

# Depletion of Urban Green Space and Its Adverse Effect: A Case of Kumasi, the Former Garden City of West- Africa

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## Abstract

Incorporating greenery has been a vital aspect of city planning. Landscape planning has been a vital aspect of city planning since the 19<sup>th</sup> Century. Since then, landscape planning has become a social necessity. Assessing the impact of the decline in urban green space is very important. Hence, using Kumasi as a case study largely fit due to the decline of the city's urban green space. Based on this the study assessed the Landcover change between 2000 to 2010 and projected the Landcover/land use for 2020. It also analyzed the temperature recordings from 2000 to 2016. The result revealed that the city has lost 19.59 km<sup>2</sup> and 33.39 km<sup>2</sup> of forest and agriculture lands respectively. It was also projected that it will further decline to 0.7 km<sup>2</sup> and 8.2 km<sup>2</sup> respectively. Among the various Landcover classes, agriculture lands were the most delicate land use which suffers massive decline in acreage. Moreover, the adverse effect of the decline in green spaces has been evident in high temperatures, unattractive environment, and atmospheric pollution. In the last decade (2000-2010), the city's temperature increased by 0.2°C but has dropped in the past six years (2010-2016). Nevertheless, it doesn't suggest that the impact of the heat waves has reduced due to the reduction in temperature. Conversely, the impact has increased due to the absence of tree cover. Ultimately, Kumasi's landscape has depleted and has lost a touch of vegetation, hence appropriate measure needs to be put in place.

**Keywords:** Green space, landscape, GIS, urban parks, urban forest and garden city.

## 1. Introduction

The world is getting to a phase when landscape design will be seen as the most comprehensive of the arts (Nagarajupalli, 2009). Incorporating greenery has been a vital aspect of city planning since the 19<sup>th</sup> Century. Urban greenery such as parks, urban forest, wetlands, meadows and street trees are a fundamental component of the urban ecosystem (WHO, 2012). Frederick Olmsted, the father of American landscape, described green spaces (landscape) as “the lungs of the city” (Scheer, 2001).

One important aim of incorporating greenery in urban plans is to prevent or at least limit the degradation of the environment to a minimum while increasing, as far as possible, ‘creativity’ in order to meet the developmental needs. Urban greenery has been associated with a wide range of benefits. Among the many benefits Quagraine (2011) postulated are: reduction in air pollution, cooling environment from reduction in temperatures, public health safety, cooling gas tanks on car parks which lowers evaporative emissions of volatile organic compounds (VOCs); reduction of urban noise, increase property values, decrease stress and aggressive behavior and increase the aesthetic environment of our cities. According to Effroymsen *et al.*, (2009), going through a day in the city which is compounded by problems such as traffic congestions, noise pollution, hot dusty streets and a stressful work, we need quickly the magnificent architecture and sculpture, the sweet smells and moist airs of gardens, shady street trees, and urban parks to relax us.

Many cities such as Paris, London, Berlin, and Vienna have made effort in incorporating urban greenery in their city plan (Hall, 1997). More so, many US cities have developed strategies to incorporate urban green spaces in park- poor neighborhood (Wolch *et al.*, 2014). Globally, cities in developed countries have more green spaces compared to the developing countries. Landscape planning in the developed countries has received much focus and recognition as compared to Africa.

From the colonial era till now, Kumasi has seen deterioration in its landscape. Rapid urbanization, high demand for open spaces, nature reserves, recreational centers for residential and commercial activities and poor management of the city’s landscape has triggered for the current poor state of urban landscape (Quagraine, 2011). Since 1950’s, the city’s landscape has kept on depleting and little interventions have been done concerning it. Green spaces which were allocated and earmarked for landscaping were never developed. Raising of concern in this regard has not all that been effectual and consistent. It has been an issue relegated to the backstage. Kumasi is becoming more of built environment with little or no urban parks, botanical gardens, nature reserves, urban street trees, etc. With the increasing decline in green spaces, it has become expedient to examine the current state of the urban greenery and its adverse effect.

## 2. Materials and Methods

### 2.1 Profile of Kumasi's Landscape

Kumasi formerly known as the garden city of West – Africa had a rich history in terms of landscape (Karboe, 2001). This history is sectioned into pre – colonial era, the colonial era and the post – dependence era to the present era.

In the pre – colonial era, Kumasi had a suitable and fertile soil which supported the growth of forest. The colonial era saw a change in Kumasi's landscape. In 1945, Maxwell Fry and Jane Drew designed a detailed landscape plan for Kumasi (Quagraine, 2011). This design was designated the Garden city of West- Africa. Green belts and urban parks were created. During this period, five urban parks were created. These parks are the Kejetia Children's playing ground (now Adehyeman Garden), parks and gardens, Kumasi zoo, Children's park and Jubilee Park (formerly known as Jackson Park) (Taylor, 2010). The post - independence era saw not much improvement in the landscape. Several smaller parks were created which served several functions but lacked urban trees.

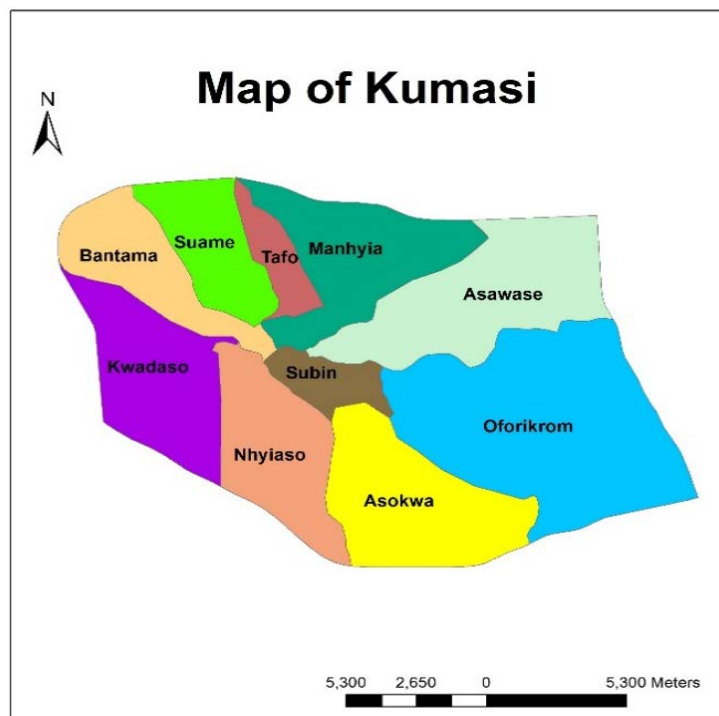


Figure 1. A map of Kumasi

Source: Town and Country Planning Department, 2014

### 2.2 Method

The research design used for this study was a case study. This approach gives an in-depth collection of information on current circumstances or the status quo of the issue at hand (Kumekpor, 2002). Equally, Woodside (2010) described the case study as an approach that aims at describing, understanding and predicting a phenomenon. This approach was adopted

in other to have a comprehensive understanding of the state and effect of Kumasi's landscape.

### 2.3 Data

According to Adjei- Mensah (2014) using different data sources for a case study approach helps to draw accurate conclusions. Against this principle, the study relied on different data sources from literature reviews, land cover images, primary data from institutions and field observations.

In acquiring the Landcover data, a suitable available dataset of 2000 and 2010 land cover and land use (LCLU) data set was obtained from Interdisciplinary Research in Earth Science (2014). The dataset was derived from high spatial resolution imagery (0.61m to 0.8m) from commercial satellites (QuickBird-2, IKONOS-2, GeoEye-1, and WorldView- 2) and has a geometric accuracy of 5m. The land cover and land use categories identified were built area, water bodies, forest, and agriculture. The limitation was the acquisition of a current dataset, which was difficult to obtain. ArcGIS 10.3.1 software was also used to calculate the area for the classes in the Landcover dataset.

Additionally, primary data were obtained from Ghana Metrological Department, Kumasi for data on temperature

## 3. Results and Discussions

### 3.1 Assessing Urban Green Spaces

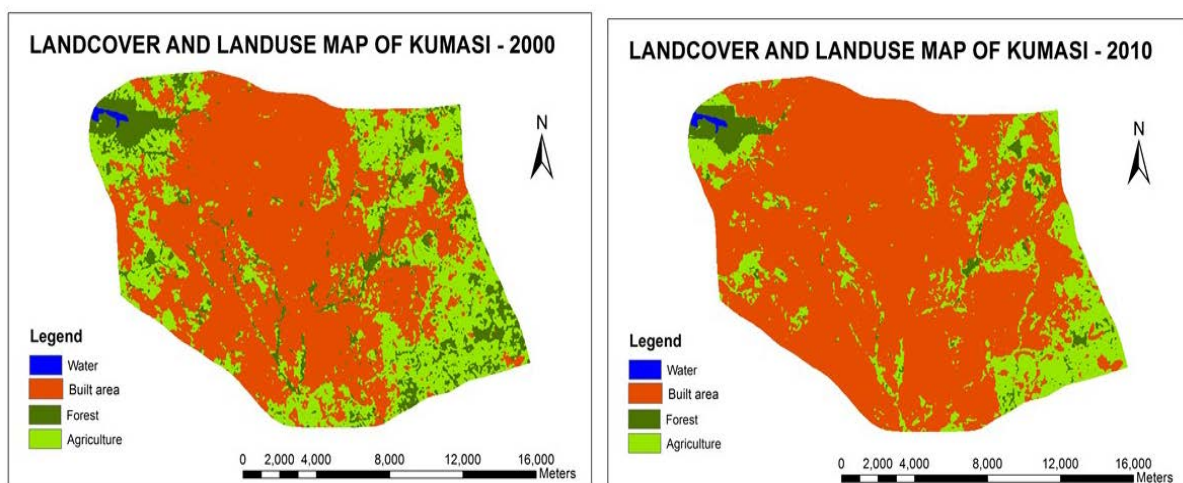


Figure 2. Landcover map of Kumasi between 2000 and 2010

Source: Author, 2017

Table 1. Various Landcover sizes and percentage change

Landcover classification	Year		Area change	Percentage change	*Projected Year
	2000	2010			2020
Built area	164 km <sup>2</sup>	216.98km <sup>2</sup>	- 52.98 km <sup>2</sup> ↑	19.29%	<b>265.51 km<sup>2</sup></b>
Water	0.63 km <sup>2</sup>	0.63km <sup>2</sup>	0	-	0.63 km <sup>2</sup>
Forest	29.49 km <sup>2</sup>	9.9 km <sup>2</sup>	-19.59 km <sup>2</sup> ↓	7.12%	0.70 km <sup>2</sup>
Agriculture	80.92 km <sup>2</sup>	47.53 km <sup>2</sup>	-33.39 km <sup>2</sup> ↓	17.28%	8.21 km <sup>2</sup>
Total	275.04 km <sup>2</sup>	275.04 km <sup>2</sup>	-105.96 km <sup>2</sup>	43.69%	275.04 km <sup>2</sup>

Source: Author, 2017

It is evident from Table 1 that there has been a drastic change in the built up area. Over the past decade, the built area has increased at an alarming rate of 19.29%, hence, causing a reduction in forest and agriculture lands. Among the various Landcover classes, agriculture lands are the most delicate land use which suffers a massive decline in acreage. It tends to imply that; agriculture lands are giving way for housing development. The impacts of the city's uncontrolled physical development are clear: reduction in green spaces and urban sprawl. In a study by Amoako & Korboe (2011) and Cobbinah & Amoako (2012), they postulated that open spaces which constituted green spaces had shown a decreasing trend over the last decade. It is not surprising that the aforementioned result is consistent with this study's findings. The city's reduction in green spaces is a clear picture of poor management from the city's authorities and Adjei- Mensah (2014); Poku-Boansi & Inkoom (2011); Amoako & Korboe (2011) and Cobbinah & Amoako (2012) all shares the same view. Since 1950's, the city's landscape has kept on depleting and little interventions have been done concerning it. Spaces which were allocated and earmarked for landscaping were never developed (Quagraine, 2011). Projects such as car parks, office plazas, schools, streets, residential buildings which are carried out in the city are not designed to have a touch of landscape. This has contributed to the current state of the landscape in Kumasi.

According to Johnston & Percival (2011) urban forests, street trees and woodlands in and around our cities, have a vital role to play in promoting sustainable communities. Currently, from the field survey, the study identified areas which can be classified as an urban forest- Manhyia planted forest, Danyame forest, and Knust botanic garden. However, these areas are not under the management and protection of the forestry commission. In addition, a report by JICA (2013) also revealed that there were no protected forests reserves in Kumasi. This clearly backs the decline of the forest cover in the city, which is projected to decline to 0.7 km<sup>2</sup> by 2020.

Furthermore, the spatial projection of the Landcover/land use classification was done using the percentage change between 2000 and 2010 to project the 2020 Landcover/land use class. Projected land cover classes (Table 1) and its corresponding areas were then generated. The result in the projection indicates that, by 2020, the built- up area will increase to 265.5 km<sup>2</sup> with forest and agriculture lands decreasing to 0.7 km<sup>2</sup> and 8.2 km<sup>2</sup> respectively. It comes as no surprise since development control has failed to tame and direct development. This has an enormous effect on biodiversity, the spatial structure of roads, water supply, electricity supply, health facilities and education (JICA, 2013). A painstaking review of JICA (2013) reveals the Kumasi Metropolitan Assembly has several ongoing projects through Millennium Cities Initiative and Ghana Urban Management Pilot Project (GUMPP). However, these ongoing projects do not emphasize on restoring the depleted green spaces in Kumasi.

### 3.2 Adverse Effect

#### 3.2.1 Rise in Temperature

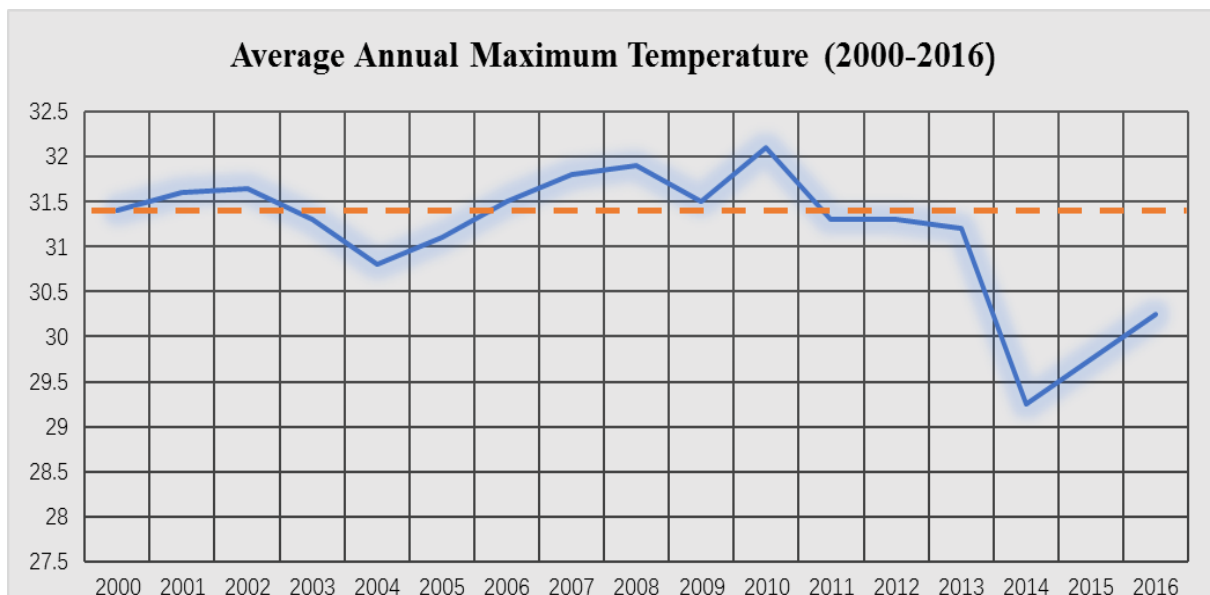


Figure 3. Average Annual Maximum Temperature from 2000 to 2016

Source: Meteorological Department, 2016

Climate change is a global issue which needs much attention and concentration. There are several factors which cause climate change globally. Studies have shown that the global average atmospheric temperature in 2013 was 0.75° warmer than it was at the beginning of the Century (IPCC, 2013). They further predicted that continual impact of climate change will result in 1.8°C average temperature increase over the century. Also, projections done by Environmental Protection Agency in Ghana predicted that by the year 2080, the average temperature in Ghana will rise by 4.5°C (Abanyie, 2011). Kumasi has been experiencing the effect of climate change in the form of heat waves and shift in precipitation pattern.



Analyses of the data above show that the average maximum temperature for Kumasi within the period of 2000 to 2016 is 31.31°C. Out of the average annual temperature for Kumasi for the period stated earlier, eight of the years were below the average while eight of the years were above the average score. The least average annual maximum temperature recorded from 2000 to 2016 was 29.25°C in the year 2014. However, the highest average annual maximum temperature recorded for the stated period was 32.1 °C in 2010. Previously over the last decade from 1991 to 1999, the average annual maximum temperature was 31.21°C (Quagraine, 2011). But over the next decade from 2000 to 2010, the average annual maximum temperature was 31.4°C. This depicts that there was an increase in annual maximum temperature over the last decade by 0.2°C. This suggests that Kumasi was hotter in the last decade. Meanwhile, in the past six years (2010-2016), the annual average maximum temperature was 30.28 °C. Comparing it to the last decade annual temperature, there has been a reduction in temperature by 1.12 °C. This explains that in the last decade (2000-2010), the city became hotter but has dropped in the past six years. Nevertheless, it doesn't suggest that the impact of the heat waves has reduced due to the reduction in temperature. Conversely, the impact has increased. Kumasi is experiencing high heat waves due to the absence of tree cover.

A study by Enete *et al*, (2014) reported that tree shading reduces the amount of heat stored within urban space. Also, another research by Ali-Toudert & Mayer (2007) recorded that tree shading has been observed to decrease afternoon temperatures by 3°C. This suggests that in Kumasi, temperature under the tree is approximately 28.16°C as compared to 31.16°C of temperature not under the tree. However, in Kumasi, due to the limited urban tree coverage, “not under tree” temperatures are most likely to be experienced. Climate change is already happening and its effects in the rise of temperature is evident, however, urban trees can be a good remedy in reducing the impact of heat waves. Experiencing these high temperatures also has an adverse effect on the skin and increases vaporization of water.

### 3.2.2 Unattractive Environment

The city has grown in size from 25sq. km by 1950 to 250 sq. km by 2009 (Kumasi MTDP, 2009-2013). The city has grown quickly over the past six decades. Housing stock and commercial buildings over the decades have not increased. However, the city's green spaces have kept on depleting over the past decades. The environment of Kumasi is an evidence of landscape depletion. The city is now made of concrete environment. The city has grown in the built environment with little nature or green spaces. There are few green spaces to break monotony. People feel discomfort whenever they walk through the central business district. Going through the city with traffic congestion, hot temperature, dusty environment, noise pollution and a stressful work, there is no attractive landscape to cool and relax us.

### 3.2.3 Atmospheric Pollution

Air pollution in cities is increasing. One of the challenges of the municipality is to reduce air pollution in the metropolis. (MTDP, 2009). Pollution is from areas of emissions from cars, industrial pollution, and domestic pollution. The transport sector emits the greatest pollution in the metropolis (Mensa-Bonsu, 2011). The vehicular emissions generate carbon dioxide

(CO<sub>2</sub>), carbon monoxide (CO), nitrogen oxide (NO<sub>2</sub>) and Sulphur dioxide (SO<sub>2</sub>). These emissions affect the quality of life. The quality of air determines the health status of the people. Urban green space depletion increases the concentration of these emissions in the atmosphere. There are few urban trees and forest to absorb the emissions from vehicles, industry and domestic. This then causes the excessive concentration of these gases in the atmosphere.

#### 4. Conclusion

Kumasi, a rich African city in terms of history, culture, traditions and natural resources is been faced with the problem of continuous decline in green spaces. The findings revealed that the city has lost 19.59 km<sup>2</sup> and 33.39 km<sup>2</sup> of forest and agriculture lands respectively. It is also projected that it will further decline to 0.7 km<sup>2</sup> and 8.2 km<sup>2</sup> respectively. Moreover, the adverse effect of the decline in green spaces has been evident in high temperature, unattractive environment and atmospheric pollution. The absence of tree coverage has increased the impact of the heat waves.

It is not too late for Kumasi to be restored back to its formal state as the garden city of West-Africa. The city can transform itself into an ecological city of this contemporary times. All that the city authorities need to do is to address every landscape problem in the city with effective measures.

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