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Green Space Security in Urbanising Medium-Sized Cities in Sub-Saharan Africa: Evidence from Sunyani Municipality, Ghana

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Abstract
Green space security is a vital issue in rapidly expanding cities, particularly in medium-sized cities in the Global South, where most future urban population growth is expected to occur. The effects of green spaces on urban and peri-urban living, including ecosystem services such as climate regulation, flood prevention, public health, recreation, biodiversity, and food production, are broadly recognised. This study examines green space security in Sunyani Municipality, Ghana, a medium-sized city undergoing rapid urbanisation. Through analysis of Landsat images from 1989 to 2023, a community survey, and institutional interviews, changes in green spaces and their socio-ecological drivers were identified. Findings indicate a 327.7% increase in built-up areas, a 41.8% decrease in dense vegetation, and systematic appropriation of designated green areas. These patterns reflect urbanisation trends typical of Sub-Saharan Africa and other developing regions. The study demonstrates that medium-sized cities experience disproportionate losses of green space relative to larger metropolitan areas, necessitating urgent proactive planning in secondary urban centres.

Keywords
Green spaces; Urbanisation; Urban and Peri-Urban Sustainability; Spatial Planning

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1. Introduction

Urban transitions reshape landscapes, with medium-sized cities emerging as important yet under-studied sites of environmental change (Muhoza & Zhou, 2025; Haase et al., 2023; Grimm et al., 2020). While research often concentrates on megacities, secondary cities house 40% of the global urban population and are projected to accommodate 96% of future urban growth, underscoring their global significance for green space dynamics (UN-Habitat, 2022; 2020). Physical environmental changes are largely driven by human activities such as farming, construction, mining, housing, and leisure. These changes indicate the extent of transformation in urban and peri-urban areas and reflect the sustainability and health of the environment (Spyra et al., 2025). In 2022, Ghana's population was estimated at 33.5 million, with 58% residing in urban areas, the third highest proportion in Sub-Saharan Africa (PRB, 2022). The Ghana Statistical Service (GSS) reports that since independence in 1957, the country's urban population increased from 23.1% to 56.7% in 2021 (GSS, 2021; 2014). The Bono Region is 58.6% urbanised, slightly above the national average, and the Sunyani Municipal Area is highly urbanised at 80.8

Urbanisation places pressure on green spaces in cities and their outskirts. These green areas provide critical ecosystem services that support urban life, including improvements to psychological, physical, and mental health (Gubbels et al., 2016; WHO, 2016; Wolch et al., 2014). They also improve neighbourhood quality and raise property values (Hoshino & Kuriyama, 2010; Mansfield et al., 2005; Tyrvainen & Miettinen, 2000), while fostering social interaction (Elmendorf, 2008). Green spaces mitigate the effects of climate change and heatwaves in urban environments (Escobedo et al., 2010) and provide aesthetic value that enhances residents' wellbeing (Wolch et al., 2014; Thompson et al., 2012; Grahn et al., 2010). They also support groundwater management by reducing surface runoff, filtering water, and recharging aquifers (Canteiro et al., 2023; Tetzlaff et al., 2021; Song et al., 2020), and enable urban food production, offering dietary supplements and income for households (Opoku et al., 2024; Bhebhe et al., 2023; Walsh et al., 2022).

Despite these ecological benefits, evidence indicates that urbanisation is reducing both the size and quality of green areas (Mensah et al., 2025; Namwinbown et al., 2024; Puplampu & Boafo, 2021; Narh et al., 2020; Abass et al., 2019). A study by Doe et al. (2022) in the Awutu Senya East Municipal Area, Ghana, documented a 152% increase in built-up area from 2014 to 2020, partly attributable to spillover from the Greater Accra Metropolitan Area. Agariga et al. (2021) reported a significant decrease in forest cover from 59,000 hectares to 34,000 hectares between 1986 and 2020 in the Asutifi North District, driven by population growth, agricultural expansion, urban development, and mining. Adusu et al. (2021) identified a similar pattern in Sunyani Municipality, attributed to urbanisation. Byomkesh et al. (2012) noted that in Dhaka, Bangladesh, green spaces declined from 44.8% to 24.1% while built-up areas surged from 13.4% to 49.4% between 1975 and 2005. Drivers included rapid population growth, economic development, illegal conversions, leasing of parks, weak protection policies, limited maintenance funding, and low awareness among policymakers and residents.

The government of Ghana launched the Green Ghana Day Project in 2021 to promote the benefits of green spaces. Celebrated annually on 11 June, the event involves distributing free tree seedlings to public and private institutions and individuals. In 2021, reports from Daily Graphic and Citi News Room indicated that over seven million seedlings were distributed by the Forestry Commission. The Ministry of Lands and Natural Resources (MLNR) states that the 2021 event achieved an 85% success rate and that plans for 2022 included planting 20 million trees nationwide. However, the initiative's overall effectiveness remains unassessed, as no formal evaluation has been conducted. Farm forestry programmes also provide seedlings to farmers, particularly cocoa farmers, to shade their farms and increase productivity. The Forestry Commission additionally employs the modified taungya system (Kalame et al., 2011) to reforest degraded reserves with farmer participation, primarily during the first three years.

Urbanisation pressures on green spaces follow common patterns across both developed and developing regions, but their local effects differ (Derdouri et al., 2025; Wei et al., 2025). Sub-Saharan Africa experiences the fastest rates of urban change globally (Montgomery, 2008), with medium-sized cities characterised by rapid peri-urban growth, complex traditional land tenure systems, and limited enforcement of planning regulations (Mensah et al., 2025; Namwinbown et al., 2024). Understanding these dynamics enriches urban ecology scholarship and addresses key gaps in research on secondary cities (Patel & Raval, 2024; Wu, 2014; McHale et al., 2013). This study examines green space security in Sunyani Municipality, a medium-sized African city, and provides insights applicable to similar contexts. The analysis advances understanding of changes in urban green space and supports evidence-based strategies for sustainable urban and peri-urban development.

1.1 Green Space Security

Green space security is a concept linked to food security and is defined by four pillars: availability, accessibility, utilisation, and stability (FAO, 2019). This paper presents the concept of green space security through these four dimensions:

- Availability pertains to the physical presence of green spaces within cities and towns. It relates to both the extent (size) and the spatial distribution of these areas (Rubaszek et al., 2023; Breuste & Rahimi, 2015; Van Herzele & Wiedemann, 2003; Swanwick et al., 2003).

- Accessibility refers to the physical distance, in terms of walking, cycling, and vehicle travel time, from users' homes to a green space. It also accounts for cost and other access barriers (Shackleton & Blair, 2013; Van Herzele & Wiedemann, 2003).

- Utilisation refers to the socio-ecological values residents associate with or derive from a green space, including its perceived usefulness and worth. Studies show that green spaces offering ample play and recreational facilities, rich biodiversity, and proximity to communities tend to have higher usage rates (Madureira et al., 2018; Shackleton & Blair, 2013; Swanwick et al., 2003).

- Stability pertains to the policies and practices that provide, protect, and manage green spaces, with the aim of their continuous improvement and use. Urbanisation often reduces green spaces due to institutional laxity and inefficiency (Abass et al., 2018; Cobbinah et al., 2021; Appiah-Opoku, 2023). Ensuring the stability of green spaces is a central concern for urban planners and managers.

1.1.1 Categorisation of Green Spaces

Various classifications of green spaces, particularly urban parks, have been proposed, focusing on accessibility and land size (Rubaszek et al., 2023; Combers et al., 2008; Breuste & Rahimi, 2015; Herzele & Wiedemann, 2003; Swanwick et al., 2003). Swanwick et al. (2003) categorised parks based on size and accessibility: principal, city, or metropolitan parks of at least 8 hectares; district parks up to 8 hectares accessible within 1,500–2,000 metres; neighbourhood parks up to 4 hectares with access within 1,000–1,500 metres; and local parks up to 1.5 hectares accessible within 500–1,000 metres. Accessibility distance is measured from the user's residence. Rubaszek et al. (2023) outlined standards for three levels of green spaces in Wroclaw, Poland, each with specific functions based on size and accessibility distance:

- Squares, pockets, and mini-parks smaller than 2 hectares with a maximum accessibility distance of 400 metres.
- Neighbourhood parks ranging from 2 to 5 hectares with a maximum accessibility distance of 800 metres.
- District and city parks over 5 hectares in size, accessible within a 1,200-metre distance.

Herzele and Wiedemann (2003) used different terminology but retained the focus on accessibility distance and surface area. They created their categorisation based on user preferences in Belgium to help monitor the quantity and quality of urban green spaces. Their system classifies green spaces into six size categories:

- Residential green space within 150 metres of a home.
- Neighbourhood green with an access distance of 400 metres and a surface area of 1 hectare.
- Quarter green with an access distance of 800 metres and a surface area of 10 hectares.
- District green with an access distance of 1,600 metres and a surface area of 30 hectares.
- City green with an access distance of 3,200 metres and a surface area of 60 hectares.
- Urban forests with access distances of 5,000 metres and surface areas of at most 200 hectares for small towns and 300 hectares for large cities.

In Ghana, green spaces are integrated into open and protected areas, as specified in the 2011 Zoning Guidelines and Planning Standards (MLNR, 2011). For settlements with at least 2,500 residents, the recommended standard is 0.5 hectares per 1,000 people, distributed evenly across the area, requiring a minimum of 1.5 hectares for a population of 2,500. Open spaces in neighbourhoods include playing fields, children's play areas, and parks with seating, comparable to mini-parks, pocket parks, or local parks described in the international literature (Rubaszek et al., 2023; Breuste & Rahimi, 2015; Swanwick et al., 2003; Herzele & Wiedemann, 2003). However, unlike some other regions, no maximum accessibility distance is specified. Protected areas include river and stream banks, coastal fronts, wetlands, forest reserves, culturally sensitive zones including sacred forests and mangroves, and other natural features (MLNR, 2011). The applicable standards are:

- Protective buffer for municipal shorelines: 60 to 90 metres (e.g., Weija Dam, Lake Bosomtwe).
- Major perennial rivers and streams: 10 to 60 metres (e.g., Volta, Tano, Offin).
- Minor perennial streams: 10 to 15 metres.
- Important intermittent streams: 10 to 20 metres.
- Streams within forest reserves: 10 to 50 metres.
- Wetlands: a buffer zone of 30 metres around the perimeter as defined by the high-water level.

1.1.2 Injustice or Preference in Green Space Accessibility?

The distribution of green spaces such as parks, gardens, community woodlands, and urban forests is linked to user preferences, environmental justice, and inequalities between wealthy and marginalised groups, particularly in low-income neighbourhoods (Jennings et al., 2012). This issue primarily concerns race, income levels, and the distinction between suburban and inner-city areas. Wüstemann et al. (2017) report that residents in German cities live within 183 metres of the nearest green space on average; however, significant per capita disparities exist between cities. Luz et al. (2019) found that Lisbon residents lack equitable access to green spaces, mainly because of uneven spatial distribution within the city. A study in Brussels found that neighbourhoods with higher proportions of low-income households often require residents to travel long distances to reach preferred green spaces (Phillips et al., 2022), suggesting that local green spaces may lack the quality features residents seek (Latinopoulos, 2022; Luz et al., 2019).

An alternative perspective holds that injustice in the distribution of green space is less a matter of wealthy versus low-income neighbourhoods, and more a function of the absence of supportive urban services that would make green spaces more attractive and purposeful. A study on urban park access and social equity in China by Xiao et al. (2017) found that underprivileged groups, such as migrants and residents of low-income housing, often have better access to urban parks. This outcome reflected deliberate public policies aimed at promoting equitable access, consistent with China's socialist approach to public policy.

2. Methods and Materials

2.1 Study Area

The Sunyani Municipality is one of twelve districts in the Bono Region. It was established in 1989 through Legislative Instrument LI 1473 upon the promulgation of the Provisional National Defence Council (PNDC) Law on Decentralisation (Law 207 of 1988) (Friedrich-Ebert-Stiftung, 2010). The district attained municipal status in 2008. It covers an area of 506.7 km², located between latitudes 7°20'N and 7°05'N, and longitudes 20°30'W and 20°10'W (GSS, 2014). It shares borders with four administrative districts, as shown in Figure 1.

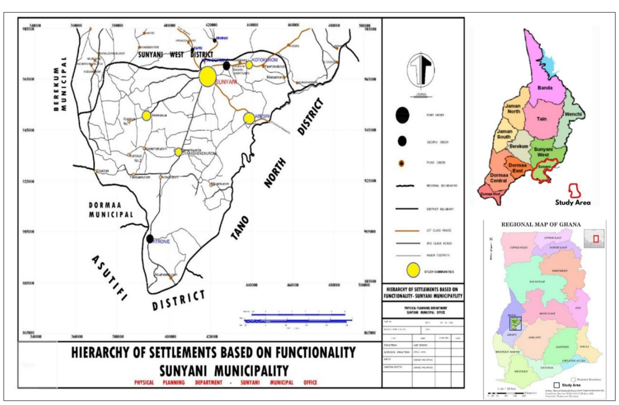

Figure 1. Study area in a regional and national context

The population of the municipality increased from 98,183 to 193,595 between 1984 and 2021, driven by migration linked to socio-economic development (GSS, 2021; 2014). The estimated population as of 2023 was 226,279, with an annual growth rate of 2.0%. This study projects the population to reach 250,007 by 2025 and 270,905 by 2030. Under the definitions for Metropolitan, Municipal, and District Assemblies, Sunyani Municipality is anticipated to attain metropolitan status by 2030 (Friedrich-Ebert-Stiftung, 2010). This transition could complicate spatial planning and development management, given the governance structures associated with metropolitan administration within the local government framework.

Sunyani serves as the central hub driving population growth in the Municipality. It hosts key attractors, including universities, businesses, administrative offices, social services, and related infrastructure. Of the total municipal population of 123,224 in 2010 (GSS, 2014), Sunyani accounted for 61.2%. Aside from Abesim (16,441), New Dormaa (6,226), and Atronie (4,638), the remaining twenty largest communities had populations ranging from 575 to 2,000. These communities reflect the city's outward expansion through land use change over the decades. Ongoing urbanisation and outward sprawl are gradually absorbing nearby towns on the city's outskirts.

2.2 Research Approach

This study employed a mixed-methods approach because human behaviours, cultures, values, processes, and institutional relations do not readily lend themselves to quantitative measurement alone. This approach provides narrative context to statistical data (Creswell, 2014, 2003; Williams, 2007), enables researchers to leverage the strengths of both quantitative and qualitative methods while minimising their respective limitations (Williams, 2007), and strengthens analytical depth and understanding of social phenomena (Fielding, 2012). Molina-Azorin (2012) indicates that mixed methods lead to stronger inferences and greater confidence in the validity of results.

2.3 Study Population

Study samples were collected from two frames. First, the community members' survey sample was drawn from the total population of five study communities (see Figure 1). The estimated population in 2023 was 128,709. The second frame consisted of institutions directly involved in land administration, spatial planning, green space management, and community development (see Table 3). These institutions were purposively selected according to their core responsibilities.

2.4 Spatial Data Acquisition

To investigate land cover and the pattern of changes in Sunyani Municipality, Landsat images from the United States Geological Survey (USGS) for 1989, 2003, 2013, and 2023 were acquired (Agariga et al., 2021; Yeboah et al., 2017; Aduah & Baffoe, 2013). Images were selected for their quality, clarity, and availability. The eleven-year intervals between images are appropriate for capturing significant physical changes over time. Table 1 presents the characteristics of the acquired Landsat images.

Table 1. Characteristics of acquired Landsat images.

Sensor	WRS Row	WRS Path	Number of Bands	Spectral Resolution	Date Acquired
LANDSAT 4 TM	55	195	8	30 m	1989-02-01
LANDSAT 7 ETM+	55	195	8	30 m	2003-12-27
LANDSAT 7 ETM+	55	195	8	30 m	2013-12-22
LANDSAT 7 ETM+	55	195	8	30 m	2023-12-18

2.5 Image Processing

Remote sensing (RS) techniques were used to correct distortions in the images. Pre-processing and stacking were subsequently carried out. As the images included multiple spectral bands, bands 1–7 were processed into an RGB composite for each of the study years (1989, 2003, 2013, and 2023). Post-preprocessing corrections addressed distortions such as scanlines and clouds, using cloud masking to remove sensor scanlines and cloud interference. Images were then classified into five land cover categories: arable land, bare land, built-up area, dense vegetation, and sparse vegetation. The Maximum Likelihood Classification Algorithm (MLCA) was applied. Thirty training samples per land cover category were selected using a stratified random sampling approach. High-resolution Google Earth imagery and local knowledge of the study area supported selection and ensured representative coverage of the different land cover types. Clear visual identification areas were prioritised, and attention was given to edge pixels and mixed classes to provide a rigorous, unbiased training dataset for accurate classification and to support reproducibility. ArcGIS 10.8 and QGIS 3.30 were used for processing. Figure 2 presents the resulting LULC maps.

2.6 Accuracy Assessment of the LULC Classifications

To assess the accuracy of the LULC maps for the study years, 20 reference points were selected per land-use category, giving a total of 100 points. ArcMap's Equalised-Stratified Sample Algorithm (ESSA) was used, and Google Earth Pro Engine was used to ground-truth these points. User accuracy, producer accuracy, and Kappa coefficients were calculated using ArcMap's Confusion Matrix Algorithm (CMA). These measures determine how accurately the LULC classifications reflect actual ground conditions, indicating the likelihood that a land cover category on the map corresponds to the actual ground truth.

2.7 Community Members' Survey

A survey of community members was conducted to examine residents' views on the availability, accessibility, use, and stability of green spaces in their neighbourhoods. The study combined geospatial data with community surveys to improve the comprehensiveness of the results (Phillips, et al, 2022; Rall et al., 2017; Bertram & Rehdanz, 2015). Simple random sampling was used to calculate the sample size for the study communities, based on the Yamane sample size formula:

$$n = \frac{N}{1 + Ne^2}$$

where n = sample size, N = population size, and e = level of precision or confidence interval (Israel, 1992). Substituting the figures:

$$n = \frac{128,709}{1 + 128,709 \times 0.05^2} = 398.76, rounded to n = 399$$

Table 2. Study communities, projected population, and sample size.

Serial No.	Community	Projected Population (2023)	% of Population	Sample Size by Proportion
1	Sunyani	101,629	79	315
2	Abesim	22,170	17	68
3	Nwanwasua	1,138	1	4
4	Kotokrom	2,457	2	8
5	Benu Nkwanta	1,315	1	4
Total		**128,709**	**100**	**399**

Proportional sampling was used to determine the sample size for each community based on the percentage of that community's population relative to the total population and the overall sample size. Results are presented in Table 2. Structured questionnaires were administered to 399 respondents in the study communities. Four research assistants conducted the administration over six weeks between March and April 2024. A total of 388 questionnaires were returned, representing a 97.2% response rate. In Sunyani, questionnaires were distributed using stratified sampling based on neighbourhood clusters, followed by simple random sampling to select households. In each household, one person was selected through convenience sampling. Respondents were required to be at least 18 years of age, consistent with Ghana's legal voting age.

2.8 Institutional Interviews

Institutional interviews included five public institutions, two traditional authorities, and one non-governmental organisation. Purposive sampling was used to select participants for face-to-face interviews with either the heads of these organisations or their designated technical officers (Puplampo & Boafo, 2021; Verheij, et al, 2023). These organisations manage or provide green spaces and land. Interviews lasted between 33 and 68 minutes, totalling 6 hours and 15 minutes. All interviews were audio-recorded with participants' consent. The lead author conducted the interviews using an interview guide, and the data were subsequently transcribed and analysed using Taguette and QDA Lite.

3. Results

3.1 Accuracy of the LULC Classifications

Table 3 reports overall accuracies of 84.48% for 1989, 83% for 2003, and 93% for 2013, with Kappa coefficients of 0.79, 0.79, and 0.91, respectively. These results indicate satisfactory validation of the study's classifications. Rwanga and Ndambuki (2017) posit that a Kappa coefficient of 41–60% is considered moderate, 61–80% indicates substantial agreement, and 81–100% represents near-perfect agreement. Kebede et al. (2022) and Rahman and Shozib (2021) further argue that a Kappa coefficient above 75% indicates very good accuracy, while a coefficient below 40% indicates poor accuracy.

Table 3. Accuracy of the LULC classifications

Year	Overall Accuracy	Kappa Coefficient (K)
1989	0.85	0.79
2003	0.83	0.79
2013	0.93	0.91
2023	0.93	0.91

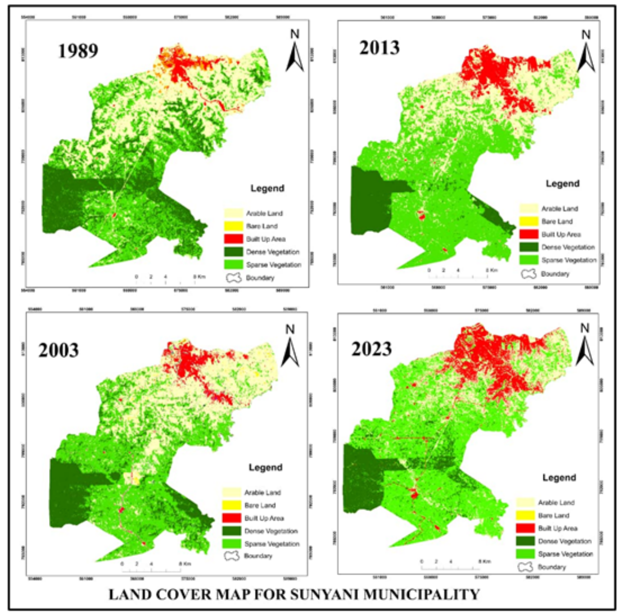

Figure 2. Landsat maps of LULC in Sunyani Municipality for 1989, 2003, 2013, and 2023

3.2 Expansion of the Built-Up Area

Over the 34-year study period (1989–2023), Sunyani Municipality experienced substantial changes in its physical landscape. Figure 2 and Tables 4 and 5 indicate significant growth in built-up area, reaching 327.7%, with an average annual increase of 4.7%. The years 2003 and 2013 recorded the most notable growth, with built-up areas expanding by 90.3%. Conversely, bare land diminished sharply by 98.8% from 1989 to 2023, with an average annual decline of 5.1%. The largest reduction in bare land occurred between 2003 and 2013, when it decreased by 87.9

Table 4. Trend and percentage distribution of LULC from 1989 to 2023.

LULC Classification	1989 (km^2)	1989 (%)	2003 (km^2)	2003 (%)	2013 (km^2)	2013 (%)	2023 (km^2)	2023 (%)	Change (km^2)	% Growth 1989–2023
Arable Land	162	32.1	170	33.6	147	29.1	106.7	21.1	-55.3	-34.1
Bare Land	8.4	1.7	3.3	0.7	0.4	0.1	0.1	0.01	-8.4	-98.8
Built-up Area	14.1	2.8	21.6	4.3	41.1	8.1	61.3	12.1	47.2	327.7
Dense Vegetation	145.4	28.8	89.6	17.7	61.7	12.2	84.7	16.8	-60.7	-41.8
Sparse Vegetation	175.5	34.7	221	43.7	255.3	50.5	252.7	50	77.7	44
Total	**505.4**	**100**	**505.5**	**100**	**505.5**	**100**	**505.5**	**100**		

Table 5. Percentage growth change in LULC for the study years.

LULC Classification	1989–2003 (%)	2003–2013 (%)	2013–2023 (%)	Average Change 1989–2023 (%)	Annual Growth (%)
Arable Land	4.9	-13.5	-27.4	-17.7	-0.5
Bare Land	-60.7	-87.9	-75	-176.6	-5.1
Built-up Area	53.2	90.3	50.1	160.2	4.7
Dense Vegetation	-38.9	-31.1	37.3	-57.6	-1.7
Sparse Vegetation	25.9	15.5	-1	41.1	1.2

3.3 Decline in Dense Vegetation and Arable Land

Between 1989 and 2023, dense vegetation decreased by 57.6%, with an average annual decline of 1.7%, as shown in Table 5. The most significant reduction occurred between 1989 and 2003, when dense vegetation fell by 38.9%. During the same period, sparse vegetation grew by 41.1%, with an average annual increase of 1.2%, reaching a peak rise of 25.9% from 1989 to 2003. Meanwhile, arable land declined by 17.7% over the study period, with an average annual decrease of 0.5%; the sharpest drop of 27.4% occurred between 2013 and 2023. An institutional respondent summarised these trends, noting the depletion of dense vegetation and the expansion of sparse vegetation:

> "Within Sunyani Municipality, we have seven forest reserves. Unfortunately, five of them have depleted. We have only two that can be considered natural forests. The remaining five have been turned into forest plantations." (IP.4)

The respondent provided additional factors behind the depletion of forest cover:

> "Since the population is increasing, food will be a challenge, so there will be a need for agricultural land for people to plant crops to feed the population. This calls for illegal activities within our forest reserves because the lands outside the forest reserves have been reduced for building activities." (IP.4)

> "Our main challenge is the annual bushfires. When we plant trees during the dry season, people set fires in the forest, and when that happens, the trees we have planted are burnt." (IP.4)

Over the 34-year study period, these LULC changes indicate a transition from forest and agricultural land to increasingly urbanised built-up areas. Expanding built-up zones are encroaching upon green spaces, leading to a significant decline. This loss affects the economic, social, and environmental services that green spaces provide.

3.4 Appropriation of Allocated Lands for Green and Open Spaces

Urbanisation in the study area has generated high demand for land. The spatial data in Figure 2 and Tables 4 and 5 clearly demonstrate built-up area expansion alongside a reduction in green spaces, including arable land. In Sunyani and Abesim, the conversion of earmarked green and open spaces, such as river and stream buffers, children's playgrounds, and marshy areas, into residential and other developed uses was particularly prominent. An institutional interviewee observed:

> "Sunyani is growing, and we have about forty schemes. If we pick the scheme, you will

> see that these areas have provisions for green spaces. Because of some issues, some chiefs have rezoned some of these open spaces, which is the department's challenge. As the town develops, the chiefs sell these created open spaces for people to build their structures, but it does not enhance the city's beauty." (IP.2)

> "When we go to the layouts, we see the sites suitable for green spaces, but other people occupy these spaces for different activities." (IP.2)

Household respondents were nearly evenly divided regarding the physical adequacy of green spaces in their neighbourhoods. The majority indicated they needed more green spaces, while a notable proportion were undecided, as shown in Table 6.

Table 6. Physical adequacy of green space as reported by household respondents.

Response	Frequency	Percentage (%)
Do not know	40	10.3
Yes	170	43.8
No	178	45.9
Total	388	100

Mean = 1.35, Mode = 2, Standard Deviation = 0.661.

When asked about the likelihood that landowners would convert allocated land to urban uses rather than maintain green spaces in local plans, respondents mostly agreed or strongly agreed. Only 10% disagreed or strongly disagreed, with the remainder neutral or undecided, as shown in Table 7.

Table 7. Cross-tabulation of the adequacy of green spaces against the tendency of landowners to appropriate allocated lands for green spaces.

Adequacy of Green Spaces	Strongly Disagreed	Disagreed	Neutral	Agreed	Strongly Agreed	Total
Do not know	0	4	6	15	15	40
Yes	8	10	29	70	51	168
No	11	7	35	64	58	175
Total	**19**	**21**	**70**	**149**	**124**	**383**

Institutional respondents corroborated household perceptions. One participant noted:

> "We realised that lands designated as open spaces are often repurposed for various uses. In a way, these lands are set aside for public use. If we had not taken action about four years ago, we might have lost the Children's Park already." (IP.3)

Another observed:

> "What baffles us is that after the scheme has been prepared, you will see someone having a lease on that same place allocated for open spaces, and when it gets to that point, enforcement becomes difficult." (IP.1)

A further institutional respondent stated:

> "When we restrict the layout, we clearly demarcate public spaces such as schools, hotels, clinics, and other areas meant for public use, designating them for specific purposes according to the layout. However, we are all aware that these public spaces are often quickly rezoned by the chiefs to sell to potential housing developers. Although laws oppose these rezonings, they frequently occur without the commission's awareness." (IP.5)

4. Discussion

4.1 Observed Patterns in Cities in the Global South

The findings support existing evidence that medium-sized cities undergo a disproportionate reduction in green spaces compared to larger urban areas (Bakhtsiyarava et al., 2024). In Sunyani, a 41.8% decrease in dense vegetation reflects trends observed in comparable Sub-Saharan African cities: Kumasi, Ghana (-39%, Abass et al., 2019); Hawassa, Ethiopia (-42%, Girma et al., 2019); Lubumbashi, Democratic Republic of Congo (-3.6 km², Ale, 2025); and Addis Ababa, Ethiopia (-32%, Arsiso et al., 2018). This indicates consistent regional effects of urbanisation on green space security. Over the past three decades, cities in Sub-Saharan Africa have typically lost 10–15% of their green spaces (Ale, 2025). Sunyani's annual green space loss rate of 1.8% falls within ranges reported for rapidly growing regions such as Sao Paulo and Mexico City, (de Lima, 2023) and Indonesia (1.6–2.3%, Susanti et al., 2016). These patterns highlight a global trend of urban ecological change driven by demographic pressures.

4.2 Decline in Availability of Green Spaces

The reduction in forest land use and cover, a key component of green spaces, is a cause for concern. Landsat image analysis reveals a significant decrease in dense vegetation, indicating a decline in both the extent and quality of green spaces at a broader scale. Dense vegetation decreased by an average of 10.9%, at an annual rate of 1.8% over the study period. This decrease is evidently linked to an increase in sparse vegetation, consistent with findings from other studies in Ghana and Sub-Saharan Africa. Aduah and Baffoe (2013) reported forest decline from 70.15% to 61.91% in the Sekondi-Takoradi Metropolitan Area, representing a reduction of 39.097 km² (11.753%) from

1988 to 2008. Similarly, Agariga et al. (2021) documented a 30.59% reduction (approximately 28,617 hectares) in forest cover between 1986 and 2020 in the Asutifi District. Adusu et al. (2021) investigated the same region and found that closed forests lost approximately 58% of land cover from 1986 to 2018. The Ministry of Environment, Science, Technology, and Innovation (MESTI) reports that, nationally, the area of closed forests shrank from 2.704 million hectares in 1990 to 1.556 million hectares in 2015, with an average annual reduction of 38,529.65 hectares. The overall forest degradation rate since 1990 has averaged approximately 45,931.03 hectares per year (MESTI, 2016). Across cities in Sub-Saharan Africa, vegetation cover generally declines by 10–15%, primarily due to rapid, unplanned urbanisation and related factors (Ale, 2025; Mensah, 2025; Appiah-Opoku, 2023).

4.3 Loss of Arable Land and Urban Food Security

The increase in sparse vegetation, also termed 'open vegetation' (Adusu et al., 2021), indicates forest degradation, possibly driven by efforts to secure arable land for a growing population. Rapid urban expansion in Sub-Saharan Africa consumes peri-urban arable lands (Muchelo et al., 2024) and displaces urban and peri-urban farmers, threatening their livelihoods and urban food security (Alemu & Kombe, 2025; Dadi, et al., 2023). Muchelo et al. (2024) found that 66.7% and 57.8% of agricultural land in Kampala and Mbarara, respectively, were absorbed by urban expansion. Tables 4 and 5 show a decrease in arable land, affecting food production for the growing population. Cobbinah, et al., (2015) noted that urbanisation disrupts peri-urban farmers' livelihoods, compelling them to seek work elsewhere. Abass, et al., (2018) observed a significant decline in staple food crop production in the Kumasi Metropolitan area due to urban land expansion into peri-urban zones. Studies in the Tamale Metropolis indicate that urban farmers are displaced onto marginal lands or further afield because of land conversion (Iddrisu et al., 2023; Kuusaana & Eledi, 2015). Opoku et al. (2024) suggest that the future of urban food security partly depends on urban farms if Sustainable Development Goal 2 (zero hunger) is to be achieved. Based on current growth trends, the population of the study area is projected to reach 250,077 in 2025 and 270,905 in 2030. Incorporating green productive areas into spatial planning and urban design is vital to addressing food supply challenges and conserving forests and green spaces within the Municipality.

Additional research is needed to understand how urbanisation affects local food production and to inform policy decisions. Priority areas for future research include longitudinal household surveys to monitor changes in farmers' livelihoods and assess the resilience of urban and peri-urban agriculture over time. Combining high-resolution satellite imagery with land-use data would enhance spatial analysis, enabling the mapping of land conversion trends and the identification of areas experiencing significant reductions in green space. Such research should evaluate the effectiveness of existing spatial planning frameworks and development controls in safeguarding food-producing green zones. It is also important to examine which urban governance models most effectively support food security and green space conservation, and how citizen-led initiatives can be scaled up to counteract the adverse effects of urban sprawl on agriculture.

4.4 Expanding Built-Up Area and the Availability and Stability of Green Spaces

The study area is predominantly covered by permeable surfaces such as vegetation and arable land, although impermeable built-up areas have increased substantially. This is consistent with Abass et al. (2018), who reported that the built-up area in the Kumasi Metropolis grew from 23.3% to 77.6% between 1986 and 2016, while green spaces declined from 76.7% to 24.4%. Muchelo et al. (2024) reported that Kampala's built-up area increased from 7.14% in 1989 to 55.10% in 2015, while Mbarara grew from 6.37% in 2002 to 30.95% in 2016. The Ghana Statistical Service states that the study area was highly urbanised at 83.1% in 2010 and 80.8% in 2021. Sunyani alone accounted for 61.1% of the urban population in 2010 and 57.2% in 2021 (GSS, 2021; 2014). The ongoing growth of built-up areas occurs mainly in new suburbs and on the outskirts of the city. Former vegetative cover is being replaced by expanding urban development, as noted by Abass et al. (2018) and Kuusaana and Eledi (2015). Land previously used for productive purposes is being converted to housing and commercial developments to meet growing urban land demand. Development in the study communities is resulting in the conversion of earmarked lands for open spaces, children's playgrounds, and parks. Even protected areas are being encroached upon by residential and commercial developments, adversely affecting the availability of and access to green spaces. Girma et al. (2019) document similar patterns in Ethiopia. Further research should examine the motivational and institutional factors underlying green space insecurity in the study area.

4.5 Inadequate Provision of Public Green Spaces

Tables 6 and 7 highlight a shortage of green spaces, particularly public parks, children's playgrounds, and urban forest. Institutional interviewees confirmed this deficiency. Although lands are allocated for children's parks and open spaces in the spatial plans of the study communities, only one recognised but poorly maintained public children's park exists in Sunyani and the entire Municipality. The other public park, known as the Office of Government Machinery (OGM) Park, is a strip in front of the Regional Minister's residence. Access to this park is highly restricted for security reasons. All other parks are either private or institutional, associated with churches, universities, senior high and basic schools, health facilities, and hotels, and remain undeveloped. Against the recommended threshold of 0.5 hectares per 1,000 residents (MLNR, 2011), the Municipality should have had approximately 193 mini or neighbourhood parks distributed evenly across the area as at 2021. The Municipality thus faces a severe deficit of green spaces, particularly public parks. This is consistent with findings from other cities, including Thessaloniki, Greece (Latinopoulos, 2022), Kumasi (Plange-Rhule et al., 2023), Accra (Yiran et al., 2025), and Mafikeng, South Africa (Munyati & Drummond, 2020). This deficit requires urgent attention from local government, regulatory institutions, and citizens alike.

5. Conclusion

This study investigated green space security in the context of rapid urbanisation in Sunyani Municipality, Ghana, between 1989 and 2023. The results indicate that the Municipality faces a critical environmental sustainability challenge that spatial planning has been unable to adequately address: significant decline in dense forest and arable land, a multi-fold increase in built-up area, and expansion in sparse vegetation. Dedicated public parks in neighbourhoods or across the city are woefully inadequate. Lands earmarked in local plans for green and open spaces have been rezoned and repurposed for housing and commercial developments. These changes have adversely affected the environment's capacity to provide ecosystem services to the growing urban and peri-urban population. The situation underscores the urgent need for planners, local authorities, citizens, and all stakeholders to coordinate their actions. The policy and planning implications of the findings are extensive. The spatial planning framework for allocating, protecting, and enforcing regulations on green spaces must be strengthened through clear policies and a supportive monitoring system. Successful strategies from other cities, such as Curitiba's low-cost integrated ecological management strategy in Brazil (Larbi et al., 2021) and the creation of urban green belts in Medellín, Colombia (Corburn et al., 2020; Patiño & Garcia, 2015), offer applicable lessons for Sunyani and similar cities in the Global South.

Aligning local urban planning regulations with international best practices and implementing targeted policy measures will help prevent further loss of green spaces and improve quality of life for expanding urban populations. This requires practical collaboration among stakeholders and sustained policy commitment at both the municipal and national levels. This study highlights the importance of green space security in secondary urban centres. While most existing research focuses on mega and metropolitan cities, medium and small towns experiencing urbanisation pressures remain comparatively understudied. Given that much future urban growth will occur in small to medium-sized cities in less-developed countries such as Ghana, planners, managers, policymakers, academics, and community leaders must prioritise these areas.

The study proposes the following recommendations. Municipal planners and managers should address both the quantity and quality of green spaces through collaborative, multi-stakeholder efforts to expand, enhance, and protect parks, buffers, marshlands, farms, street trees, forests, gardens, and other green zones. Enforcing existing laws and regulations on local spatial planning and development control is essential. Successful models, such as Da Silva and Lima's (2023) 15% green area ratio for Brazil, Kenya's urban greening programme (Mbugua, 2025), and application of digital technologies to urban forest management in Nairobi and Kampala cities (Chisika & Yeom, 2023) offer instructive precedents. Urban planners should ensure sufficient green spaces are embedded in municipal development plans, applying the standard of 0.5 hectares per 1,000 residents consistently during spatial planning and actual site development. Multiple locations suitable for parks, gardens, woodlands, and open spaces of different types should be allocated. Ecological connectivity between green spaces should be emphasised to create a network that promotes biodiversity and guarantees residents access to interconnected green areas. A national policy dialogue focused on green spaces in urban and peri-urban areas is needed, with the aim of developing a comprehensive green spaces policy and implementation guidelines for all stakeholders.

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7. Declaration of Competing Interest

There is no perceived or actual conflict of interest. This work is part of an ongoing PhD study being undertaken by the corresponding author under the supervision of the second and third authors.

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9. Data Availability

Owusu Debrah, Frank Kofi (2024). "Spatial and household perception survey data on green spaces security in Sunyani Municipality in Ghana", Mendeley Data, V1. https://doi:10.17632/ddk84gsf4z.1

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