gondwe et al. (2019), which attributed the disregard for sustainable measures or strategies to the limited knowledge in implementing management plans of landowners and land management institutions. This disregard was argued by Gondwe et al. (2019), was confirmed by the spokesperson for the traditional council who stated that:

We own the land, so as people are settling here, we cannot say we will not sell the land to them, and when we do, we cannot tell them what to use the lands for. Therefore, it is the assembly's responsibility to check and control. In as a people, all we want is for our community to expand to bring about development so we will continue to sell our lands. It is the job of the Assembly planning department to see to it that the development that is happening is sustainable (57-year-old male).

This underscores the fact that most land is assigned without sufficient consideration of planning criteria, even though in theory a permit from the assemblies is required before one may purchase land for a certain

development. This was noted by each, and every planning officer included in the research.

According to the research, even though the Awutu Senya East Municipal assembly was funded by a World Bank project in 1990 to consult with traditional authorities on land use and development issues, land litigation is still a major barrier to progress across much of the country, of which Kasoa is a part. Institutions and procedures governing land use often play a significant role in the emergence of such conflicts. Several studies have suggested that the effects of urbanisation, including population growth and stress on the natural environment, are consistent with the goals of land management institutions and the mechanisms they use to regulate the land. This raises the issue of how well the assembly is planning, considering the dynamics of the current rate of increase. The Development planning officer initiated that.

The assembly as you can see development is happening at an increasing rate most of which has not approved every effective, but resource need to check these irregularities are not available to us. We do not have vehicles to go to the field to inspect and put a stop to irregular constructions. Moreover, because we do not work on weekends people use that to build wherever they want. To demolish a structure in Ghana you need a court order and that alone takes a long process, which most times do work (50-year-old male).

The study results show that the assembly's inability to implement sector plans is a result of the indiscriminate nature of landowners and the assembly's inability to discontinue landowners from building with no regard to planning.

This confirms literature studies by Akudugu, (2012, 2013); Chinsinga (2008); Crook, (2003). These studies indicated that an effective planning requires a strong legal foundation because it gives the planning authorities the regulatory support, they need to help the planning authorities achieve their aims and objectives. The planning rules in Ghana have created a framework, nonetheless, that is not very responsive to the socio-cultural and economic situation on the ground which makes implementation challenging. Concerning Ghana's decentralised system, there is a discrepancy between ideals and realities. The report continues by arguing that local officials' motivation to do their jobs well is hampered by the lack of suitable resources at the Sub-national levels. Inadequate human resources and a weak legal framework, among other reasons, are cited in a number of published publications as being detrimental to the efficiency of decentralised systems of administration at the local level.

The intervention of Urbanization on Environmental Sustainability

Considering the many implications of urbanization on the natural environment. Varied stakeholders to ensure sustainability is achieved if not to the full extent put measures of intervention in place. The rapid increase in population has been found to influence and accelerate the rate of urbanization. Over the past few years, as the study shows, the rapid rate of urbanization in the study area, Kasoa, has resulted in several environmental problems. There

is therefore no doubt that some interventions need to be undertaken to protect the natural environment to achieve environmental sustainability, which is a target of SDG 11 that focuses on environmental sustainability. From the various interviews conducted for the study, it was clear that the Municipal Assembly of the study area was pushing for measures to recover the loss of vegetation cover that has been lost to the built-up environment.

In an interview for the study, the head of the Land and Spatial Planning Authority stated that, the assembly during its last general meeting agreed to enact a byelaw. These by-laws at requiring residents in the study area to planting of trees to be incorporated into the assembly permit system where before permits are issued to developers will be giving seedlings for planting in the form of one tree one house. This is to be done in collaboration with the Forestry Commission. In an interview with some of the unit committee members, a member of the committee confirmed that such an initiative had been discussed at the general assembly and members have agreed to such considering the rate of urbanization in the area and to also restore the loss of vegetation and contribute to green spaces in the study area.

The challenge, however, according to an official from the parks and garden unit under the LUSPA is the continued supply of seedlings to the assembly to give out to individuals to plant. In an interview, he opined that because this is not a tree-planting initiative backed by the government the continued commitment on the side of the forestry commission to supply the needed seedlings for the initiative could be of concern. Another challenge is the continued water supply to help the trees to grow. Water supply is a huge problem in the study area due to different reasons such as lack of proper

planning, destruction of pipelines due to discriminate constructions in the area however the authority is considering food planting trees which need little or no water to grow.

On the other hand, the government of Ghana launched the Green Ghana project in 2018 with the stated goal of encouraging the people of Ghana to plant 20 million trees by 2028 in an effort to slow the effects of climate change and global warming and to secure the future of the planet's environment. The head of the Development Planning Unit in the study area stated in an interview that although the assembly has involved the people in this annual project since it began, the aftermath has not been very successful due to people's lack of interest and the communities lack of water supply to ensure the growth of the trees that were planted. However, he thinks the assembly will educate the locals on the necessity of such an initiative to help preserve the project and fight climate change if the new plan is adopted and resources are made available.

According to Aisa Kirabo Kacyira, Deputy Director and Assistant Secretary-General of the United Nations-Habitat, part of the solution to urbanisation rests in how cities are planned, managed, and deliver services to their residents. The literature implies that unsustainable development can result from poorly managed urbanisation. Strategies like incorporating land-use governance into urban planning frameworks are recommended in the report. When this is achieved, cities will be planned, designed, and developed in a way that reduces their negative effects on the natural world. This will strengthen their economy and make them more resistant to climate change. Research suggests that firms can save money on utilities, transportation, and

other necessities by locating in compact communities that have these features already in place. As a result, private investment for economic growth is bolstered, along with productivity and efficiency.

The study also discovered that the ASEMA assembly is presently engaged in a "produce permit" activity thanks to the efforts of the Development Planning Unit and the Land Use and Spatial Planning Authority. Since this is central to the Authority's mission, the Land Use and Spatial Planning Authority has been working on it for quite some time. The difficulty, though, has been the activity's actual usefulness. The head of the Authority says that the lack of funding from the assembly is to blame for this difficulty. According to the results, a combined task force comprised of representatives from the development-planning unit and the Land Use and Spatial Planning Authority was formed to combat the threat posed by unchecked development in the study region. Although there has been a decline in unauthorised construction since this regulation went into effect, the problem of unchecked land usage remains.

Summary of Chapter

This section of the thesis included a four-Landsat satellite image with the results and analyses of the data gathered from the fieldwork and secondary sources. Data tables and figures displayed land cover attribute information generated between 1985 and 2021. They were discussed in light of other related material in an effort to shed light on the study's research questions. Discussion also turned to findings from interviews with a range of interested parties about land management and governance in the study area, as well as initiatives to attain environmental sustainability.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter presents a summary of the entire research, key findings and the overall conclusions that were drawn from the study. The chapter also presents some recommendations deemed necessary and finally proposes some areas for further studies.

The main purpose of this study was to assess the urban expansion of Kasoa and its effects on environmental sustainability. The study sought to:

- Analyse the extent of urban expansion in Kasoa from 1986 to 2019.
- Examine the surface temperature of the area of Kasoa.
- Assess the land-use governance of Kasoa.

To achieve its goals, the study chose for an explanation sequence research design that allowed for extensive and detailed explanatory investigation, data gathering, and analysis. The study included both quantitative and qualitative methods. Regarding the quantitative side of things, satellite pictures from 1985, 2003, and 2021 were analysed using ArcGIS version 10.5, and the results were presented in tables and maps. Land Use and Spatial Planning Authority chiefs, directors, and staff; Environmental Protection Agency; Lands commission; Development Planning Department; Assembly members; Opinion Leaders; and others were interviewed in depth to collect primary data. Thematic analysis was performed on their responses using the qualitative analysis software MAXQDA Minar.

Key Findings

The following were the key findings that emanated from the study.

- The findings of the image analysis pertaining to the diverse land use and land cover (LULC) categories spanning from 1985 to 2021 evince significant transformations in the region's land cover and land use. The recorded data indicates that the vegetation experienced a reduction in its area, decreasing from 46.3186 sq. /km in 1985 to 11.6442 sq. /km in 2021, which corresponds to a decrease of 74.9 percent.
- The land size exhibited an increase in both built-up area and bare land. The built-up area has undergone a significant increase from 0.355 sq./km in 1985 to 59.6286 sq./km in 2021, resulting in a percentage increase of 16696.8 Percent. Similarly, the bare land has also experienced a substantial increase from 0.010 to 14.5503 sq./km in 1985, indicating a percentage increase of 145403 percent.
- The area covered by water surfaces exhibited a decline similar to that observed in agriculture. The study area's water surface area was recorded as 1.524 sq. / km in 1985, which subsequently decreased to 0.6336 sq. / km in 2021, indicating a reduction of 58.4 percent. Similarly, the agricultural land area decreased from 47.737 sq./km in 1985 to 9.4824 sq./km in 2021, representing a total land size decrease of approximately 80 percent.
- Between 1985 to 2021 the study area experienced significant changes in temperatures. The lowest temperature for the area in 1985 was recorded at about 9.96 degrees Celsius to about the highest temperature of 30.8 degrees Celsius.

- In 2003, the lowest temperature increased from 9.96 degrees Celsius in 1985 to 21.5 degrees Celsius, while the highest temperature recorded did not and was just around the 30 degrees Celsius as recorded in the year 1985. However, the result was not the same in 2021; the lowest temperature recorded a significant increase of about 24.6 degrees Celsius with the highest temperature recorded at about 34 degrees Celsius. This significant increase in temperature in 1985 from an average of 9.96 degrees Celsius to 34 degrees Celsius showed a percentage increase in temperature in the study area of about 147 percent.
- The study's results indicate that the urbanisation rate in the region is attributable to migration, the spillover effect of the expanding population in the capital city of Accra, and the study area's proximity to the aforementioned city. As per the statements made by the area's chief, the expansion of the community is attributed to the rise in population growth. This phenomenon has resulted in the transformation of farmland and vegetation into urbanised regions. According to the Land Use and Spatial Planning Authority, the region is experiencing rapid growth that exceeds initial projections.
- The challenge of managing sustainable development in the area is compounded by the fact that the land is not under state ownership. At present, there exists a dearth of legal frameworks or regulations that safeguard the natural ecosystem in areas experiencing swift urban growth. Representatives of the Land Use and Spatial Planning Authority have indicated that while permits for diverse land use are

granted to the public, there is a dearth of legislation in effect to safeguard against the swift depletion of natural habitats due to urbanisation. The responsibility of comprehending the impact of deforestation on the environment and climate rests with the customary leaders and proprietors of land.

Conclusions

Based on the findings of the study, the following conclusions can be drawn:

Land Cover and Land Use Changes

Kasoa has experienced significant changes in its land cover and land use classes over the past four decades due to population increase. The area of built-up land increased by approximately 16,696.8 percent from 1985 to 2021. Consequently, there was a significant decrease in vegetation and agricultural areas by about 75 percent and 80 percent respectively, as these areas were converted into built-up areas due to urban expansion. This observation is consistent with other research findings in similar areas. Additionally, there was an increase in bare land as some vegetated areas were cleared to accommodate other land use classes.

Surface Temperature Changes

The surface temperature of Kasoa has undergone notable changes. The study area exhibited an average minimum temperature of 9.96 degrees Celsius in 1985, which escalated to 24.6 degrees Celsius in 2021, indicating an approximate 147 percent increase. The maximum temperature also increased from 30.8 degrees Celsius to 34 degrees Celsius, reflecting a 10.3 percent rise. The regions within the study area that experienced the highest temperatures are those developed for human habitation, aligning with previous research

indicating that urbanized regions significantly contribute to rising temperatures.

Environmental Policies and Management

There are no specific laws or policies in Ghana that directly protect and manage the environment to achieve environmental sustainability. Land management institutions execute their responsibilities through the implementation of local policies and strategies. Noncompliance with these policies is often due to a lack of respect for local governing bodies. When belief systems collapse, community members tend to act with impunity, leading to rapid environmental degradation.

Recommendations

Based on the key findings and conclusions of the study, the following recommendations are made:

Enactment of Environmental Protection Laws

The Ministry of Local Governance, Decentralisation, and Rural Development, through the local decentralized governance system (District Assemblies), should enact laws and policies aimed at protecting the natural environment. This is crucial due to the rapid population growth and accelerated rate of urbanization in Ghana. The Ministry must decentralize its commitment to achieving the Sustainable Development Goals (SDGs) through sensitization and public education on the importance of sustainable living.

Stakeholder Coordination and By-Law Implementation

Various stakeholders and land management institutions, such as the Traditional Authority, Land Use and Spatial Planning Authority (LUSPA), Environmental Protection Agency (EPA), development planners, and Lands

Commission, should collaborate to develop and implement appropriate by-laws to protect the natural environment from unplanned conversions to other land uses.

Environmental Education

The LUSPA, in partnership with the EPA, should embark on environmental education initiatives to inform community members and the public about the need to conserve and protect the environment. These initiatives can include community workshops, radio programs, and frequent announcements at community centers.

Collaboration for Local Law Enforcement

Traditional Authorities and landowners should work with Metropolitan, Municipal, and District Assemblies (MMDAs) to help implement existing local laws. This collaboration will help curb the indiscriminate building of structures and the creation of concrete surfaces, which contribute to increased surface temperatures. The resultant effect will be more orderly land development based on planning schemes, enhancing environmental sustainability.

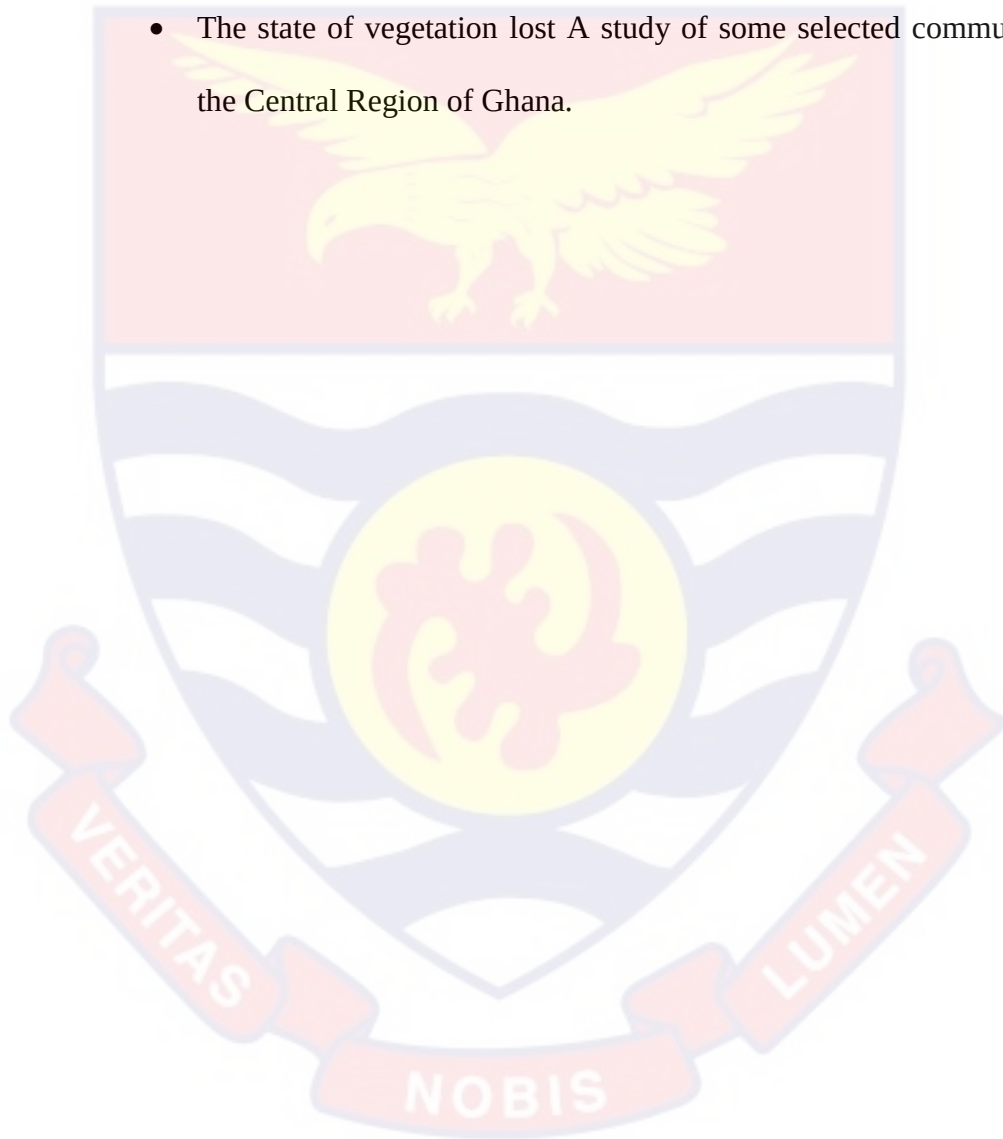
Tree Planting Initiatives

The Forestry Commission should work with the Awutu Senya East Municipal Assembly and traditional leaders to plant trees and ensure their growth to replenish lost vegetation. This will contribute to environmental sustainability and help mitigate the effects of urbanization on the natural landscape.

Areas for further studies

Based on the finding of the study, the following research topics have been suggested for further research:

- Air quality as an indicator of environmental sustainability in Kasoa Ghana
- The state of vegetation lost A study of some selected communities in the Central Region of Ghana.



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APPENDIX A

UNIVERSITY OF CAPE COAST

COLLEGE OF HUMANITIES AND LEGAL STUDIES

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

INTERVIEW GUIDE- LAND MANAGEMENT INSTITUTIONS

Good morning/afternoon. My name is Berikisu Liman. I am a student reading MPhil Geography and Regional Planning at Department Geography and Regional Planning, University of Cape Coast (UCC). I am researching *Effects of Urban Expansion on Environmental Sustainability: Analysis of Land Use/Cover fragmentation in Kasoa, Ghana*. We want to understand how urban expansion is regulated and its consequences on environmental sustainability. We are interested in understanding how urban land-use policies are implemented taking into consideration environmental sustainability in the area. For example, how sustainable policies are implemented ensures that environmental sustainability is achieved. The information, which you are going to share with us, will not be shared with anyone else. If you however do not feel comfortable talking to us, please let us know. We are not going to share any information about our discussion with you, with your superior, or with anyone else. We are not giving any rewards for participation in the study. We thank you for your willingness to take part in this study. This discussion should take about 30 minutes. Please confirm that you have understood why we are doing this study and whether I can continue with the interview. If you need to get any other information, please contact Berikisu Liman via email at berikisu.liman@stu.ucc.edu.gh or 0500029492.

Demographics

1. Sex
2. Age
3. Level of Education
4. Number of years stayed in the community.
5. Occupation
6. Position in Institution (if applicable)

Module 1- Understanding the Dynamics of the Urban Expansion.

7. What can you say about the dynamic of urban expansion in this area?
8. What are some of the identified changes you have observed since you settled in the area? Probe into causes of the identified changes.
9. How long have you known or observe these changes be to happening?

Module 2 Understanding the Expansion of Kasoa Affected the Vegetation

Richness of the Area

10. In your perspective, have there been any changes in the vegetation (greenness) in the area over the last 30 years/ since you settled here? (Probe: how and why).
11. Do you think the changes in urbanization has affected the vegetation in the area since you settled here? Probe (Activities such as agriculture, built-up).
 - Air pollution
 - Flooding
 - Agriculture/ farming
 - Plant life / other species

Module 3- Understanding the Nature of the Land Use Governance in Kasoa.

12. What do the national policies say about regulations of urban expansion in relation to environmental sustainability?
13. What policies/interventions have been put in place by your institution to ensure the regulation of urban expansion in the area?
14. Are there any of these policies/ interventions geared toward ensuring sustainability? (Particularly environmental sustainability thus green vegetation, planned land cover change.)
15. How effective are these policies in combatting rapid urbanization and environmental sustainability.
16. How have these policies impacted the area since urbanization started here rapidly
17. How involved are the communities in the formulation and implementation of these policies and interventions.
18. What role do the communities play in the management and regulation of the ensuring sustainability?
19. In your opinion, what could be done differently to ensure rapid urbanization happens along with environmental sustainability?

APPENDIX B

UNIVERSITY OF CAPE COAST

COLLEGE OF HUMANITIES AND LEGAL STUDIES

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

INTERVIEW GUIDE- LOCAL AUTHORITY

My name is Berikisu Liman. I am a student reading MPhil Geography and Regional Planning at Department Geography and Regional Planning, University of Cape Coast (UCC). I am researching *Urban Expansion on Environmental Sustainability: Analysis of Land Use/Cover fragmentation in Kasoa, Ghana*. We want to understand how urban expansion is regulated and its consequences on environmental sustainability. We are interested in understanding how urban land-use policies are implemented taking into consideration environmental sustainability in the area. For example, how sustainable policies are implemented ensures that environmental sustainability is achieved. The information, which you are going to share with us, will not be shared with anyone else. If you however do not feel comfortable talking to us, please let us know. We are not going to share any information about our discussion with you, with your superior, or with anyone else. We are not giving any rewards for participation in the study. We thank you for your willingness to take part in this study. This discussion should take about 30 minutes. Please confirm that you have understood why we are doing this study and whether I can continue with the interview. If you need to get any other information, please contact Berikisu Liman via email at berikisu.liman@stu.ucc.edu.gh or 0500029492.

Demographics

20. Sex
21. Age
22. Level of Education
23. Number of years stayed in the community.
24. Occupation
25. Position in Institution (if applicable)

Module 1- Understanding the Dynamics of the Urban Expansion.

26. Could you briefly explain to me about the dynamics of urban expansion in this area?
27. What are some of the identified changes you have observed since you settled in the area? Probe into causes of the identified changes.
28. How long have you known or observe this change be happening?

Module 2 Understanding the Expansion of Kasoa Affected the Vegetation

Richness of the Area

29. In your perspective, has there been any changes in the vegetation (greenness) in the area over the last 30 years. Kindly explain your answer. (How) consider other land cover types.
30. Do you think the changes in urbanization has affected the vegetation in the area since you settled here? Such as:
 - Air pollution
 - Flooding
 - Agriculture/ farming
 - Plant life / other species

Module 3- Understanding the Nature of the Land Use Governance in Kasoa.

31. Is the community aware of any measures put in place by government agencies to regulate urban expansion and to ensure environmental sustainability?
32. How involved are the communities in the formulation and implementation of these identified measures and interventions to manage land use land cover change? (In terms of consultation and engagement)
33. How effective are these policies implemented by the government to manage the land use land cover changes?
34. What measures/interventions have been put in place by the communities ensure the regulation of rapid urban expansion and environmental sustainability?
35. How have the policies influenced the changes that is happening in the communities now?
36. In your opinion, what could be done differently in the management and regulations of land use land cover changes to ensure environmental sustainability.

APPENDIX C

UNIVERSITY OF CAPE COAST

COLLEGE OF HUMANITIES AND LEGAL STUDIES

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

INTERVIEW GUIDE- FOCUS GROUP DISCUSSION

My name is Berikisu Liman. I am a candidate of MPhil Geography and Regional Planning at the Department Geography and Regional Planning, University of Cape Coast (UCC). I am researching *Urban Expansion on Environmental Sustainability: Analysis of Land Use/Cover changes in Kasoa, Ghana*. We want to understand how urban expansion is regulated and its consequences on environmental sustainability. We are interested in understanding how urban land-use policies are implemented taking into consideration environmental sustainability in the area. For example, how sustainable policies are implemented ensures that environmental sustainability is achieved. The information, which you are going to share with us, will not be shared with anyone else. If you however do not feel comfortable talking to us, please let us know. We are not going to share any information about our discussion with you, with your superior, or with anyone else. We are not giving any rewards for participation in the study. We thank you for your willingness to take part in this study. This discussion should take about 30 minutes. Please confirm that you have understood why we are doing this study and whether I can continue with the interview. If you need to get any other information, please contact Berikisu Liman via email at berikisu.liman@stu.ucc.edu.gh or 0500029492.

Demographics

- 37. Sex
- 38. Age
- 39. Level of Education
- 40. Number of years lived in the community.
- 41. Occupation
- 42. Position in Institution (if applicable)

Module 1- Understanding the Dynamics of the Urban Expansion.

- 43. What can you say about the dynamic of urban expansion in this area?
- 44. What are some of the identified changes you have observed since you settled in the area? Probe into causes of the identified changes.
- 45. How long have you known or observed this change to be happening?

Module 2 Understanding how the Expansion of Kasoa have affected the Vegetation Richness of the Area

- 46. In your perspective, have there been any changes in the vegetation (greenness) in the area over the last 30 years. (Probe: how and why)
- 47. Do you think the changes in urbanization have affected the vegetation in the area since you settled here? Probe (Activities such as agriculture, built-up)
 - Air pollution
 - Flooding
 - Agriculture/ farming
 - Plant life / other species

Module 3- Understanding the Nature of Land Use Governance in Kasoa.

48. Is the community aware of any measures put in place by government or non-governmental organizations to regulate urban expansion and in achieving environmental sustainability in any of the areas listed below?

- Green vegetation (green spaces such as forest reserves)
- Planned land cover change. (Land use for settlement, farming, etc.)

49. How involved are the communities in the formulation and implementation of these identified measures and interventions to manage land use land cover change? (Probe: conception, consultation, brainstorming, engagement, implementation, monitoring, etc.)

50. Are there any measures or activities being done by the communities in the terms of groups, unions, or enterprises to help achieve environmental sustainability indicators listed below:

- Green vegetation
- Planned land cover change.

51. How effective are this intervention implemented by the government to manage land use land cover changes?

52. What measures/interventions have been put in place by community authorities to minimize rapid urban expansion and attain environmental sustainability?

53. How have the policies influenced the changes that are happening in the communities now?

54. In your opinion, what could be done differently in the management and regulation of land use land cover changes to ensure environmental sustainability?