SPATIO-TEMPORAL CHANGE DETECTION OF URBAN GREEN SPACE AS A RESULT OF REAL ESTATE IN GREATER ACCRA REGION

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ABSTRACT

Urban green space comprising parks, gardens, forests, wetlands and grasses, etc. is a fundamental component of the urban ecosystem which constitutes an integral part of the urban environment considering the immense benefits ranging from protecting biodiversity to improving quality air, aesthetics, and recreation. Greater Accra due to numerous anthropogenic activities conducted to uplift the region's physical developments has lost a significant amount of its vegetation, especially with the influx of lucrative real estate. This paper discusses the spatiotemporal change in green space and the impact residential developments have had on urban green space over the last 14 years (2007-2021), predicts the impact in the next 5 years, and lastly suggests effective measures to integrate green space into residential development to safeguard the urban ecosystem. Google Earth and QGIS software were used to process satellite data into the various landuse/landcover classes. The study discovered an ineffective policy implementation, low enforcement of existing regulations, and a lack of monitoring mechanisms (GIS & and other mapping software) to evaluate green space alongside residential development. The study also revealed a 1.4% annual decrease in urban green space and a 20% decline in Greater Accra's vegetation cover within the last 14 years. The study discovered some farmlands and wetland vegetation have been converted into sand wining and residential development sites. The main contributing factors to the situation are ineffective policy implementation, low enforcement of existing regulations, and a lack of monitoring mechanisms. The study recommends the integration of green space management plans as part of all residential development activities and proposes a well-structured institution among key stakeholders to ensure effective collaboration toward the formulation, implementation, and enforcement of policies on green space and residential development. An intense public education is proposed to create awareness of the benefits and need to safeguard the green space towards attaining SDG 11.

Keywords; *Sustainable Development Goal 11: Green infrastructure: Green Roof model: i-Tree Eco model: Real estate development: Land Change Modular.*

1. Introduction

Africa is increasingly becoming a hotbed for urban development by real estate developers, on the global front (Watson et al., 2013) This reflects the recent development trends in major cities like Johannesburg, Abuja, Nairobi, Accra, etc. where different architectural edifices are sprinkling up. The last decade depicts a change in the pattern of urban growth in Ghana, especially in the Greater Accra Region which complements the current global trends in the formation of shopping malls, long-glass towers, resort centres, huge affordable housing projects, and others (Aabeyir et al., 2022). Shelter is a basic requirement for humanity and the attempt to enhance physical infrastructural development has a direct spatial alteration on temperature, vegetation, and climate across the globe (Aabeyir et al., 2022).

Greater Accra, like many other developing centres, is affected by the situation where the demand for accommodation exceeds the supply. The inflow of new residents necessitates the erecting of additional establishments and a new way of life. Thus, enough land and resources are required to support these developments which influence individuals and estate development companies to resort to accessing already occupied lands (old structures) and turning them into modern residences. Those who cannot afford the exorbitant prices of existing structures resort to the urban peripheries to grab lands from farmers. The arable lands are turned into building sites which has the potential to negatively influence food security and urban green. Despite the numerous opportunities presented by the extensive developments, this emerging developmental trend poses a detrimental effect on the physical environment, especially the urban green space. The alteration of the urban green space has become the most threatening human-induced urban phenomenon of our dispensation resulting in climatic changes such as urban heat islands (Addo-fordwuor, 2014). The green infrastructure like wetland vegetation and street trees morphed into other land use forms like road construction, residential facilities, education, banks, and health facilities. Recent debate and research works are centered on the accessibility, distribution, alteration, and benefits of green spaces, however, concerns about the preservation, sustainability, and potential restoration of the green spaces before infrastructure

development in Ghana are not highlighted. For instance, (Osumanu et al., 2019) in their work "Expansion of Wa in Space and Time" emphasized the change in green space but failed to provide a comprehensive account of sustainable practices to preserve urban vegetation. The research attempts to bridge.

(Puplampu & Boafo, 2021) revealed most areas in underdeveloped countries are rapidly declining in urban vegetation and continuously face the effects of the change in climate in the form of high-rise temperatures and perennial floods. Hence, the need to further deliberate and establish the correlation between green space availability, functionality, and development associated with Real Estate Development. As noted by (Clement et al., 2020), an improved standard of urban comfort depends basically on the quantity and quality of vegetation and this is a reflection of the assertion that "when the last tree dies, the last man dies". However, the survival of green space is threatened by the conversion of urban vegetation space into physical infrastructure and public utilities. This void therefore presents a range of problems to urban development in the dispensation of climatic change relating to shocks and stresses like floods, heat waves, etc. Comprehensive studies in Ghana (Adarkwa, 2012; Addo-fordwuor, 2014) show infrastructural developments like road networks, and commercial structures contribute to the changes in green space. (Stow et al., 2007) a similar study in Accra revealed a 5.9% reduction in green space cover between 2002 and 2010. (Anarfi et al., 2010) assert that the lack of research attention and policy direction on urban vegetation constitutes a huge sustainable development challenge for city developers and planners. The growing threat to green space in Greater Accra is gradually eroding the societal benefits residents derive from the environment making this study relevant to pursue. The resuscitation of urban vegetation lies at the heart of the concept of Sustainable Development Goal 11, which intends to make cities inclusive, resilient, and sustainable (Hall, 2006) but it's in jeopardy hence, the need to provide an effective framework to compel developers to response to challenges engulfed with the urban green space amid their activities. Under these circumstances, it is important to assess the spatial orientation and distribution of Real Estate and residential activities in Greater Accra, and the green space dynamics as an essential component of sustainable urban advancement. Hence, the research will examine and project the spatial variations in Real Estate establishments and vegetation in Greater Accra from 2007 to 2021; analyze the impact Real Estate and Residential Development

has on the urban vegetation space and environment in Greater Accra; and then predict the condition of Real Estate and residential development activities and vegetation in the next 5 years (2028). Lastly, this study suggests effective measures for further development in the Real Estate industry without distorting the spatial distribution of the Greater Accra green space. Aside from contributing to the academic literature, the study will serve as a reference to enlighten policies' direction towards safeguarding green space. This research provides empirical evidence on Real Estate Development's impact on urban vegetation in Greater Accra and a glimpse of how the region will look in the future should the trend continue. The findings of the study will also provide stakeholders in the regional development with critical information on areas to anticipate Real Estate and Residential Development in the future.

1.1. Research Study Area

Greater Accra is the smallest among the sixteen (16) regional demarcations of Ghana in terms of landmass. It extends about 3245km² and is considered the fastest-growing region in terms of infrastructure and population. The population is 5,455,692. (GSS, 2021) and comprises of 29 Metropolitan, Municipal and District Assemblies (MMDAs). The Greater Accra Region is considered the focal area of the study due to the lucrative and accelerating nature of real estate and residential activities and their impacts it on the available vegetation. Figure 1 shows the extent of the study area.

Figure 1. Map of the study area (Greater Accra)

1.2. Defining Urban Green Space

Greater responsibility for green space is now required in urban areas than before due to the competing interest for urban space, predominantly in the areas of Real Estate and residential establishments, where developers erect and sell structures or acquire vast lands and sell them to individuals to develop them into residential and commercial structures (Elmqvist et al., 2013; Seitzinger et al., 2012). Hence, the need to study and understand the concept of urban green space with Real Estate Development and how to integrate the sustainability of the green space into Real Estate development activities to safeguard the urban ecosystem. Green space often contradicts other terminologies like open space, urban vegetation, or green infrastructure and is in most cases, used interchangeably. In an attempt to clarify and distinguish green space from other concepts of the urban landscape, we look to some definitions from previous scholars like (Swanwick et al., 2003) who describe green space as spaces that are primarily covered by vegetation which transcend beyond urban gardens or parks and covers lands predominantly made of 'resilient surfaces' like shrubs, grass and trees that can be commercial or publicly manage and access. It could be either linear along communication routes, semi-natural (woodland/wetland), functional (allotments, churches, school grounds) or amenities (gardens and parks). They are greenery or natural habitats in the urban areas including parks and gardens, urban trees, recreational venues, forest reserves, ramsar sites, etc., which are mostly located within the city along water bodies or transport networks like roads and railways and could be considered as areas of public ownership or open access (Diko & Palazzo, 2019). Green infrastructure is a widely used term to reference the interconnected number of green spaces located across urbanized areas (Mell, 2008). Irrespective of the minor diversities in various definitions regarding green space, it can be concluded that urban green space extends to all areas with some form of vegetation either man-made or natural, which is not only limited to urban parks and gardens (Adjei et al., 2017) but also extends to cover unsealed, permeable, "soft" surfaces like soil, shrubs and street trees that could either be managed and accessible privately/publicly (Adjei et al., 2017). Urban green space, urban vegetation, and green infrastructure will be used interchangeably in this study to connote one phenomenon.

1.3. Impact of Urban Green Space

According to (Asare, 2022), green space is the core of the urban advantage and contributes to the wealth of urban communities by encouraging higher quality urban living, social solidarity and integration, city productivity, and civic distinctiveness. This sentiment is equally shared by (Alcamo et al., 2003) that, the urban green space provides and regulates services of ecosystems and their relationship with humanity, such as the reduction of pollution in urban areas. Several research works carried out on the functions of green space have categorized them into ***ecological function*****s** where urban trees enhance the quality of air by controlling air pollution (Nowak et al., 2006) and contribute to the atmospheric reduction of Carbon dioxide by direct sequestration (Mcpherson et al., 2017); ***socio-cultural values*** where green spaces serve as conducive spaces where residents can gather, create social bonding and relieve inhabitants from stressful urban living, hasten recovery from medical conditions, and fight sedentary lifestyles associated with obesity and cardiac diseases (Byrne & Sipe, 2010); ***economic benefits*** where prospective jobs and products accrue from green spaces like fruits and firewood, whereas jobs like landscaping, planting initiatives and the maintenance of these spaces constitute some underlining economic benefits; and ***structural functions*** where urban green space contributes to the architectural designs of the natural surrounding by defining urban structures, controlling urban development, buffering around urban zones, regulating traffic etc. (Memon et al., 2008).

1.4. Adverse Implications of the Diminishing Green Space

The rapid alteration of urban wetlands covered by green spaces and other land uses (commercial and residential) reduces the connectivity of water bodies and drainage channels to an undulating landscape. The transformation of green areas into hard impermeable surfaces leads to perennial floods in the core areas of the city since the hard concrete surfaces do not drain running water (Addo-fordwuor, 2014). The urban forest and reserved sites are considered storehouses for biodiversity, however, the deforestation and degradation of wetlands put the rare species of flora and fauna considered medically and economically significant under threat (Addo-fordwuor, 2014).

1.5. Defining Real Estate and Residential Development

The meaning of a house, built up, residence, and real estate are used interchangeably to connote a common phenomenon in the Ghanaian context. Real Estate is comprehensive and encompasses variables like land and structures with their associated fitting fixtures (Appiah, 2021). Real Estate in planning connotes physical structures, properties, and any temporal fixed structures on the piece of land (Appiah, 2021). "Real" in the investment world refers to the raw land, buildings, structures, and other possessions. Real Estate development is a continual reconfiguration of the built environment to meet various societal needs. Meaning, that the construction of physical structures forms only a single phase of development and needs to be rearranged, hence real estate encompasses land and the elements on it, labour skills and management, entrepreneurship skills, and capital (Stapleton, 1986). Real Estate Development is a business process that invests in improving property and renting or selling these properties to purchasers whereas Real Estate Developers are the professionals (individuals or companies) who coordinate all of these activities, converting them from paper to real property (Belayhun, 2020). Moreover, it is important to distinguish Real Estate Developers from constructors although many developers also manage the construction process.

1.6. Models of Residential Development and Urban Greenspace Sustainability

Several models focus on conserving urban green space, and they could be in forms like green urbanism, green planning models, new urbanism, compact city, smart growth, etc. These models emphasize the theoretical support to incorporate green space into the physical landscape and trace the link between urban green space and sustainable urban development which existing research work has given limited or no attention to, especially in the developing world. All these models have different approaches to integrating green space into urban development to improve urban green space sustainability. *A few urban green models are briefly discussed below.*

- **The i-Tree model** is a sustainability model that requires the combination of GIS and field data to quantify and evaluate the environmental values provided by urban trees in a defined geographic area. It is advantageous because it uses constant peer-review techniques and prudent field data to evaluate the structure of urban forests, ecosystem

services, and benefits. However, urban vegetation and ecosystem cannot be measured in the field and requires modelling techniques to quantify and exhibit urban green space values and risk.

- **The Greenway Model (Green Wedges)** is an urban greening management model, primarily for green spaces formed along linear features such as roads, rivers, railways, ridges, etc. This protects green spaces along the linear features and brings vegetation to urban areas (Taylor & Todd, 1995).
- **The Green Roof Model** is a contemporary approach to improving the greening of communities (Missios et al., 2005) and it is about the creation of green space on the roofs of buildings with benefits that include reducing urban heat island and improving air quality, regulates indoor temperature, creating beauty to the urban landscape and extending the life expectancy of a roofing system. The application of the Green roof model, however, is not widespread like other green planning models due to the high cost associated with its installation on the buildings despite the innovative ideas to incorporate green spaces in new urban centres (Getter & Rowe, 2006).
- **The Green Urbanism model** is an approach that guides projects and policies that aims to upgrade new urban centres to maintain and protect green spaces as part of the urban landscape. The underlying objectives associated with Green Urbanism are to ensure physical development facilitate and inspire advanced sustainable and healthy living (Walls, 2008).

Preparing for urban greening under a green infrastructure technique happens at the commencement of development and varies from the standard practice of choosing green space as an afterthought to the development (Wright, 2011; Eisenmann, 2013).

1.7. Research Methodology

The study adopts a descriptive research design which reveals the accurate profile of respondents (individuals), institutions, and the phenomenon of interest. Data is obtained by identifying the people who initiate the changes in green space, the extent of the change, the institutions in charge of managing and regulating Real Estate development and urban green

space, as well as how green spaces are integrated into residential development plans to safeguard urban green space in Greater Accra.

This study obtained both primary and secondary data. Questionnaires were designed for landlords, real estate developers, and stakeholders at the helm of managing urban vegetation and physical development to seek information on their understanding of the concept of green space and how they assess and evaluate the changes in green space. It also sought to find out their knowledge of the institutions and regulations required to manage green spaces in the study area. The study employed 85 respondents including public stakeholders in managing green space and physical development planning agencies (15), Real Estate developers (25), and landlords/individual house owners (45). Mixed method approach was adopted where both qualitative and quantitative data were collected to facilitate diverse avenues for exploring data. Visual field observation and satellite data were also collected to ensure validity and complement the data from the questionnaire. Descriptive statistics were used to summarize the quantitative data and presented in maps, tables, and graphical formats. The questionnaire for Real Estate Developers was intended to identify the green space areas under threat, the inclusion of green space management in their activities, and how they intend to safeguard the available green spaces during and after their developmental activities. This study employed the use of Landsat images for classification in 2007, 2013, and 2021 (17yrs differences). Google Earth was used as a base map to extract training and ground truth samples.

2. ANALYSIS AND DISCUSSION OF FINDINGS

2.1. Analysis of Questionnaires

Table 1: Respondents on Regulations for Managing Green Space

Response	Respondent	%
EPA Guidelines	8	9
Spatial Planning Act	4	5
Zoning Regulation for Green Space	6	7
No idea	67	79
Total	85	100

Source: Field survey, 2023

Table 2: How Respondents Evaluate Green Space

Responses	Respondents	%
GIS & Other Software	14	35
Drone	9	22
No mechanism	7	43
Total	30	100

2.2. Analysis of Satellite Data

Table 3: LULC classes considered for this study

Class Code	LULC class	Description
1	Vegetation	Thick vegetation stands and grooves of evergreen and deciduous trees forming a dense canopy, less thick vegetation stands and grooves of evergreen and deciduous trees forming a less dense canopy, and other farms, stretches of street trees, etc.
2	Built-Up	Areas without vegetation cover (Bald soil patches), exposed rocks, landslides, earthen roads, settlement, urban areas, real estate, and bare lands
3	Water	All water reflectance (lakes, dams, lagoons rivers, and streams)

Table 4: LULC classification of Residential areas and Green spaces in Greater Accra region 2007 - 2021

2007	Class name	Spatial Resolution (m)	Red	Green	Blue	Pixel Count	Area (m2)	Coverage
2	Vegetation	30*30	76	230	0	1580010	1422009000	38%
3	Built-up		255	235	175	2495084	2245575600	61%

4	Water		0	169	230	32811	29529900	1%

2013	Class name	Spatial Resolution (m)	Red	Green	Blue	Pixel Count	Area (m2)	Coverage
2	Vegetation	30*30	76	230	0	860669	774602100	20%
3	Built-up		245	245	122	3237355	2913619500	79%
4	Water		0	197	255	18128	16315200	1%

2021	Class name	Spatial Resolution (m)	Red	Green	Blue	Pixel Count	Area (m2)	Coverage
2	Vegetation	30*30	85	255	0	751839	676655100	18%
3	Built-up		255	235	175	3335039	3001535100	81%
4	Water		0	169	230	29274	26346600	1%

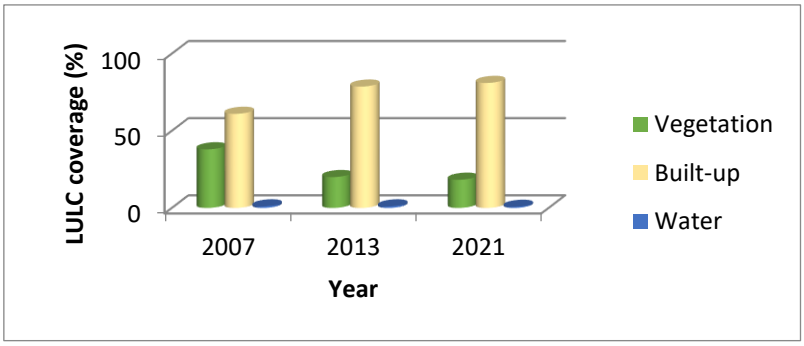
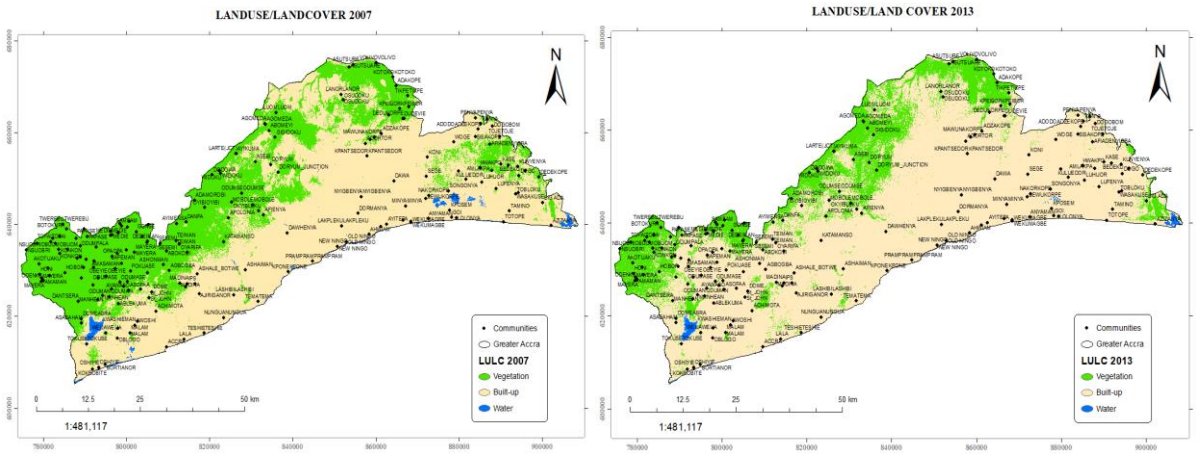


Figure 2. LULC Change 2007 – 2021



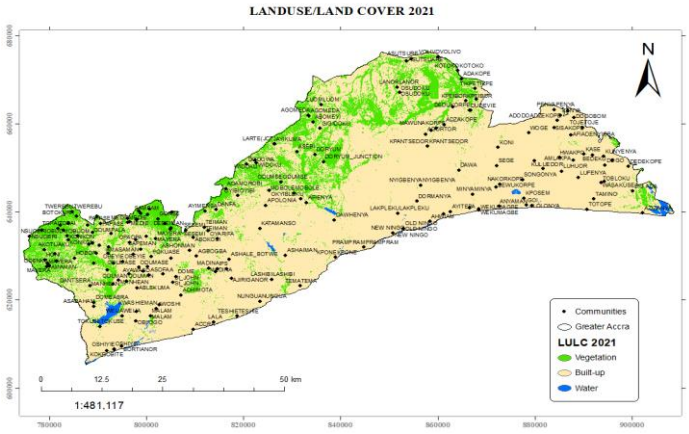
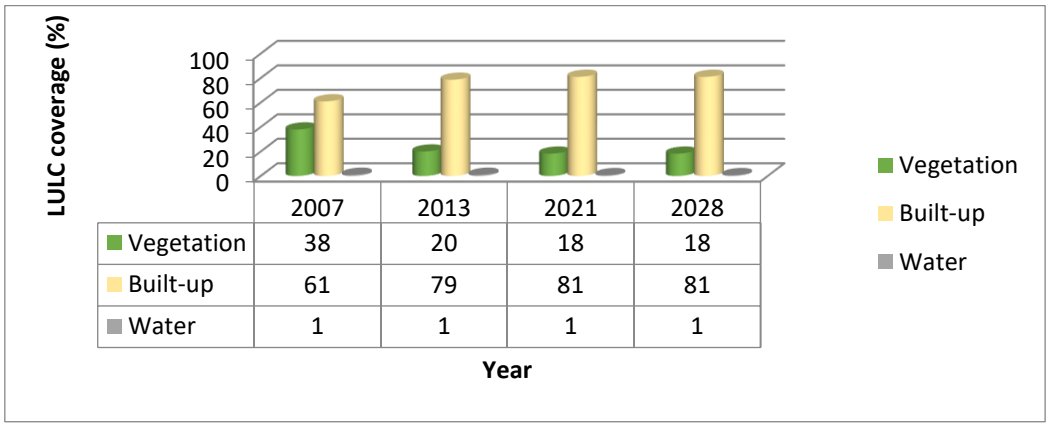


Figure 3. LULC Changes and Prediction 2007- 2028



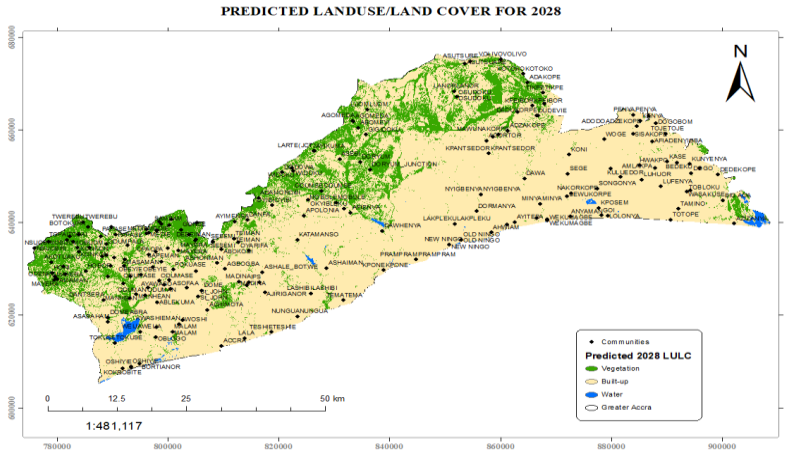


Figure 4. LULC Prediction 2028

2.3. Discussion

The study revealed that 63% of residential developers (Real Estate Developers) do not have green space management plans as part of their residential activities and 43% do not have mechanisms being it drones, GIS, or other mapping software to monitor and evaluate changes of green space in their areas. More than half (55%) of respondents agree that there are public institutions and agencies designated to manage the greenspace however 79% are not aware of any regulations regarding managing green space and hence agree the regulations and institutions are not effective considering the rate of decline of vegetation in their community. The study also revealed large acres of green space in Weija Oblogo, Adakorpey, Abekorpey, Larpleku, and Tsopoli have been replaced with residential structures and identified some sand-wining sites for collecting sandstone to aid the development of new residential areas which contribute immensely to the depletion of the green space. Some peripheral areas earmarked as farmlands around Tsopoli, Asebi, Doryum, Nsobiri, Old Ningo, and other wetland vegetations in Tetegu identified during the survey have gradually been converted to residential areas that impede the sustainability of urban vegetation in Greater Accra. Greater Accra LULC revealed 30% vegetation coverage and 61% built-up (residential areas) in 2007. However, the LULC classification recorded an increase in built-up to 79% and a decrease in urban green space to 20% in 2013. In 2021, the residential development had increased to a coverage of 81% with an 18% reduction in urban vegetation. This means that the built-up class representing residential development within the Greater Accra region keeps increasing at a rate of 1.4% per year. Approximately 20% (755959500m²) of green spaces in Greater Accra have been replaced by residential development between 2007 and 2021. This is evident in how residential development within the region is gradually replacing green spaces. A prediction for the next 5 years (2028) revealed the same LULC as in 2021. This might be a result of awareness being created within the region to plant more trees to increase the green spaces. The prediction signifies the need to integrate green space management plans into residential developments, creating awareness of green space by stakeholders and encouraging individuals and communities to comply with the regulations and ordinances instituted in managing the urban vegetation alongside residential developments. Models like the Urban Growth model, i-Tree eco model, Green roof model, etc. with elements of sustainability have proven to be effective

in Australia, Germany, the UK, and India. These require to be integrated into real estate and residential development to mitigate problems of real estate and residential development on green space in the future. *Figures 5 to 8 show some converted greenspaces.*

Figure 5. Sand wining at Adakorpey (Dawhenya)

Figure 6. Converted farmland in Afienya

Figure 7. Residential flat units at Tema Community 25 **Figure 8**. Wetland vegetation in Tetegu Estate under

Source: Author's field survey, 2023

2.4. Conclusion

As the world's population keeps increasing significantly, the density of urban dwellers continues to intensify since more people keep trooping into the urban centres to seek available opportunities, and as such, enough pressure is placed on the urban green spaces to erect residential structures in an attempt to accommodate the growing urban population. This is encouraging individuals and real estate developers to acquire and convert green spaces and other areas earmarked as environmentally sensitive into luxurious residential sites. The build-

up class representing the residential development appreciated at 1.4% per year. Approximately, 20% (75599500m²) of green spaces have been replaced by residential development between 2007 and 2021. This is evident on the Greater Accra LULC maps from 2007 to 2021 where notable green space areas like Osudoku, Teiman, Katamanso, Dawa, Amaman, etc. have all declined and replaced with residential structures. The study confirms a decline of green spaces due to factors including a lack of effective policies, programs, and plans to integrate management of greenspace into real estate and residential activities, lack of knowledge on modern mechanisms to monitor greenspace, etc. Farmlands, wetlands, and other green spaces in some sensitive localities were observed to be transformed into residential sites. The activities of sand winners were revealed to be a major event contributing to the decline of green spaces with Tsopli, Weija Oblojo, Dawhenya, Larpleku, etc. Walkways along streets of most residential areas are covered with pavements, depriving their communities of the comfort and aesthetic looks green space offers to the environment. The prediction revealed the same LULC as 2021 and this is attributed to awareness being created within the region like erecting high-rise structures and planting more trees to conserve the green spaces. The prediction signifies the need to integrate green space management plans into residential developments to attain the standard SDG 11.

2.5. Recommendation

Urban Green space serves a vital purpose in the relationship between humanity and nature and can help maintain ecological balance if planned properly. It is also important we recognize urban green space as part and parcel of urban residential development plans depending on its function: recreational, conservation, natural landscape, or aesthetics. Below are some important measures recommended based on the objectives, discussions, and conclusion of the study.

2.5.1. Develop Effective Mapping Mechanisms

The study identified a lack of effective mapping systems in assessing and monitoring changes in the region's overall green space and residential development. The study recommends GIS, Google Earth Engine, drones, and other mapping software as reliable tools to monitor and

assess the distribution of green space. Spatial statistics in GIS now make it possible to develop correct explanations for urban green space variables like distance, density, and accessibility. Parks and green spaces could be digitized using ArcGIS to execute plans to address the deficit of green space and help to inform decisions on which areas should be prioritized for planting, set targets, and protect existing trees.

2.5.2. Increase Public Awareness and Prioritize the Growth of Green Space

The study reveals some residents did not see the relevance of green spaces in their space and overlooked the substantial values related to green spaces like aesthetics, shades, recreation, etc. Hence the study proposes an initiative that expands the current level of awareness in the form of educational events, various public outreach, and workshops for institutions, schools, and communities on the media platforms, etc. Communities or real estate developing companies who adhere to the green space plan and policies or have a percentage of green space must be awarded and recognized in print and electronic media platforms to increase compliance with protecting and improving green space.

2.5.3. Effective Coordination Between Institutions & Agency

The study revealed most individuals and residential developers lack green space management plans as part of their residential development activities. A well-structured institution is recommended to be established for key stakeholders responsible for managing green spaces (LUSPA, Dept of Parks & Gardens, NADMO, Traditional authorities, NGOs, etc.) to ensure effective collaboration, public participation, and open dialogue with the conscious effort of implementing all formulated policies, plans and programmed on the urban green space. More so, a comprehensive policy must be formulated and implemented by stakeholders to compel residential communities to include green spaces in all residential development activity to maintain and enhance the existing urban green cover.

2.5.4. Incorporate Green Space Management Plan into Residential Development

The study observed that trees along the roads and streets in Greater Accra have been replaced with pavement or concrete surfaces usually because there is too little space within a road

sidewalk and forecourts to provide all the required soil to successfully grow a mature tree. This has deprived the streets and houses of the required shades and aesthetic views. There could still be pavements and tiles and still have green space hence, the study recommends adopting **avenue plantations**, a more easy, cost-effective way of providing good growing space for shady and ornamental flowering trees planted along the streets and residential areas without the tree roots damaging the pavements in an open planting bed. A shared solution whereby the tree is planted within a smaller planting area of a concrete surface but has access to additional soil volume with a design that allows aeration. The choice of tree to plant must suit the soil and be deep-rooted not to break the pavement. The trees must be fast growing with a long-life span and be wind resistant. The aesthetic social value must be considered while making the choice of trees and must be given proper maintenance.

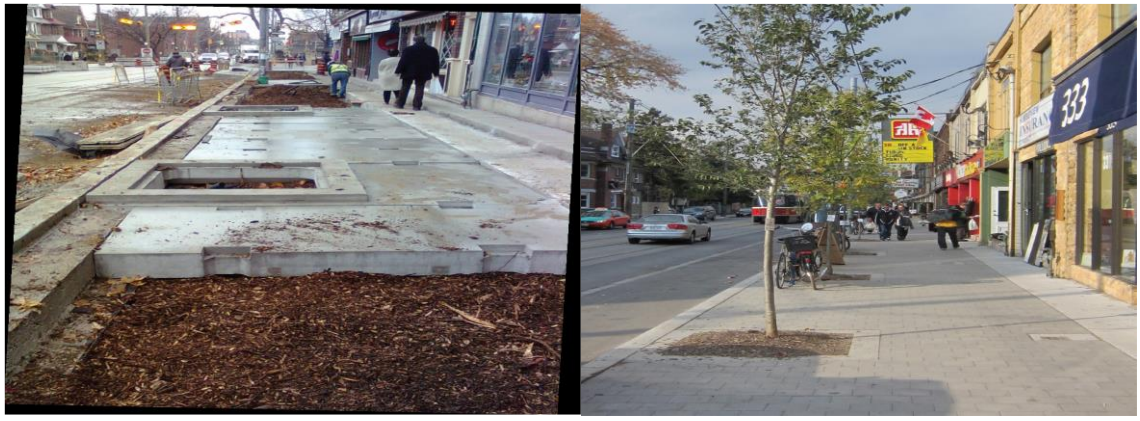


Figure 9. Avenue plantation in an open planting bed **Source:** (Olsson, 2012)

Figure 10. Green space in an open planting bed **Source:** (Olsson, 2012)

The study identifies sustainable urban planning as necessary to enhance the quality of life and preserve the integrity of the natural ecosystem. Hence, the study recommends two significant

sustainable greenspace models (the i-Tree eco model, and the Green Roof model) that focus on the conservation of green space by incorporating green space into the physical landscape amid the influx of real estate and residential activities. **The i-Tree eco model** requires a combination of GIS and field data to quantify and evaluate the environmental values of urban trees in a defined geographic area. Inventories of information regarding trees in a defined are put into GIS to determine the ecological services that are provided by the trees in the vicinity. The i-Tree eco model could help assess the risks and benefits of urban tree placement. However, it is costly and time-consuming because it requires the services of specialists and trained researchers to sample plots. **The Green Roof Model** in recent times has emerged as an important model in sustaining urban green space by providing socio-ecological services. It is highly adopted in most European communities and must be encouraged by planners, policymakers, and individual residential owners in Ghana, precisely Greater Accra to consider implementing the green roof technology as a sustainable development strategy.

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