

DEPARTMENT OF THEORETICAL AND APPLIED BIOLOGY
COLLEGE OF SCIENCE

**APPLICATION OF GIS AND MULTI CRITERIA DECISION ANALYSIS IN
SELECTING ACCESSIBLE URBAN PARK SITES IN KUMASI METROPOLIS**

BY:

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DECLARATION

I, Bridgette Berlinda Naa Dei Amasa hereby declare that this thesis, “**Application of GIS and Multi Criteria Decision Analysis in Selecting Accessible Urban Park Sites in Kumasi Metropolis**”, consists entirely of my own work produced from research undertaken under supervision and that no part of it has been published or presented for another degree elsewhere, except for the permissible excepts/references from other sources, which have been duly acknowledged.

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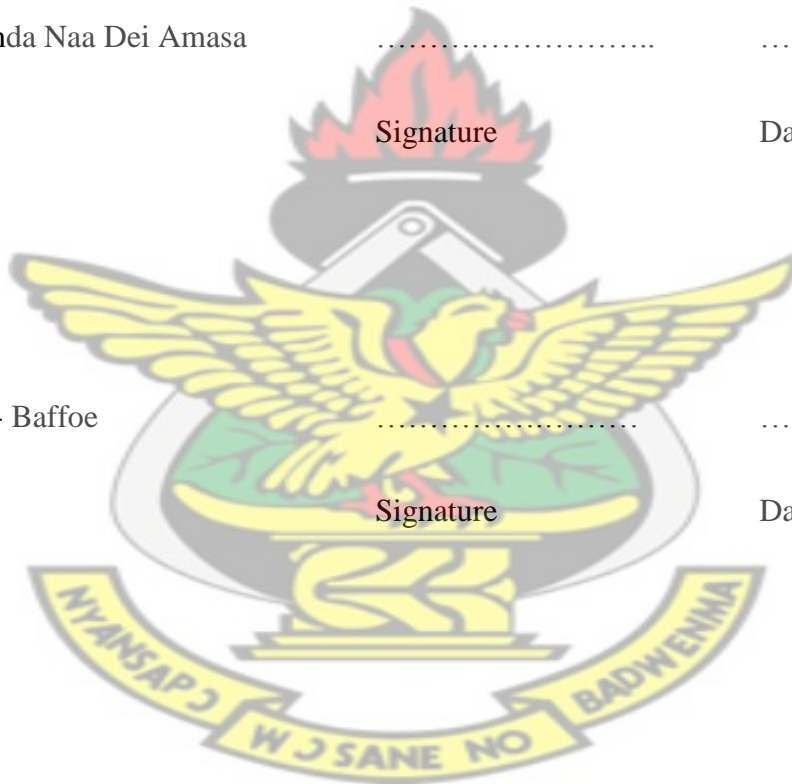
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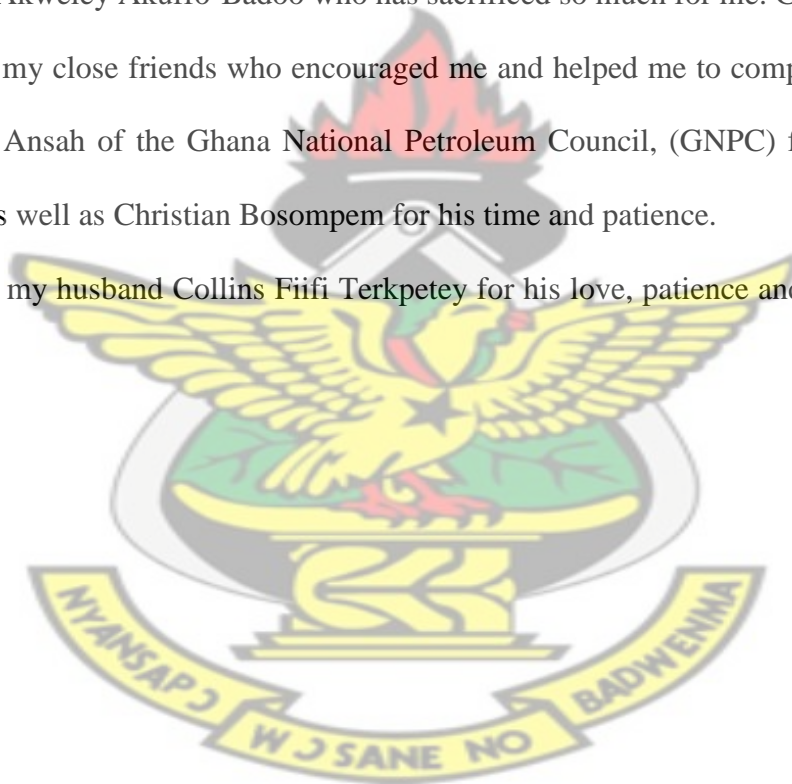
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ABSTRACT

Urban areas show increasing signs of environmental problems such as the quality of air, traffic congestion, acoustic quality and limited land resources, while green areas and open spaces are under continuous threat due to more competitive land uses. With parks acting as “natural tranquilizers”, their importance lies in helping one to escape the stress of city life in Kumasi metropolis, the second most highly populated city in Ghana, which lacks accessible and well distributed green parks and green spaces. Current urban greens in Kumasi have come under great pressure due to rapid increase in development projects. Being the region’s transit and market centre, residents face daily air pollution problems as well as excess heat problems amidst the “automobile infested” concrete space and bare open spaces in green deficient neighbourhoods. Field studies showed that overall, residents have knowledge of the benefits of green spaces in urban areas, but are less willing to patronise them due to their current poor conditions. With the rapid increase in population in Kumasi in the last decade, it is highly necessary to improve the urban green spaces such as parks (especially in high density areas) in order to maintain quality of life. Owing to the fact that Kumasi lacks accessible urban parks for use by its residents, Geographic Information System (GIS) tools were used in creating different datasets of the study area and three sets of criteria which were integrated into the Multi Criteria Decision Process (MCDP). Using literature, field surveys and experts opinions, data layers were created both criteria and sub-criteria to produce the final map of suitable areas for urban green parks in Kumasi. The results showed that 10,968,100 m² of study area was very suitable, 9,168,250 m² was suitable and 3,016,650 m² was least suitable for urban park development in Kumasi metropolis.

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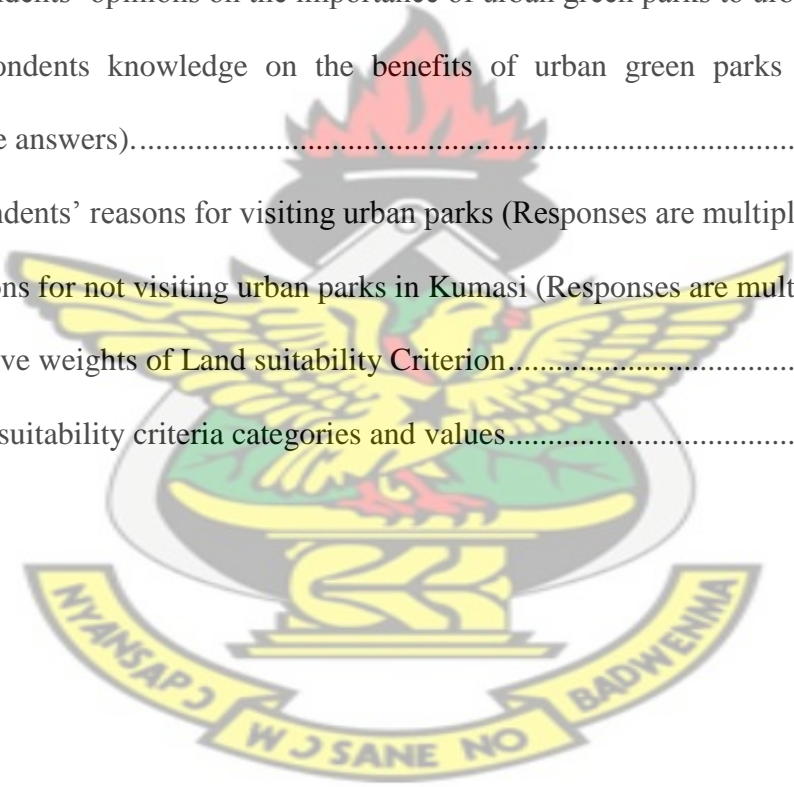
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CHAPTER ONE

1.1 INTRODUCTION

In urban settings, urban parks and public nature reserves are often the urban dweller's only accessible places to experience nature (Kickbusch, 1989).

The natural elements of urban green parks have the ability to function as “natural tranquilizers” which is very important in urban areas where stressful conditions occur daily.

Frederick Law Olmsted, the 19th-century American landscape architect, believed in the restorative quality of green nature that “operates by unconscious processes to relax and relieve tensions created by the artificial surroundings of urban life” (Maller *et al.*, 2009).

Today irregular and unsustainable expansion of cities especially large cities in third world have resulted in environmental pollution intensification and physical development of cities has resulted in inaccessibility of nature to city dwellers due to the destruction of urban green areas and consequently the increasing demand for land (Laghai and Bahmanpour, 2012). According to the World Commission on Environment and Development-WCED (1987), uncontrolled and rapid development projects consume land and natural landscapes needed for urban green parks and recreation areas. The degradation of air quality and decrease of surface for urban parks are major threats to the quality of large urban ecosystems (Kong and Nakagoshi, 2006) as they accentuate pollution (Shen *et al.*, 2007), increase the costs of recreation and leisure services (Charkiolakis *et al.*, 2008; McPherson *et al.*, 1997), undermine the general health of the population and facilitate social segregation problems (Tyrväinen *et al.*, 2007; Gidlöf-Gunnarsson and Öhrström 2007; Gobster, 1998).

With a significant increase in population and urban growth in cities today, there is the need for an increase in urban green parks to cater for the needs of the growing population both in the present and future especially in high density neighbourhoods.

It was at the European Landscape Convention, where the Council of Europe quoted that to achieve sustainability, development should be based on a balanced and harmonious relationship between social needs, economic activity and the environment. Recently, however, efforts to preserve the natural environment are focused on large, bio-diverse and relatively untouched ecosystems (Chiesura, 2003); this has caused less attention to be paid to benefits of urban parks for urban dwellers and how they can be incorporated close to where people live and work in cities like Kumasi.

Kumasi metropolis in the Ashanti Region of Ghana is of high economic importance due to its unique centrality and transit point for many local and international trading routes. This inflow of immigrants and rapid urbanization has left Kumasi experiencing depletion of its urban greenery for development projects. Once interspersed with beautiful landscapes, Kumasi stood out and was popularly known as the “Garden City of West Africa”. Today, urban parks and reserved green spaces have come under great pressure due to rapid increase in development projects which not only neglect the provision of more green spaces but also destroy the little existing greenery. Though the metropolis contains urban green in certain areas, they are not easily accessible to its residents. Being the region’s transit and market centre, this “automobile infested” built up space with bare open spaces in green deficient neighbourhoods create daily air pollution problems as well as excess heat problems for its residents. Urban parks, being a source of urban green have the potential to provide ready access to nearby nature in communities which lack much green in the Kumasi metropolis. The restoration, establishment and preservation of urban green parks in Kumasi is essential as part of the growth of the city.

1.2 PROBLEM STATEMENT

Kumasi metropolis which is the second largest city in Ghana is also known to be the second most populous in Ghana. It is a very important historical centre for Ghana and its unique centrality as a central point to many places in the country makes it a place for several people to move to. Migration and the high birth rate over the years has led to increased pressure on green spaces and parks which are a key requirement for high density neighbourhoods. As a result, some existing parks in Kumasi have been encroached upon and developed into a built up environment. Many of the urban parks and gardens that once spanned across Kumasi served as meeting places where many residents of different age groups fraternised and engaged in several outdoor games and activities.

Today, many urban green parks and gardens that gave Kumasi its accolade “Garden City” have either been abandoned, taken over by weeds, transformed into lorry stations or into commercial centres. With almost all parks in the Kumasi metropolis converted into commercial centres, many residents have been denied the space to fraternise, share ideas and relax amidst the hustle and bustle of life in Kumasi. This study seeks to bring to light the importance of urban green parks in Kumasi and how stakeholders can create and make them accessible to its residents in areas where they are absent using Geographic Information Systems (GIS).

1.3 OBJECTIVES OF STUDY

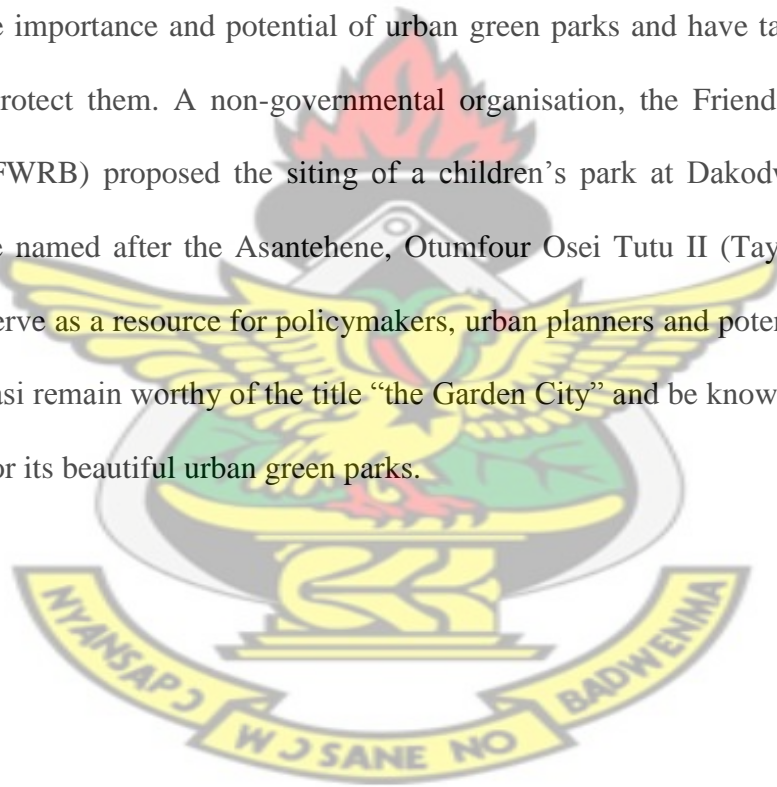
The main objective of this research was to identify suitable sites for urban park development considering land availability and accessibility in relation to population densities of residents in Kumasi. The specific objectives include:

- To assess the current green coverage in Kumasi
- To determine the current status of lands which were allocated as urban parks
- To identify the barriers to urban park development in Kumasi

- To assess the interests of residents of Kumasi in the creation, use and maintenance of urban parks

1.4 JUSTIFICATION

Given that Kumasi is continuously increasing in size and population, it is vital that the scarce amenities of urban parks be increased to cater for its increasing population. A report by Kotze, (2012) stated that Kumasi lacked public amenities such as parks and that many residents spent their leisure hours at bars, nightclubs and pubs and that there is potential to invest in developing parks to cater for nature needs of residents of Kumasi. Some investors have realised the importance and potential of urban green parks and have taken initiative to redevelop and protect them. A non-governmental organisation, the Friends of Rivers and Water Bodies (FWRB) proposed the siting of a children's park at Dakodwom in Kumasi which was to be named after the Asantehene, Otumfour Osei Tutu II (Taylor, 2010). This study hopes to serve as a resource for policymakers, urban planners and potential investors to help make Kumasi remain worthy of the title "the Garden City" and be known not locally but internationally for its beautiful urban green parks.



CHAPTER TWO

2.0 LITERATURE REVIEW

Urban parks are very significant to urban people as they want to go there during their spare time to relax (Bilgili and Gökyer, 2012). As most cities in the world continue to increase in population, especially in developing countries, there is the accompanied continued increase in built up areas at the expense of urban open spaces. Studies, however, show that there is a high willingness of people to pay for the increase of green spaces in urban areas (Haq, 2011).

The World Commission on Environment and Development, (1987) defines sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The Rio Declaration on Environment and Development states that human beings, who are at the centre of concerns for sustainable development, are entitled to a healthy and productive life in harmony with nature (Le Blanc *et al.*, 2012).

2.1 DEFINITION AND HISTORY OF URBAN PARKS

Urban green spaces is used in this study as a comprehensive term, including all urban parks (private and public), forests and green vegetation which add value to the inhabitants in an urban area (Singh *et al.*, 2010). Park history suggests that the urban park is of great significance since it is one of the few examples of initiatives by the local government to improve the environment in urban areas. The urban park is a 19th century Western response to unhealthy and disintegrated urban environments caused by industrialization and rapid urbanization in the 18th century which caused a dispersal of a poisonous vapour that was characterised by a foul smell (Crompton, 2013).

In 1783, over 4,000 private country estate parks, were owned by English nobility or royalty (Crompton, 2005). The public were not permitted to walk in them till the early 19th century

when they were granted access by the Crown in response to pressures exercised by the city's large and rapidly growing population (Henneberger, 2002). The pressures for more public park space in London forced the government to respond leading to the establishment of Victoria Park which was also the Crown's property, developed for use by the people (Crompton, 2005).

Frederick Law Olmsted, a prominent American planner, valued of the presence of parks in American cities as they allowed an escape from the polluted air into a space of sunlight, trees and foliage. Central park in New York, probably the best known park in the western world, was co-designed by Olmsted. The site was in part selected because it offered many obstacles to systematic private development as it was characterized by physical barriers and was unsightly mainly occupied by many of the outcasts of the city, so it was a squalid messy landscape of squatters, pigsties, trash, slaughter houses, goats, mud and swampland, with a pervasive noxious odour (Crompton, 2005). Today, there is a widespread of urban parks across cities worldwide.

2. 2 URBANISATION, POPULATION DENSITY AND URBAN GREEN

Urban growth is estimated by the Un-Habitat to be at 3.7 percent a year, more than twice the world's urban growth rate (Frierie, 2013). The United Nations, (2012) and United Nations Populations Fund-UNFPA, (2011) estimates that by the year 2050, over 75% of the world's population will live in an urban environment accompanied by an ever increasing demands for urban public services. High demand for land will cause green space destruction and land use change. Urban areas today have become major centres of concentration for businesses, buildings, recreation, culture and market and some cities also serve as travel destinations as well as transit points to other places of interests (Haq, 2011). This raises concerns as to whether urban areas will be environmentally hospitable for residents.

According to Sandström, (2009) urban green spaces can be looked upon as multifunctional systems of considerable importance to the quest for sustainable development, including recreational purposes and other features important for human well-being. With the continuous increase in the size and population of urban areas, it is necessary to satisfy the need for more green spaces in high density neighbourhoods to preserve their co-dependent relationship. Population density creates park demand, and public parks attract density (Izmailyan, 2012) and it is for this reason that the larger populations have built and maintained great urban parks like Central Park and Prospect Park in New York, the Bois de Boulogne in Paris, and the Chapultepec Park in Mexico City. As people leave rural areas to cities, there is the need to provide access to urban green in their daily lives.

With the increasing number of vehicles with untreated exhausts, expanding industrial sectors, and poor natural ventilation in many cities creating serious smog problems and pollution-induced hypertension, respiratory diseases and other serious health problems, it is necessary to preserve and create urban parks (Inter-American Development Bank, 1997). It is therefore essential to employ sustainable development approaches in planning, designing and managing urban parks for the present and future generations. In order to influence decision makers to develop more urban parks, it is important to highlight their benefits.

In many urban areas, provision, preservation and development of park spaces for residents is a neglected agenda. Cebu, a province in the Philippines, has grossly inadequate public parks, play areas and recreational areas. City officials in Amman, converted public areas and parks into built up areas. Temples are erected in public parks in India; houses are constructed in open public places in Bangladesh; in Nairobi, private interests occupy riparian lands (UN Habitat, 2012).

2.3 IMPORTANCE OF URBAN PARKS IN SUSTAINABLE CITY DEVELOPMENT

Cities make up only two percent of the earth's surface, yet they are home to over half of the world's population since people choose to be at the heart of economic activity, and to have more job opportunities and other social and economic advantages (European Commission, 2010). The Rio Declaration at the United Nations Conference on Sustainable Development (UNCSD), held in 1992 in Rio de Janeiro, Brazil, and the Programme of Action at the International Conference on Population and Development (ICPD), held in Cairo, Egypt, in 1994 both placed humans at the centre of development. These declarations recognize and emphasize the need to promote human well-being and higher living standards, but at the same time they stressed the need to do so in harmony with nature (Pauleit *et al.*, 2004). Cities need to be seen as parts of ecosystem rather than as autonomous social units distinct from nature (United Nations University- Institute of Advanced Studies-UNU-IAS, 2004). It is in the best interest of cities to promote public goods such as public transport, green areas and public spaces (UN Habitat, 2012). The combination of urbanism and nature is important in order to achieve cities that are healthy, civilizing, and enriching places in which to live (Drescher and Franco-Will, 1997).

Park history has shown that urban parks are valuable assets to have in cities. Many strategies for a city's sustainability mainly focuses on man-made and built components of the urban environment whereas little attention is given to the natural components of the urban structure (Chiesura, 2003). Urban planners need to remember that its residents make up an urban community and their well-being should be a top priority. Development of sustainable cities should focus on improving the wellbeing of residents in their everyday surroundings. Well-designed urban parks have the potential to transform individuals, making them more conscious of community, encouraging them to practice sustenance of that community with a sense of pride (Agada, 2012). Although the expansion and growth of the urban areas is

important, nature in a city is very important for its survival. The urban green spaces such as urban parks influence the social, economic and environmental aspects of the urban community, directly the liveability of the city (Cilliers, 2010). Natural places such as urban parks offer an opportunity for urban dwellers to be to be refreshed from dealing with demands such as crowds, noise, and pollution issues. It is highly important that these green areas such as accessible urban parks be given the value and attention to be protected and created in areas where they are lacking especially in densely populated areas in the city. It is essential to have a perception and understanding of the role that these urban parks play in the urban areas, in order to understand its value and advocate for its development, restoration and preservation in urban environments. The roles and benefits of urban parks are discussed below.

2. 3. 1 ENVIRONMENTAL BENEFIT OF URBAN PARKS

Urban heat island effect, a common phenomenon in urban centres can be reduced by vegetation in urban parks which supply cities with ecosystem services ranging from conservation of biodiversity to the regulation of urban climate (Haq, 2011). Research has shown that on the average, 85% of air pollution in the form of poisonous materials and emissions from factories and car exhausts such as sulphur dioxide and nitrogen oxides can be trapped by vegetation in urban parks in overcrowded cities (Bolund and Sven, 1999). Urban parks can also reduce the noise levels from traffic and other sources which can be stressful and create health problems for people in urban areas (Haq, 2011). Improved air quality as a result of urban park vegetation has a positive impact on physical health with benefits such as decrease in respiratory illnesses (Sorenson *et al.*, 1997). Urban parks which include the use of plant species adapted to the local condition with low maintenance cost, self-sufficiency and sustainability (Loures *et al.*, 2007) serve as centres for reproduction of species and plant

conservation, and improvements in soil and water quality for the maintenance of ecological a sustainable urban landscape.

2. 3. 2 SOCIAL BENEFITS OF URBAN PARKS

Besides important environmental benefits, parks offer avenues to socialise as important psychological service. Thompson (2002), views open spaces in cities such as parks as places to celebrate cultural diversity, to engage with natural processes and to conserve memories. As a solution to rebuild social cohesion, Bogotá in Colombia, has improved many of its public spaces (sidewalks, public parks and libraries) (UN Habitat, 2012).

Nettleton (1992), reviewed some of the literature describing positive emotional states arising out of time spent in natural settings and that viewing natural settings such as parks and makes higher density living more comfortable. Many parks and gardens in some cities are important because of their historical and cultural value. An example in Ghana is the Kwame Nkrumah Mausoleum in Accra which houses the remains of the first President of Ghana Osagyefo Dr. Kwame Nkrumah. Today, this site, with its beautiful and serene landscapes, the garden like historical site is a tourist attraction for many who visit Ghana.

2. 3. 3 ECONOMIC BENEFITS OF URBAN PARKS

Studies show that urban parks are good financial investments for a community. Urban areas with greenery are aesthetically pleasing and attract many residents and investors. One of the factors responsible for the rapid economic growth of Singapore and Kuala Lumpur, Malaysia was their beautification projects which attracted significant foreign investments (Sorenson *et al.*, 1997). Study on effects of neighbourhood parks on price of residential buildings in Hong Kong showed that neighbourhood parks had the ability to lift real estate prices (Jim & Chen, 2010).

When Fredrick Law Olmsted conducted a study on how parks helped property values in the US, he discovered that over a 17-year period, there was a \$209 million increase in the value of the property as a result of the creation of New York's Central Park. A 2001 survey by the National Association of Realtors (NAR) revealed that 57 percent of people would choose homes close to parks and open green space over one that was not and that 50 percent of the people would be willing to pay 10 percent more for a house located near a park or protected open space property (American Planning Society, 2013).

2. 3. 4 HEALTH BENEFITS OF URBAN PARKS

City life is dominated by mechanical time (punctuality), yet our bodies and minds are dominated by biological time (Maller *et al.*, 2009). The results of conflicts between mechanical and biological time can be unpleasant by causing irritability, restlessness, depression, insomnia, tension and headaches, and indigestion (Furnass, 1979). Parsons *et al.*, (1998), stated driving to be a stressful activity which causes several physiological changes in the body, including activation of the sympathetic nervous system and increased blood pressure. Urban open green spaces such as parks offer city dwellers a more stress free environment to fraternise regardless of sex, age or socio-economic background (Grahn and Stigsdotter, 2003). Studies also show that viewing nature is important and an effective means of relieving stress and improving well-being (Wang *et al.*, 2013). Other studies showed that green space nearer to home (De Vries, 2002; Grahn and Stigsdotter, 2003) leads to regular visits by residents and that most people prefer a natural, green setting for such leisure activities such as walking and cycling (Herzog, 1992). Plants improve air circulation, provide shade and cooling effect which helps to lower air temperatures. A park of 1.2 km by 1.0 km can produce an air temperature between the park and the surrounding city that is detectable up to 4 km away (Heidt and Neef, 2008).

2. 4 INITIATIVES TO INTEGRATE URBAN PARKS INTO CITIES

As an important amenity that promotes public health, urban parks contribute to community wellbeing, encourage active lifestyles (Wang *et al.*, 2013), and contribute towards the development of social capital and healthy cities (Chiesura, 2003, Jones *et al.*, 2009). It is necessary that the provision of urban parks and open spaces is accompanied by the need to ensure their equal distribution to urban residents. Today, many great cities worldwide have at least one world-famous green space to attract tourists and residents out such as London's Hyde Park, Albert Park in Melbourne and the most famous Central Park in New York. Greenbelts and greenways which aside parks are other forms of green space and other environmentally-orientated designs, such New York's renowned High Line, a disused lifted railway that has been transformed into a wonder of a green space, are essential for maintaining the integrity of a developing city, ensuring the safety of certain natural areas and increasing the general quality of life for its citizens (Kotze, 2012).

Few communities have taken full advantage of the potentially enormous social, environmental and economic opportunities that can accrue from using these sites to enhance a city's green space and overall green infrastructure (De Sousa, 2002). In Mexico City, high priority has been given to creating healthier and more sustainable urban lifestyles for residents by increasing access to public parks and urban open spaces (UNFPA, 2011) Equitable open space distribution should not be selective in areas that have park access in the urban environment (Wang *et al.*, 2013). In Britain between 1988 and 1993, over 19% of brownfield areas have been converted into useful green spaces (De Sousa, 2002).

The development, management, and policy implementation of urban green spaces as part of urban environment are highly integrated into sustainable development goals at local and global level (Tuzin *et al.*, 2002). In Canada, the Leitrim wetlands and Findlay Creek provide the natural focus around which the community has an official plan which provides a

continuous system for recreation, to protect natural features and to provide for a transition in uses (Ottawa City Council, 2005).

Urban areas can comprise a large range of green spaces, such as public parks and gardens, playing fields, derelict land, green space on institutions and private green space, but also woodlands, wetlands, farmland on the fringe and coastal areas: all of which can provide for the experience of nature when properly developed and well maintained by responsible authorities and local residents. In the quest of creating quality green spaces, the standards should be set at local levels to accommodate activities and future changes (Haq, 2011).

In England, English Nature (1996) recommends certain sites for urban park development which include:

1. Sites which are yet to be developed and taken over by plants and animals.
2. Land along the natural course of water-ways, which are occupied by now mixtures of planted and spontaneous plants.
3. Areas of woodlands which, through by management, support important wild plant and animal species.
4. The poorly managed parts of parks, school grounds, sports pitches, golf courses and church compounds.
5. Small-sized plots along residential and commercial roads, pathways, car parks and properties which are often colonised by wild plants and animals.

2. 5 REQUIREMENTS FOR URBAN PARK SITES

There will be great demands in the landscapes of the future (Antrop, 2000) and so it is important to identify area that lack access to urban parks to enable urban planners and city officials to implement adequate measures to provide for the growing population. Understanding association between urban population density and the amount and distribution of green spaces is important in considering their provision and use currently and for the

future. Planning urban green spaces such as urban parks requires the consideration of users views as failure of inclusion of stakeholders' participation will reflect on the neglect of social and environmental functions (Balram and Dragicevic, 2005).

2.5.1 ACCESSIBILITY

The presence of large amounts of parkland in cities is important, but equally vital is to have parks which are nearby and easily accessible to residents (Rigby, 2014). In order to encourage people to be close to nature, the accessibility of urban parks should be considered. Distance of parks from close to where people live or work appears to be an important requirement for use of green spaces. People in close proximity to green spaces use them more often as shown by a study in Helsinki, Finland, which showed that in areas with good access to recreational green spaces, people living close patronised parks often (Haq, 2011). Urban parks should be at the heart of neighbourhood and at most five minutes' walk for residents within the community hence the distance one walks, cycles or drives should be adequately short (Haq, 2011).

Therefore, accessibility and proximity of parks are very important factors in the location of an urban green space. Planning in cities should be concerned with equity and a better distribution for people in the society (Ismaila and Yusuf, 2006). That is why according to Tabassum and Sharmin, (2013) accessibility, regardless if it is measured in time, cost, distance, or population, is the most important variable that one must consider in the early stages of planning. People need to know the locations of local green spaces, and be encouraged to use them.

2.5.2 SIZE AND SPATIAL DISTRIBUTION

Research on the issue of size of urban park varies. Developed countries have currently adopted a general standard of green space of 20 m² park area per capita (Singh *et al.*, 2010). International minimum standard recommended by World Health Organization (WHO) and adopted by the publications of United Nations Food and Agriculture Organization (FAO) is a minimum availability of 9 m² green open space per city dweller (Kuchelmeister, 1998). The size of urban parks represents an important indicator for assessing the sustainability (Chiesura, 2003) and their availability is an expression of the housing quality (Loures *et al.*, 2007).

2.5.3 NATURE AND BIODIVERSITY

Many open spaces, through their natural atmosphere, and management may cause habitat improvement in green space areas that are not rich in biodiversity (Natural England, 2010). Proper management of streams, creation of beautiful green landscapes and regular landscape maintenance practices of open spaces are some improvements which can improve biodiversity in urban areas. Local residents and community schools can improve the value of their local open spaces by making these areas more attractive sites in their communities and encouraging local protection. This will allow local authorities to showcase their achievements with pride. Additionally, urban areas must have beautiful parks provide all their associated benefits (Ward Thompson, 2002).

2. 6. SOME TYPES OF URBAN PARKS

As urban areas of the world continue to grow, there is a great opportunity to improve cities, making them healthier for people, simply by increasing greenery (UNEP, 2011). However, with the scarcity and high cost of land in cities today, some cities around the world have come up with innovative and environmentally friendly measures to ensure their residents have access to nature which is so important to human well-being. A few types of urban parks created as a result of scarcity of land are explained below.

2. 6. 1 SPARK PARKS

According McCord (2003), in 1983, as a result of high cost of land, Houston increased deficient green space coverage by least 5,000 acres by creating parks known as SPARK parks on existing municipal lands. SPARK parks utilise sites on public schools in low income areas to create community parks hence reducing the cost to remedy Houston's green deficit. An agreement was formed between the Houston Parks board and the Houston School District to help communities to have access to resources to improve their communities. Schools benefited in three ways: improved school facilities, increased community contribution, and funding sources (McCord, 2003). The SPARK Park helped to improve the school's image and had a positive impact on the community (McCord, 2003) and made way for the creation of urban parks where land acquisition was a problem.



Plate 1: MacGregor Elementary Park project

Plate 2: Cunningham Elementary

in Houston from SPARK, Inc.

Park Project in Houston from SPARK, Inc.

(Source: McCord, 2003)

2.6.2 POCKET PARKS

A pocket park is defined as less than 5,000 square meters (less than half the size of a soccer field) with a visible element of green which can be well maintained and attractive in the long term (Blake, 2002). Pocket parks are also known as mini-parks or vest-pocket parks. They serve several function as spaces for small events, play areas for children, spaces for relaxing or meeting friends, taking lunch breaks and a refuge from the bustle of surrounding urban life and offer opportunities for rest and relaxation (Blake, 2002). These small areas of urban nature have definitely proven that parks do not have to be large to be beneficial especially in areas of extreme population density. With the rapid rate of urbanisation leading to depletion of green spaces, these pocket parks are an ideal solution for access by large numbers of people.

Philadelphia is one of the first cities to begin developing pocket parks within its neighbourhoods (Triman, 2012). These green spaces were constructed mainly by the community on the site of vacant or abandoned lots that had become eyesores located in low

income areas that needed local open space. In New York, the Paley Park which is a private owned public park is the most famous and most successful pocket park designed as an oasis away from the bustle of Manhattan (Blake, 2002).

2.6.3 RAIL PARKS AND LINEAR PARKS

The Rail Park can be a teaching tool for other cities that want to build urban parks with limited resources (Leader, 2011). In New York, an important railway park is the renowned High Line which was built on an historic freight rail line elevated above the streets on Manhattan's West Side in 1999 by community residents, Friends of the High Line when the historic structure was under the threat of demolition (Friends of the High Line, 2002). In Belgium, in the city of Antwerp, an old neglected railway marshalling yard has been re-developed into a park known as the Park Spoor Noord as part of a public-private partnership supported by the European Regional Development Fund-(ERDF) (European Commission, 2014). This project has resulted in a green, recreational space and residential development allowing more than 30,000 people to live within 800 meters of the park as well as becoming a favourite urban spot for the citizens of Antwerp and many visitors.

Greenways are linear parks or corridors of protected open green space which follow natural features such as rivers, streams, ridge lines or mountaintops and may also be established along abandoned railroad lines, utility rights-of-way, scenic roads or other man-made features (Tennessee Parks and Greenways Foundation, 2008). Linear parks are facilities for active recreation such as walking, jogging, or biking thereby combining elements of transportation with recreation (Houston, 2013).

2. 7 URBAN PARK DEVELOPMENT IN KUMASI

Kumasi Metropolis falls within the moist semi-deciduous vegetation zone of Ghana which has favourable soil conditions which support farming and green (Mensah, 2014). The establishment of the Ashanti capital's location is tied to the fertility of the land (Adarkwa and Post, 2001) which favoured soft and green landscaping. During the colonial period, open spaces and parks in Kumasi were developed by British soldiers to create healthier environments, to create familiarity and instil cultural and social values through the introduction of recreation as a result of concerns of general unhealthy and unsanitary nature of the city (Schmidt, 2005). By the early 19th century, Kumasi impressed its European visitors with its cleanliness, urban open spaces which served several functions (McCaskie, 1995). Kumasi earned the accolade the Garden city of West Africa after the 1945 city plan of the area which converted the city's landscape to green spaces creating beautiful physical landscape with green spaces interspersing with physical developments (Korboe, 2001).

In 1903, the wetlands adjacent to the city's central park were converted into a railway station which connected the lines from Accra and Takoradi and some of the open spaces which served multiple functions were also converted into orderly designed squares. In 1945, a more detailed conceptual landscape plan which considered Howard's Garden City concept was drawn for Kumasi by Fry and Drew which included creation of urban green belts and urban parks (Schmidt, 2005). As a result, parks with well-defined purposes including those for bandstands, cricket grounds and playing fields akin to the English landscape design of the end of the 19th century and the beginning of the 20th centuries were developed (Quagraine, 2011).

The five parks created during the colonial period are the Kejetia (now Adehyeman Gardens), Suntreso park (Department of Parks and Gardens), Kumasi Zoo, Amakom Children's Park and the Fante New Town Park. Most of these parks were located far away from the

residential areas and therefore were under-used which eventually led to their present state (Asare, 2013). Some other parks in Kumasi in the early 1960s include the Prince of Wales, located adjacent the Kumasi Zoological Gardens; the Abbeys Park at Ash-town; the Jackson Park near the Prempeh Assembly Hall; the Kotoko Park, behind the Manhyia Hospital; the Addo's Park behind the Manhyia Palace; the Rivoli Park at Bantama; the Asafo Tennis Court near the Kumasi Polytechnic. Recently, most landscape projects undertaken by the Kumasi Metropolitan Assembly target road tree and shrub planting neglecting the bare open spaces which require proper landscaping services to serve as attractive parks for use by residents (Asare, 2013).

The Asafo Tennis Court, near the Kumasi Polytechnic, which has now been transformed into a lorry terminal, was also a spot where tennis fans never missed the opportunity to group as they competed with one another to assess their expertise (Asare, 2013). The Kumasi Children's Park, located behind the SDA Church at Amakom, off the KNUST-Asafo high street is currently now a place of worship and a den for thieves and drug addicts, it creates no attraction for its use by residents. The Prince of Wales Park, which was grassless and sprawled for more than 200 square metres, served very useful purposes some decades ago, such as bicycle riding which was a form of entertainment which attracted a lot of youth around Bantama, Suame, Mbroum, Manhyia, Asafo, Adum, and Amakom (Quagraine, 2011). Today, the Prince of Wales Park has been replaced by a lorry terminal, which has also been converted into a commercial centre. The Adehyeman Gardens, sandwiched between the Kejetia lorry terminal and the K. O. Methodist Bookshop, used to be the citadel for indoor games for the aged, in particular. The Gardens were beautified by a variety of flowers and grass which acted as magnets that pulled the youth into the gardens for rendezvous and a background for photo shoots as part of their socialisation activities (Asare, 2013).

2.8 NATIONAL POLICIES ON URBAN GREEN SPACES IN GHANA

The Ghana National Urban Policy Action Plan (2012), states that urban inhabitants have a right to the sustainable development of human settlements, environmental quality, good health, and wellbeing which is a key guiding principle in accordance with Ghana's Environmental Policy. Park history demonstrates that parks are beneficial for urban residents' wellbeing and health. As part of the initiatives to improve environmental quality of urban life, National Urban Policy Action Plan (2012), also seeks to protect open spaces, green belts, forest reserves, water bodies, wetlands, water catchment areas and other ecologically sensitive areas from physical development and urban encroachment. This policy also seeks to ensure effective planning and management of urban growth and sprawl, and ensure adoption and implementation/enforcement of relevant recommendations and land use controls as well as strengthen the use of remote sensing (such as aerial photographs and satellite imageries) and a Geographic Information System (GIS) to enhance urban development and management. The Ghana National Environmental Policy, (1995) advocates for providing facilities and avenues for the entire population to participate in environmental management.

Urban parks, aside their benefits of relaxation and stress relief, have shown to be primarily for environmental management in urban areas. Education on these policies and implementation of these policies will help safeguard land reserved for parks in Kumasi.

CHAPTER THREE

3.0 MATERIALS AND METHODS

The study area was the Kumasi metropolis in the Ashanti region of Ghana.

3.1 LOCATION AND SIZE OF STUDY AREA

Kumasi, the second largest city in Ghana, is located in the transitional forest zone in the Ashanti region. It is the most populous district in the Ashanti Region (KMA, 2006). It is about 270 km north of the national capital, Accra; 397 km south of Tamale; and 120 km south east of Sunyani. It lies between latitude $6^{\circ}35'' - 6^{\circ}40''$ and longitude $1.30^{\circ} - 1^{\circ}35''$ and has an elevation which ranges between 250 – 300 metres above sea level covering an area of about 254 square kilometres (Adarkwa, 2011).

Millennium Cities Initiative (2010), estimates the current growth rate of Kumasi to be 5.4 percent per annum which is as a result of its vibrant commercial activities and its role as the regional capital (Amoako and Afrane, 2011). High growth rate of the city's population has led to a rapid growth of settlements in all directions. The location of Kumasi serving as the centre of major routes to several parts of Ghana makes it a hub for many economic activities and important destination for many migrants from other parts of the country (KMA, 2010). The Asawasi sub-metro according to the Department of Town and Country Planning, is currently no longer a part of the Kumasi metropolis. Kumasi metropolis is made now up of nine sub-metros (Figure 3.1) which include:

1. Oforikrom sub-metro
2. Asokwa sub-metro
3. Nhyiaso sub-metro
4. Subin sub-metro
5. Tafo sub-metro
6. Manhyia sub-metro
7. Suame sub-metro
8. Bantama sub-metro
9. Kwadaso sub-metro

THE STUDY AREA

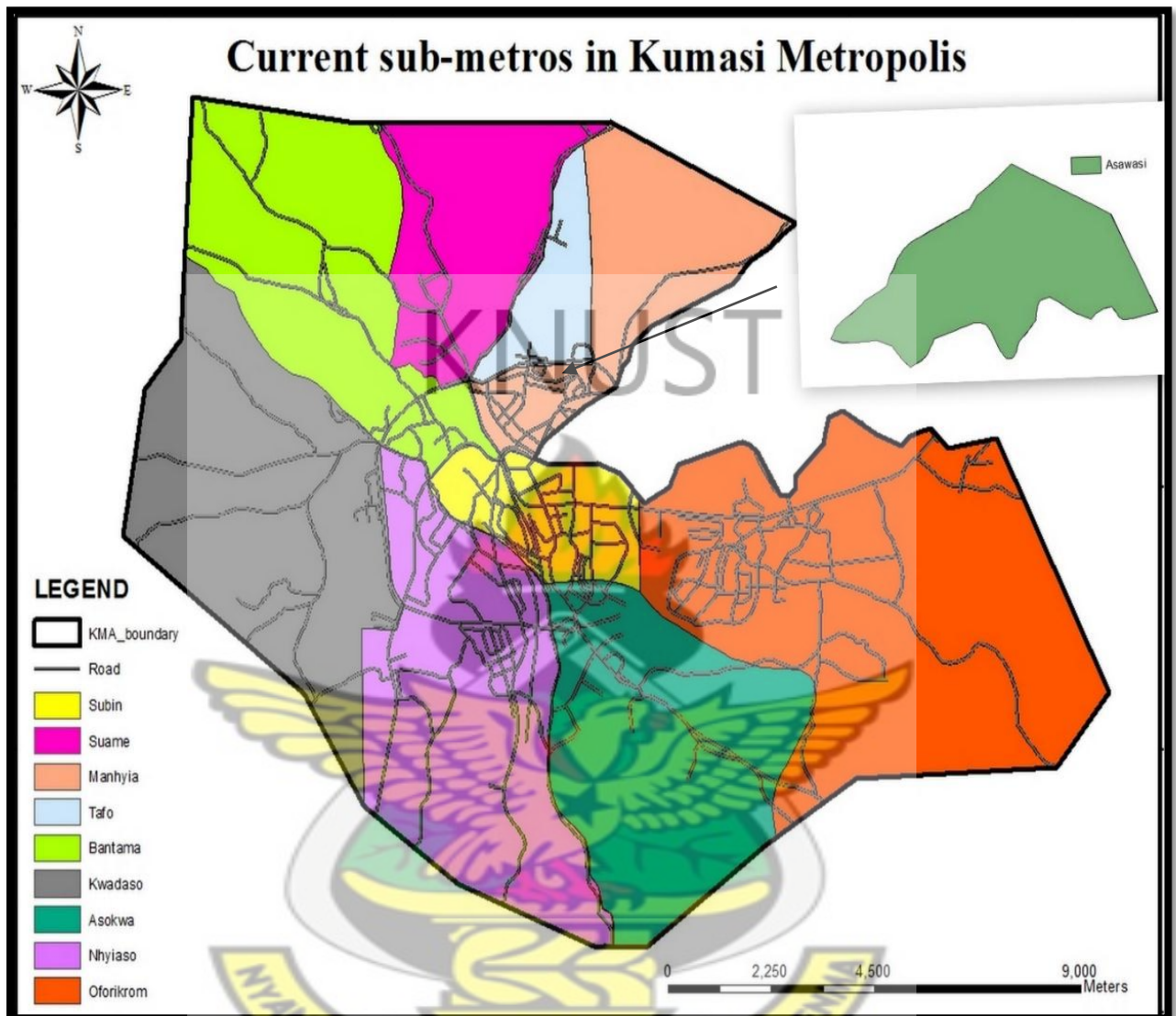


Fig 1. Map of Kumasi metropolis and the current nine sub-metros

3.1.1 LAND USE

The current metropolitan area of Kumasi is an assumed size of approximately 250 square Km (Amoako and Afrane, 2011). Major land uses in the metropolis are residential, commercial, industrial, educational, civic and culture, open spaces and circulation (as shown in Table 1). Residential Land use makes up the principal living areas in the metropolis (Amoako and Afrane, 2011). Commercial activities in the metropolis take approximately 6 km² (2.4%) of

the total land area and are mainly concentrated in the central part of the metropolis. The central area comprises Adum shopping area, the Central and Asafo Markets, Kejetia and Asafo transportation terminals which act as the main magnetic points, creating concentration of activities in the metropolis (KMA, 2006). Sites for Educational facilities total about 34.7 sq. km (17.3%) of the metropolitan area with the largest educational land user being the Kwame Nkrumah University of Science and Technology (KNUST) located in the eastern section of the metropolis (KMA, 2006). Sadly, open spaces take up 11% of the total land area in the metropolis.

KNUST

Table 1. Land use structure (Source: KMA Town and Country Planning Department, 2010)

Land use	2000		2010	
	Area (km ²)	Percentage (%)	Area (km ²)	Percentage (%)
Residential	109.6	43.8	111	44.4
Industrial	10.6	4.2	10.1	4.0
Commercial	6	2.4	6	2.4
Educational	43.8	17.5	43.3	17.3
Civic	18.8	7.5	18	7.2
Open space	28.1	11.2	27.5	11.0
Circulation	33.1	13.2	34	13.6
Total area	250	100	250	100

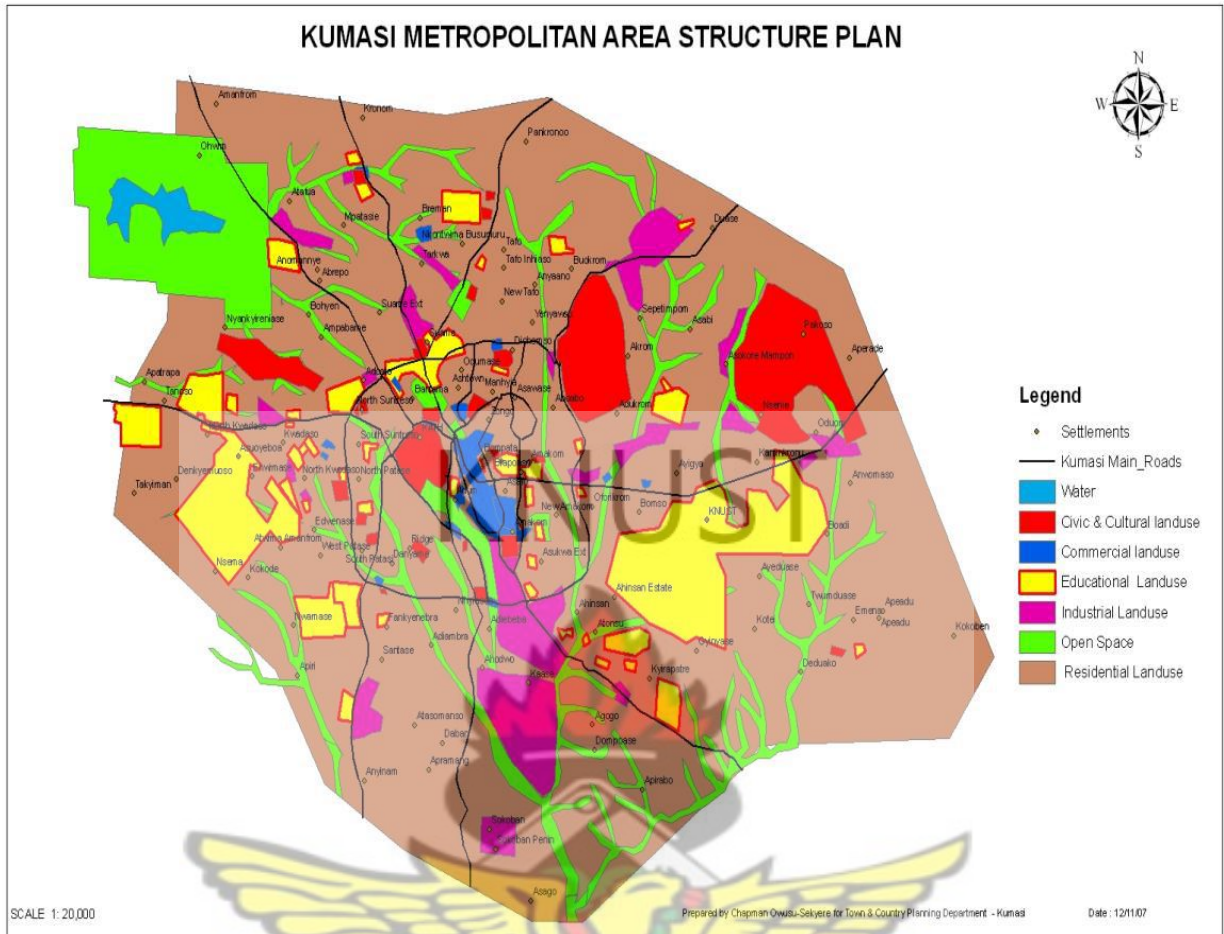


Fig 2. Land use structure in Kumasi (Source: Town and Country Planning Department, Kumasi, 2008).

3.1.2 CLIMATE AND VEGETATION

The Metropolis falls within the wet sub-equatorial type (KMA, 2006) with an average minimum annual temperature of about 21 °C and average maximum annual temperature of 30°C (KMA, 2010). The average relative humidity is about 85%. The city falls within the moist semi-deciduous South-East Ecological Zone. The main species of trees found are Ceiba, Triplochiten, and Celtis with exotic species and rich soil has promoted agriculture in the periphery (KMA, 2010). A patch of vegetation reserve within the city has led to the development of the Kumasi Zoological Gardens, adjacent to the Ghana National Cultural

Centre and opposite the Kejetia Lorry Terminal which serves as a centre of tourist attraction. In addition to its scenic beauty as a tourist centre, it serves other functions such as education, preservation of wildlife, leisure and amusement. Apart from the zoological gardens, there are other patches of vegetation cover scattered over the peri-urban areas of the metropolis. However, the rapid spate of urbanization has caused the depletion of most of these nature reserves (Asare, 2013).

3.2 SOURCES OF DATA

The first aspect of the research involved data collection from primary data sources, the field survey, based on the personal observations of locations and state of the current urban parks in Kumasi metropolis. Information about these urban park locations were collected from the Department of Parks and Gardens and the Department of Town and Country Planning. Interviews with personnel responsible to park allocation, development and maintenance from the Kumasi Metropolitan Assembly (KMA), the Department of Parks and Gardens and the Department of Town and Country Planning were conducted. Current green coverage of the metropolis was digitized from Google Satellite imagery and Aerial photographs using ArcGIS 9.3 software. Questionnaires were administered randomly to 140 people living and working within a 1000 meters radius of the location of the seven selected urban parks in Kumasi. Personal interviews and discussions were held with some of the 140 residents sampled to assess their views on urban parks in Kumasi metropolis.

Data collected from questionnaires was analysed using the Statistical Package for Social Scientists (SPSS, version 16). Secondary data comprised of the existing base-map of Kumasi metropolis, layouts of some suburbs in Kumasi, Google Maps Imagery (2014), Aerial Photographs (2007), Global Positioning System (GPS) coordinates and published literature. All data collected was integrated into ArcGIS 9.3 software for analysis.

3.3 GIS AND MULTI-CRITERIA DECISION MAKING (MCDM)

Combining GIS and MCDM is a powerful method in land suitability assessments (Chen et al., 2009). A set of criteria are chosen and assigned their corresponding weights and utilized to solve Multi Criteria Decision Analysis through analysis in the ArcGIS software. In executing the assessment of the multi-criteria the MCDM component is used and the result is transported into the GIS environment for display. The multi-criteria evaluation functions are fixed into the GIS software program which will in turn help in carrying out developments easily.

KNUST

3.4 GIS DATABASE DEVELOPMENT

The following procedure was adopted in Arc GIS 9.3 for database development and analysis in UTM Zone 30 coordinate system. The base map of Kumasi metropolis was scanned and geo-referenced to change it into earth coordinates, which was then digitized in Arc GIS 9.3 software to develop data layers. All data collected were integrated and transferred into the ArcGIS software as shown in Table 2.

Green space coverage in Kumasi included trees, grass and wetlands. The current green coverage was calculated by digitizing green space areas from Aerial photographs and Google Satellite imagery using Arc GIS software. The areas were then calculated in Arc GIS and the results obtained are approximate values to give a fair view of the green coverage in Kumasi.

Other data that were digitised included: existing green parks together with built up areas and available road networks so as to identify distribution pattern of their different locations.

Table 2. Data sources

Data	Source	Representation in ArcGIS
Existing Park locations	Department of Parks and Gardens-Kumasi, Department of Town and Country Planning, Kumasi	Point shape file
Transportation networks	Survey Department, Ghana	Line shape file
Aerial photographs	Survey Department, Ghana	Polygons
Google Imagery	GOOGLE Earth Maps	Polygons
Population data	KMA Metro office Statistics department	Excel file
Sub-metro maps	Department of Town and Country Planning, Kumasi	Polygons

3.4.1 THE ANALYTICAL HIERARCHY PROCESS (AHP)

In this study, the Analytical Hierarchy Process (AHP), which was proposed by Saaty in 1980, was used as the multi-criteria decision analysis (MCDA). The AHP is a step wise method used to guide decision-makers to decisions that solve problems based on priorities of a set of criteria or factors (Miller, 1998). It uses pair-wise comparison method to weigh criteria by calculating the weights of the required factors related to individual criterion data layers using their associated matrices where all known relevant criteria are compared to each other (Chen *et al.*, 2009). The combination of AHP method combined with GIS is a new trend in land

suitability analysis as one of the commonly used methods of Multi Criteria Analysis (Jafari and Zaredar, 2010).

The AHP involves the following steps:

1. Criteria selection

Criterion evaluation encompasses each objective as well as attributes of multi-criteria decision issue (Malczewski, 2006). Criteria to be evaluated are represented as thematic maps or data layers. The decision traits were assigned numerical values that weighed the references of each objective. Criteria was selected using literature reviews and interviews with experts and residents of the Kumasi metropolis. To select suitable park sites in Kumasi, the following criteria were used: (1) Accessibility, (2) Population density and (3) Land availability. A decision Table was created with rows representing the alternatives, columns representing the criteria and fields for criterion scores.

2. Weighting of criteria

In order to determine the relative importance of criteria, the pair-wise comparison matrix was applied using the nine point weighing scale (shown in Table 3).

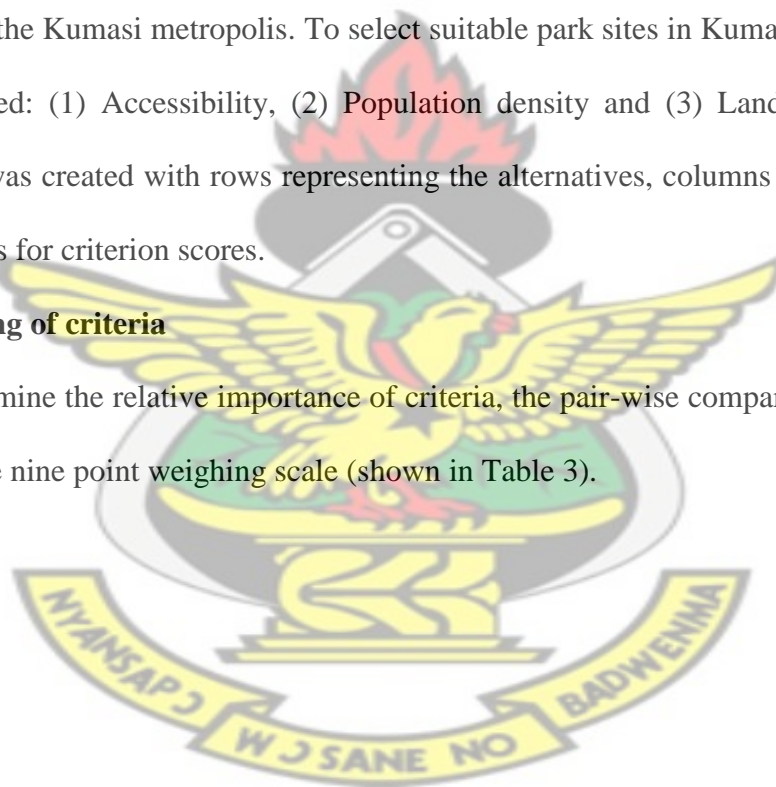


Table 3. Saaty's Nine-Point Weighing Scale of Relative Importance

Descriptions	Scale
Equally preferred	1
Equally to moderately	2
Moderately preferred	3
Moderately to strongly	4
Strongly preferred	5
Strongly to very strongly	6
Very strongly preferred	7
Very strongly to extremely	8
Extremely preferred	9

Source: Jafari and Zaredar, (2010)

Assigning weights to each criteria is a critical element in suitability analysis often based on mixture of implicit knowledge, personal experience and individual opinions (Yang, 2003). For this study, criterion weights were assigned based on consultation with various park stakeholders and literature on suitable criteria for urban park development to give the resultant values of each criterion map for the study area. The process of pairwise comparison involves comparing each criteria to each other including themselves using the scale of judgements from the comparison Table and giving them scores.

A normalised pairwise matrix is then derived and the largest Eigen value derived from the matrix weighting vector of each corresponding criterion.

The pairwise comparison matrix was calculated manually using MS Excel bearing in mind that consistency ratio (CR) should not exceed the desired range, i.e. >0.10 .

When $CR (X) \leq 0.1$, the pairwise comparison matrix is considered to be consistent. In the case $CR (Y) \geq 0.1$, the comparison matrix, is not acceptable and should be improved. The

computation of Consistency Ratio (adapted from Imtiaz *et al.*, 2011) was carried out using the following steps:

- The relative priorities of each criterion were multiplied by the pairwise comparison matrix to obtain a weighted sum vector.
- This weighted sum vector was divided by the related priority weights of each criterion to generate a consistency vector;
- The average value of this consistency vector was calculated and denoted by λ_{max} (Eigen value)
- The Consistency Index (CI) was calculated using the formula in Equation 1.
- The result of the CI was used to compute or the CR which was either accepted as being consistent based whether the result was ≤ 0.1

The following formula (Mendoza, 1997; Mohit and Ali, 2006) was used by Imtiaz *et al.*, (2011) and was further applied in this study to yield a suitability map for suitable park sites:

$$E = \sum_{i=1}^n w_i * v_i$$

Where: W_i = relative importance or weight of factors/parameters i ,

V_i = relative weight of parameters i ,

n = total number of parameters related to the study.

In order to prevent bias, criteria weighting the Consistency Ratio (C.R) was used.

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad \text{Eq 1.}$$

$$CR = \frac{CI}{RI} \quad \text{Eq 2.}$$

Where n = the number of criteria to be compared in the matrix

λ_{\max} = the largest Eigen value

RI = random consistency index

RI is the random index which represents the consistency of a randomly generated pair wise comparison matrix. The number of criteria being compared determines the value of RI.

Table 4. Random consistency indices for different number of criteria (n).

N	1	2	3	4	5	6	7	8	9
RCI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45

Source: Imtiaz and Abdul- Nasir, (2011).

Land suitability analysis was done in Raster format to be able to demarcate sites easily. Suitability maps were created under a raster GIS environment, based on various scenarios. Each map represents one criterion known as thematic or data layers with each layer representing alternative places for a decision. The suitability map was generated in Arc GIS 9.3 by an overlay of each criterion map to locate suitable areas for parks in Kumasi.

A flowchart showing a summary of the methodology is shown in Figure 3.

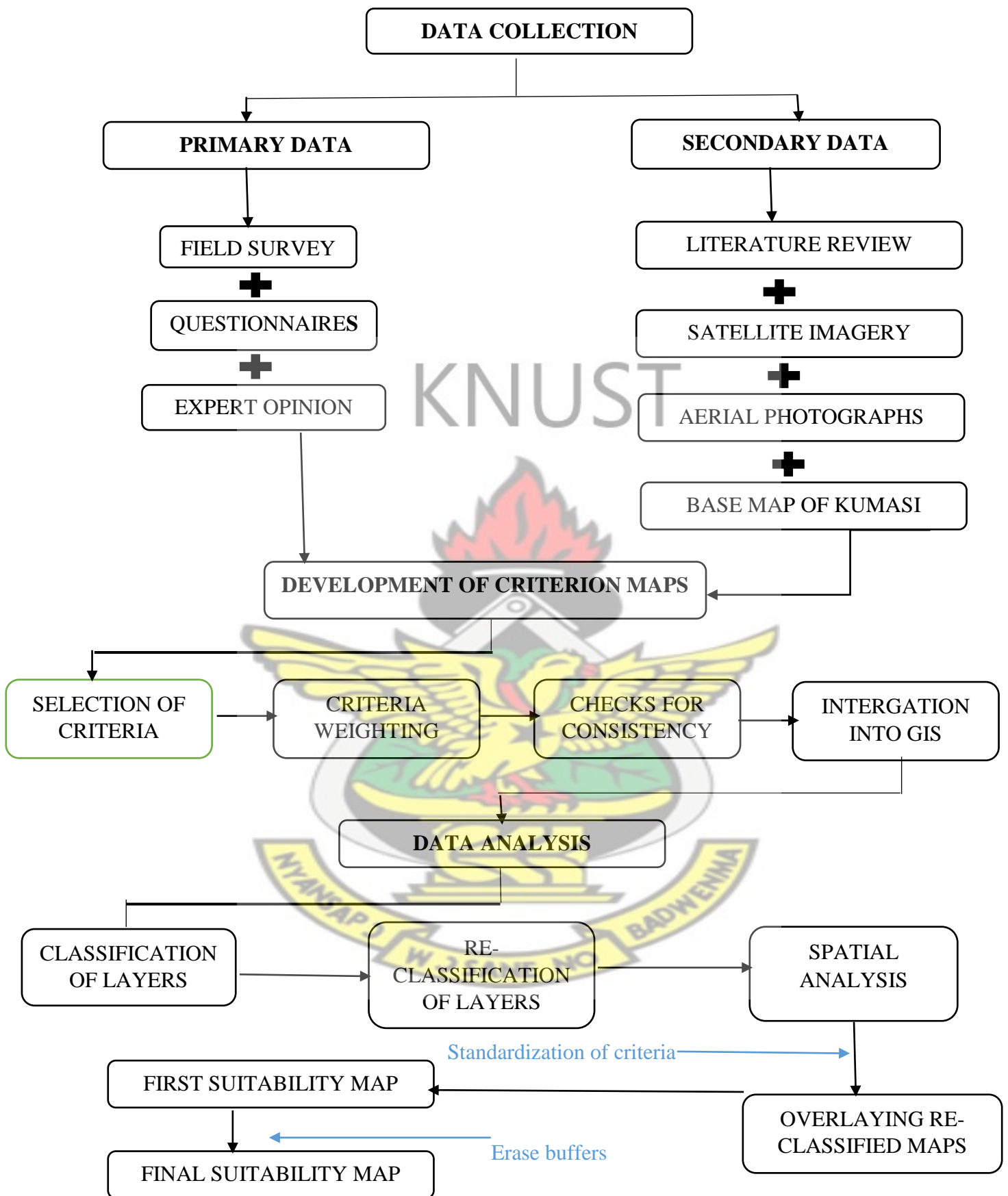


Figure 3. Flowchart of summary of methodology

CHAPTER FOUR

4.0 RESULTS

4.1 GREEN SPACE ANALYSIS IN KUMASI METROPOLIS

As stated earlier in Chapter 2, urban green space comprise all urban parks (private and public), forests and related vegetation that add value to the inhabitants in an urban area (Singh *et al.*, 2010).

4.1.1 CURRENT GREEN COVERAGE IN KUMASI METROPOLIS

The visual representation of the green coverage in Kumasi is illustrated in Fig 4 below.

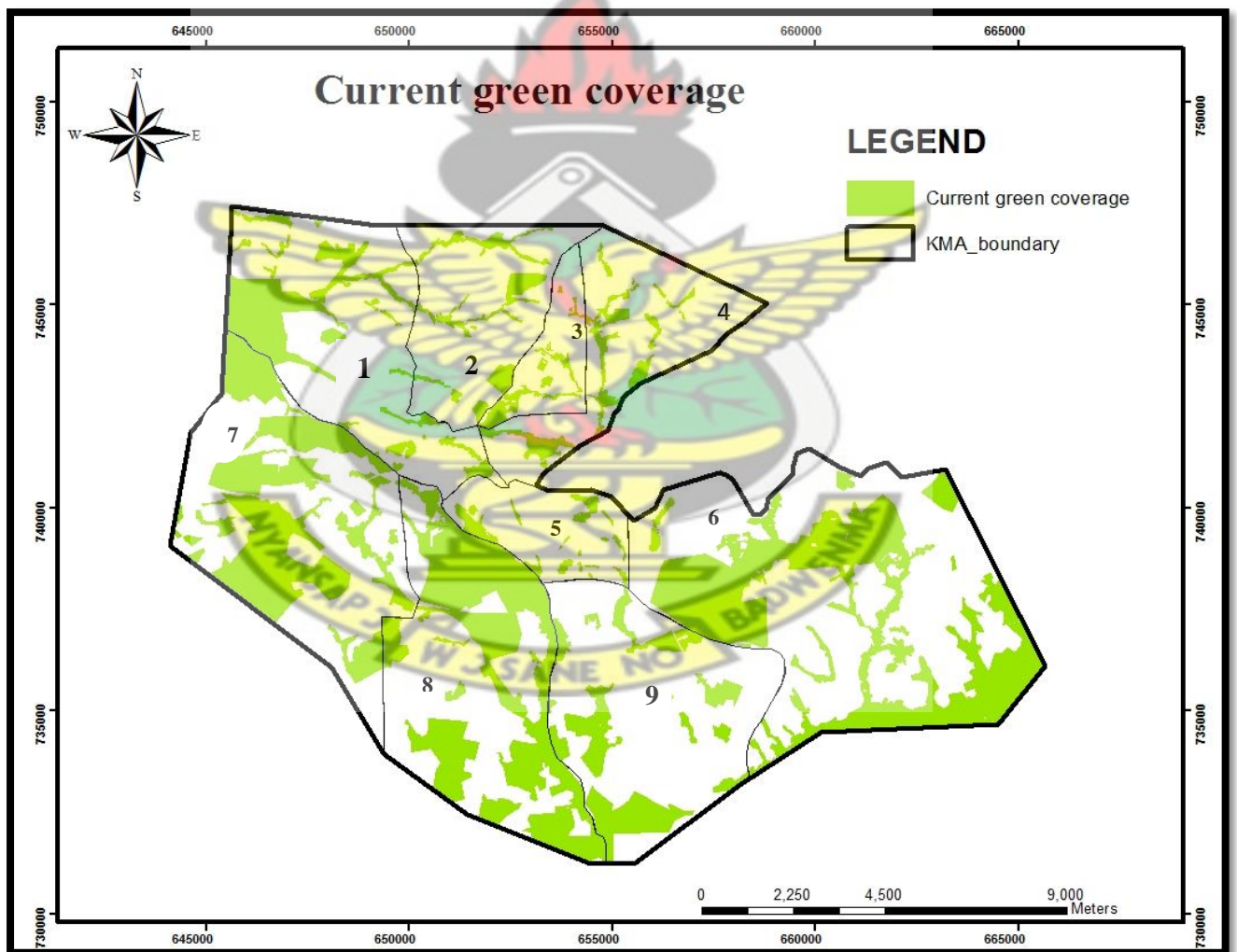


Fig 4. Current urban green space coverage in Kumasi Metropolis from data obtained.

The numbers by each sub metro name below correspond to the locations of the numbers in Fig 4.

- | | |
|------------|--------------|
| 1. Bantama | 6. Oforikrom |
| 2. Suame | 7. Kwadaso |
| 3. Tafo | 8. Nhyiaso |
| 4. Manhyia | 9. Asokwa |
| 5. Subin | |

Results showed that Manhyia, Suame, Subin and Tafo sub metros had the lowest green space coverage (10.0-11.57%) while Kwadaso and Nhyiaso had the highest green space coverages of 40.96% and 47.39% respectively.

Table 5. Current urban green coverage in Kumasi Metropolis

Sub-metro	Sub metro area (m ²)	Green coverage (m ²)	Green coverage per sub-metro (%)
ASOKWA	26,545,004.91	5,044,771.94	19.00
BANTAMA	24,295,118.58	5,309,491.28	21.85
KWADASO	31,052,264.02	12,720,300.06	40.96
MANHYIA	15,226,280.62	1,691,862.03	11.11
NHYIASO	29,081,447.07	13,781,081.39	47.39
OFORIKROM	48,908,660.77	17,850,347.33	36.50
SUAME	15,052,706.74	1,636,902.78	10.87
SUBIN	8,250,972.84	821,766.914	10.0
TAFO	5,348,375.69	618,730.96	11.57
Total	203,760,831.2	59,475,254.69	29.19

The Kumasi Metropolitan area covers a total surface area of 254 km² according to the Kumasi Metropolitan Assembly. Currently, its land area is approximately 203.76 km² owing to the fact the Asawasi sub-metro area is no longer part of the Kumasi Metropolitan area. The current approximate green coverage in the metropolis excluding the Owabi Natural reserve is about 59.48 km²

4.1.2 CURRENT SITUATION OF THE URBAN PARK SYSTEM IN KUMASI

Layouts obtained from the Department of Town and Country Planning revealed that there were several areas which had been zoned as Public Open Space, Children's playground, Public parks and Nature Reserves. Unfortunately, some of these sites which had been zoned for such purposes were either in a deplorable state or had been encroached upon and used for other purposes. Figures 5 and 7 show zoned out areas by the Department of Town and Country Planning for public parks in certain suburbs of Kumasi while Figures 6 and 8 show the current status of those lands. Some areas zoned out as Public parks have been built up while others have little space available to be used.

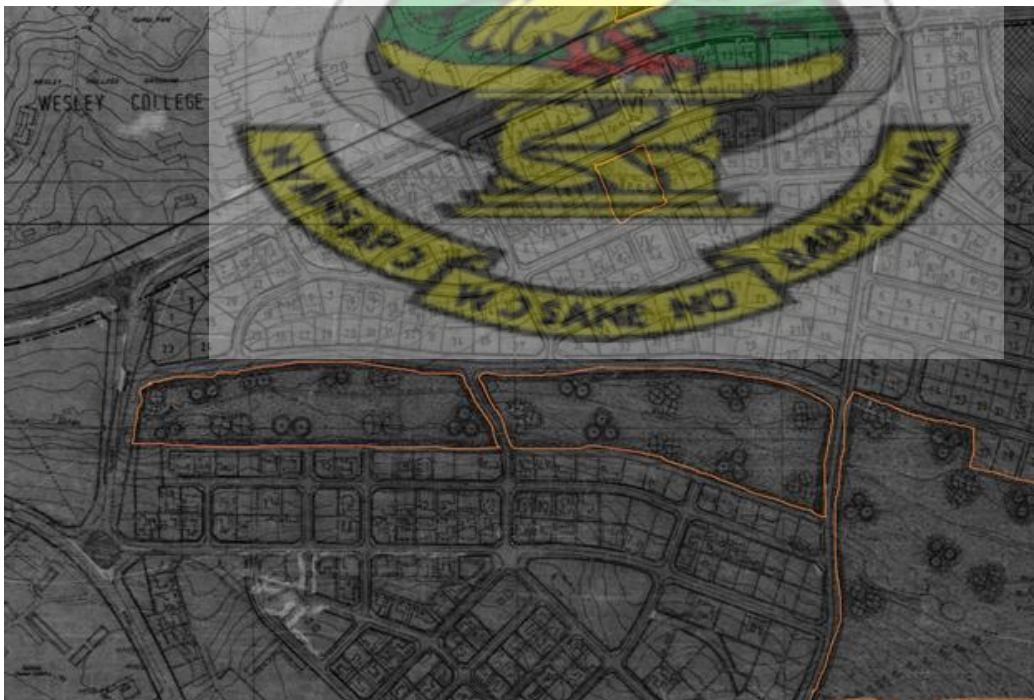


Plate 3: Plan of part of New Tafo (Source: Town and Country Planning Department, Kumasi, 2008).



Plate 4: Current status of part of New Tafo

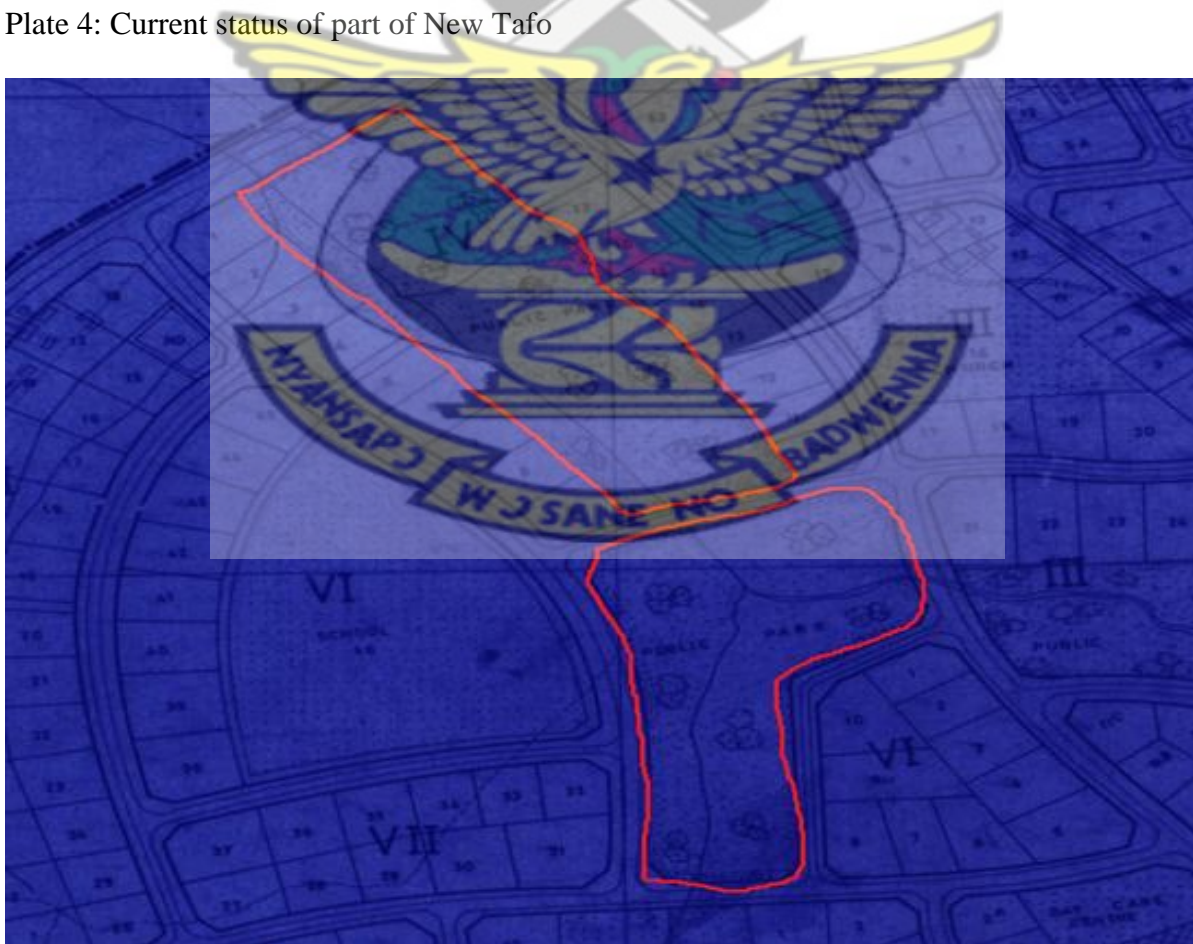
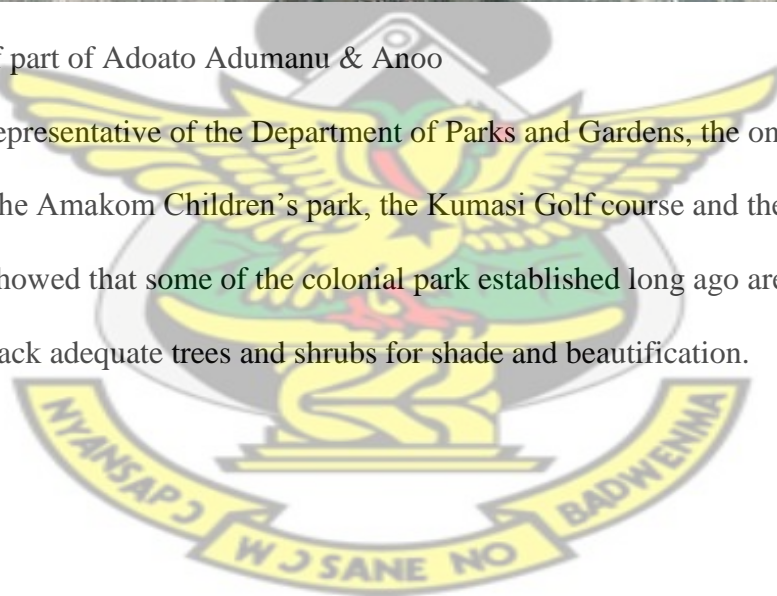


Plate 5: Plan of part of Adoato Adumanu & Anoo (Source: Town and Country Planning Department, Kumasi, 2008)



Plate 6: Status of part of Adoato Adumanu & Anoo

According to a representative of the Department of Parks and Gardens, the only existing urban parks are the Amakom Children's park, the Kumasi Golf course and the Jubilee Park. Further studies showed that some of the colonial park established long ago are now poorly landscaped and lack adequate trees and shrubs for shade and beautification.



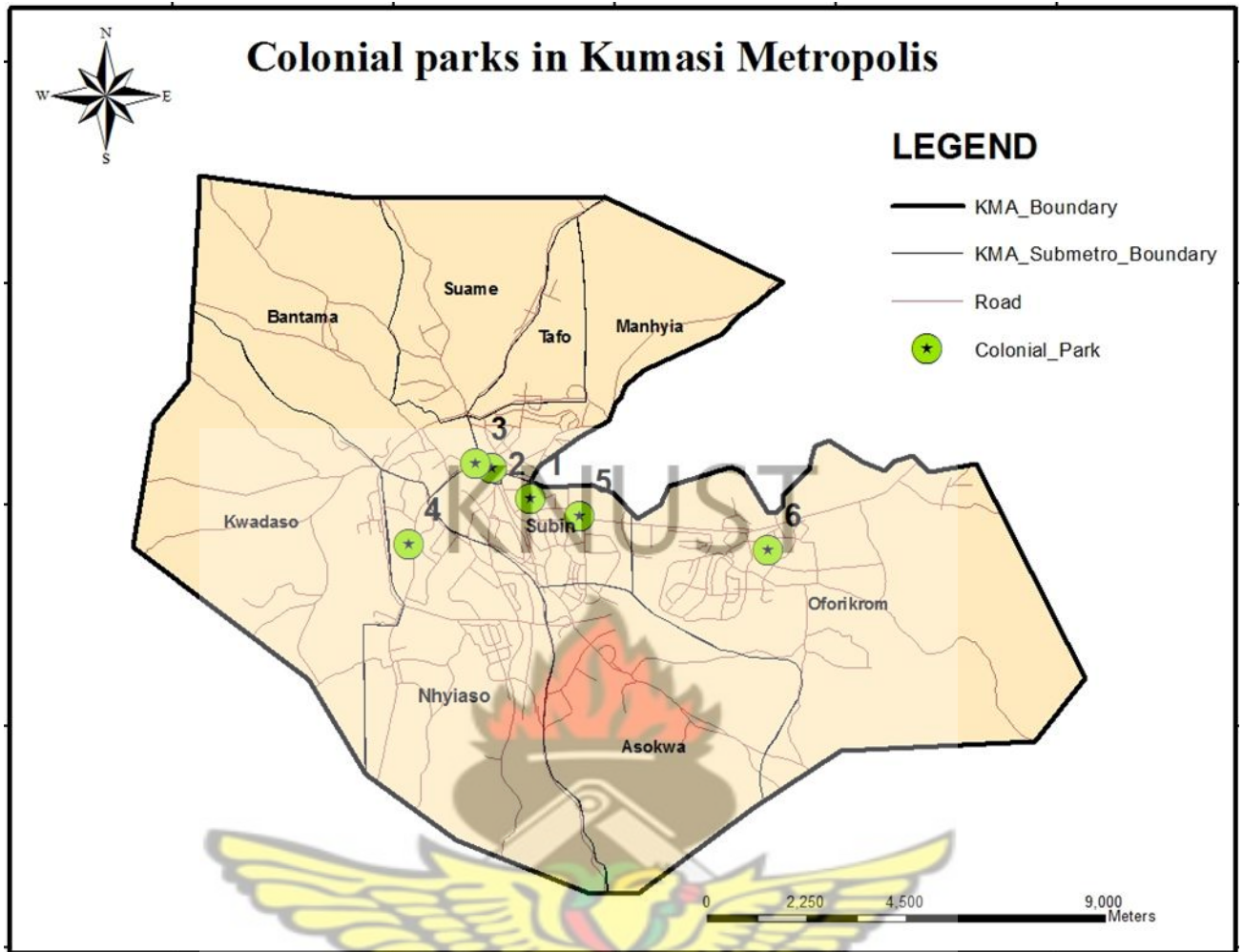


Fig 5. Colonial parks in Kumasi Metropolis (Adapted from Quagraine, 2011).

The numbers by each park name correspond to the locations of the numbers in Fig 5.

- | | |
|------------------------------|---------------------------|
| 1. Jubilee park | 4. Suntreso park |
| 2. Kumasi Zoological Gardens | 5. Amakom Children's park |
| 3. Adehyeman Gardens | 6. KNUST Botanic Gardens |

The distribution of current accessible urban parks in Kumasi are shown in Figure 6 below.

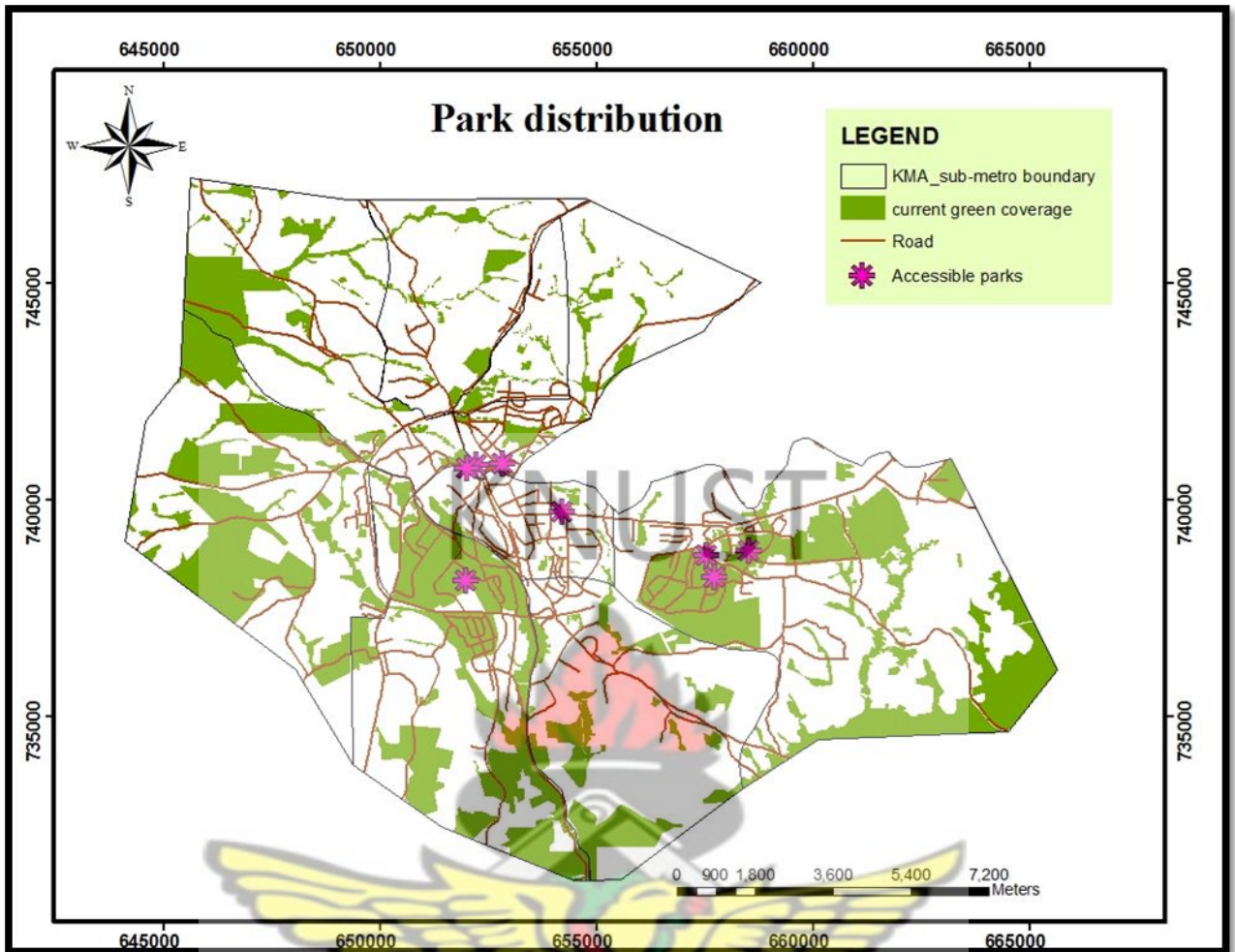


Figure 6: Park distribution in Kumasi metropolis

The numbers by each park correspond to the locations of the numbers in Figure 6.

- | | |
|-------------------------------|--------------------------------------------------|
| 1. KNUST Ceramics open space | 5. Rattray Park (which is still being developed) |
| 2. KNUST Botanic Gardens | |
| 3. KNUST Royal Parade Grounds | 6. Kumasi Zoological Gardens |
| 4. The Kumasi Golf course | 7. Adehyeman Gardens |
| | 8. Amakom Children's Park |

An assessment of the locations of the colonial parks (Fig 5) and the current parks as well (Fig 6) shows that they are not evenly distributed across the metropolis. Urban parks in Kumasi are centred at the middle of the metropolis making them less accessible to residents living further off close to the boundary of the metropolis.

The Departments which were found to play a role in urban green space creation, protection and management in the study area include:

1. Department of Town and Country Planning, Kumasi
2. Department of Parks and Gardens, Kumasi
3. The Kumasi Metropolitan Assembly, Planning unit
4. Lands Commission
5. Forestry Commission

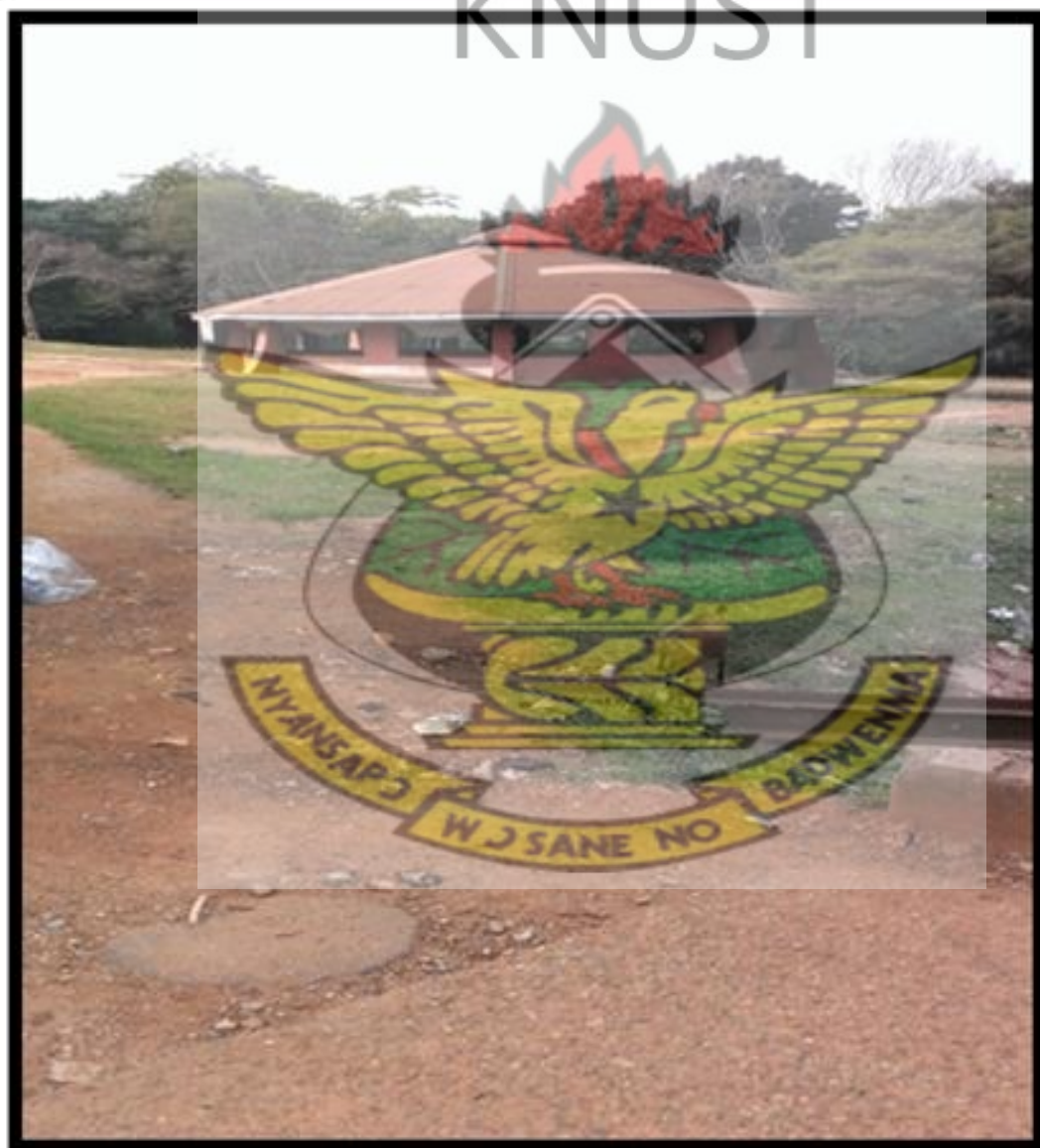


Plate 7: View of Amakom Children's Park from the main entrance.



Plate 8: View of Rattray Park still under construction near the Golden Tulip hotel.

(Source: Author's field survey)

4.1.3 PROBLEMS OF THE URBAN PARK SYSTEM IN KUMASI

The current accessible urban parks in Kumasi were grouped under the sub metro in which they were found and their approximated total park areas were calculated using the Arc GIS software. Comparing the park areas in each sub metro, the park area per capita was calculated using the formula below and results are compiled in Table 6.




The Park per capita refers to the number of public green spaces that can supply some recreational needs to every resident in the city (Oh and Jeong, 2007). It is calculated by:

Park area per capita = Park areas (including public green space)/ Total urban population

Park area ratio = Park area / total land area

Table 6. Urban park comparison for the sub-metros in Kumasi Metropolis

Sub-metro	Land Area/km ²	Population	Park area/km ²	No. of parks	Park area ratio (%)	Park area per capita/m ²
Oforikrom	48.91	247,886	0.55	4	1.12	2.21
Asokwa	26.55	376,038	-	0	-	-
Nhyiaso	29.08	262,006	0.60	2	2.05	2.27
Subin	8.25	121,770	0.07	1	0.79	0.54
Kwadaso	31.05	413,503	-	0	-	-
Bantama	24.29	270,430	0.11	1	0.43	0.39
Suame	15.05	346,297	-	0	-	-
Tafo	5.35	289,410	-	0	-	-
Manhyia	15.23	288,895	0.01	1	0.08	0.04

-  - At least one current accessible green park
-  - No current accessible green park
-  - High green coverage with no park

Comparing the recent population census (2010) with the previous one which was conducted in 2000 (Figure 7), it is evident that there is an increase in the number of residents in Kumasi. Unfortunately, sub metros with the highest population densities (Tafo and Suame) have no current accessible green park. Kwadaso sub metro which had one of the highest green space coverage's had no accessible urban park for its residents.

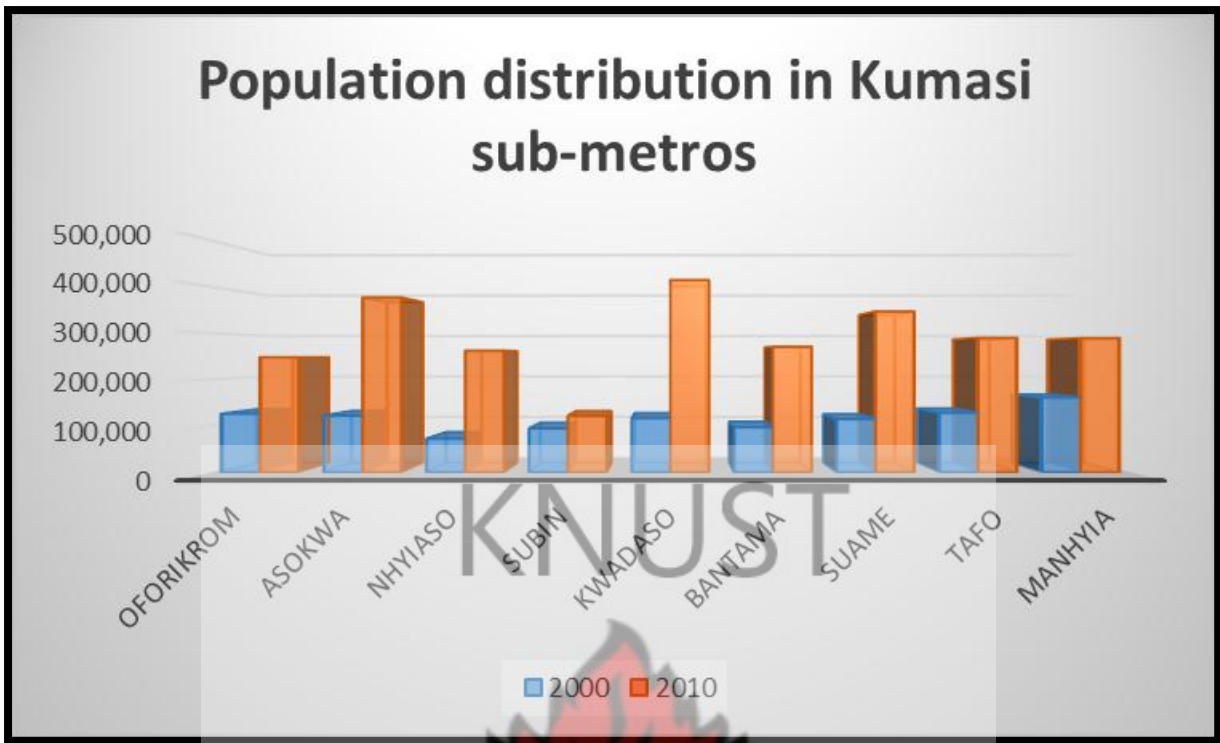


Fig 7. Graph of Population distribution in Kumasi sub-metros (Source: KMA, 2010).

4.2. URBAN DWELLERS ATTITUDES TO URBAN PARKS

Seven selected urban parks in Kumasi Metropolis which were (still) found to be green (i.e. have vegetation on the land) included:

1. KNUST Ceramics open space (which is yet to be named)
2. The KNUST Botanic gardens
3. The Royal Parade Grounds
4. The Kumasi Golf course
5. The Kumasi Zoo
6. The Amakom Children's park
7. The Adehyeman Gardens

The numbers by each park correspond to the locations of the numbers in Figure 8.

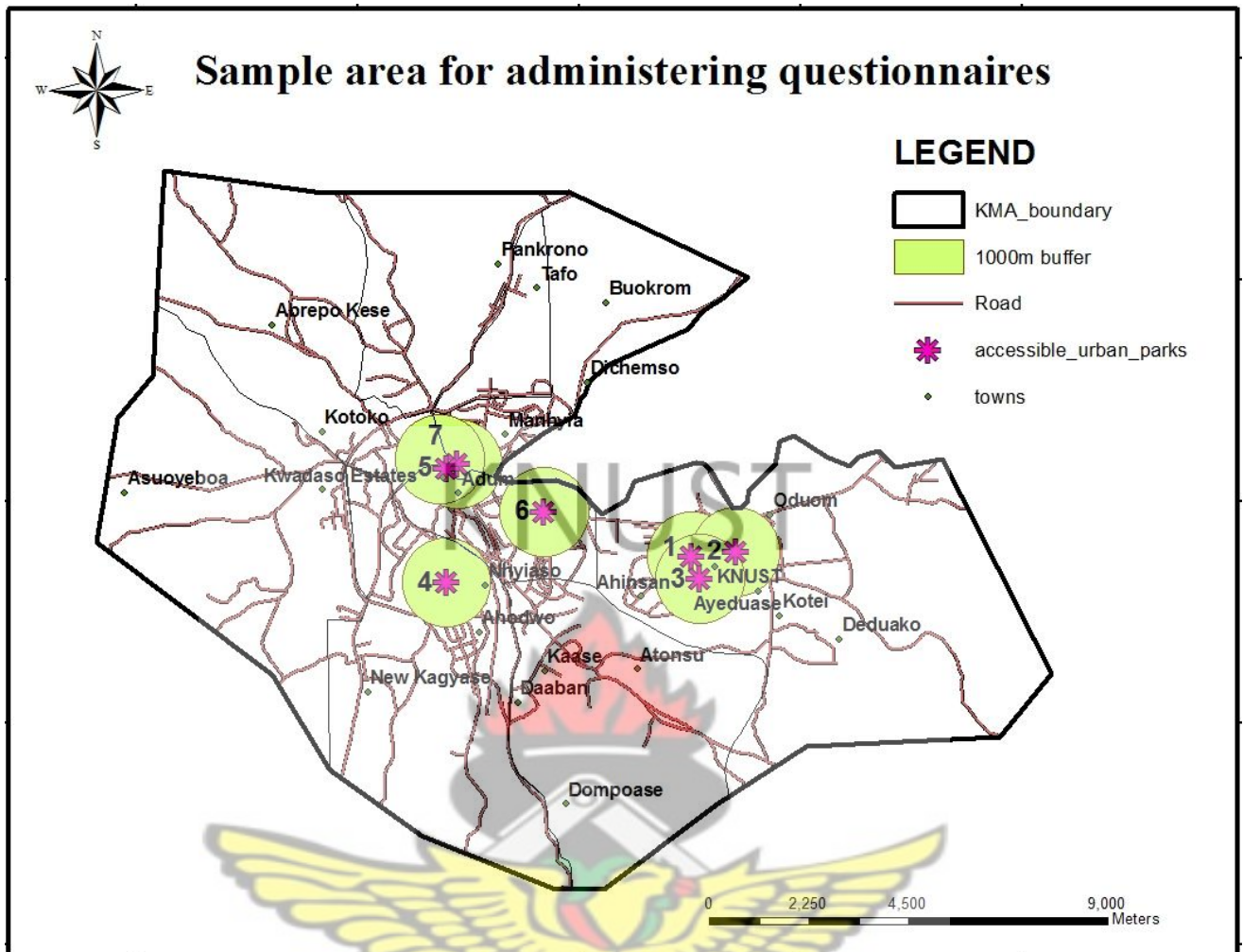


Fig 8. Sample area for questionnaire administration

The respondents also gave their personal views in interviews during the process.

Respondents were asked their personal opinion on the importance of urban green parks. This was to determine the value they gave them and how they viewed them in the urban setting as shown in Table 7.

Table 7. Respondents’ opinions on the importance of urban green parks to urban areas

Level of Education	Importance of urban green parks to urban areas				
	Not important	Important, not priority	Very important	Indifferent	Total
Basic	0	0	9	0	9
Secondary or Senior High	0	1	42	0	43
Technical/vocational	0	1	8	1	10
Tertiary	4	32	34	8	78
Total	4	34	93	9	140
Percentage (%)	2.9	24.3	66.4	6.4	100

The study revealed that majority of the respondents (66.4%) ranked urban green parks in urban areas as very important. Many of those who viewed them as important were residents who have had secondary or senior high school education.

It was important that the study found out if respondents knew the benefits that urban green parks had in the urban community. The knowledge on the benefits were grouped according to the level of education of the respondents to determine whether education played any role in the awareness of the importance of urban green in urban communities.

Table 8. Respondents knowledge on the benefits of urban green parks in urban areas (Multiple choice answers).

Benefits of urban green parks in urban areas					
Educational background	Beautification/ Aesthetics	Relaxation and stress relief	Recreation	Cooling effect and air pollution control	Water pollution control
Basic	6	5	7	2	0
Secondary	21	36	29	18	7
Technical/ Vocational	5	8	5	5	3
Tertiary	38	55	54	20	9
Total	70	104	95	45	22
Percentage (%)	20.8	31.0	28.3	13.4	6.5

With regards to the benefits which could be derived from the presence of urban green parks, 31.0% of the respondents stated that they were of great benefit in the role they play in helping them relax. Some (28.3%) also viewed them as important places for recreation away from work activities. Few, however, viewed them as important for cooling effect and air pollution control (13.4%) and water pollution control (6.5%).

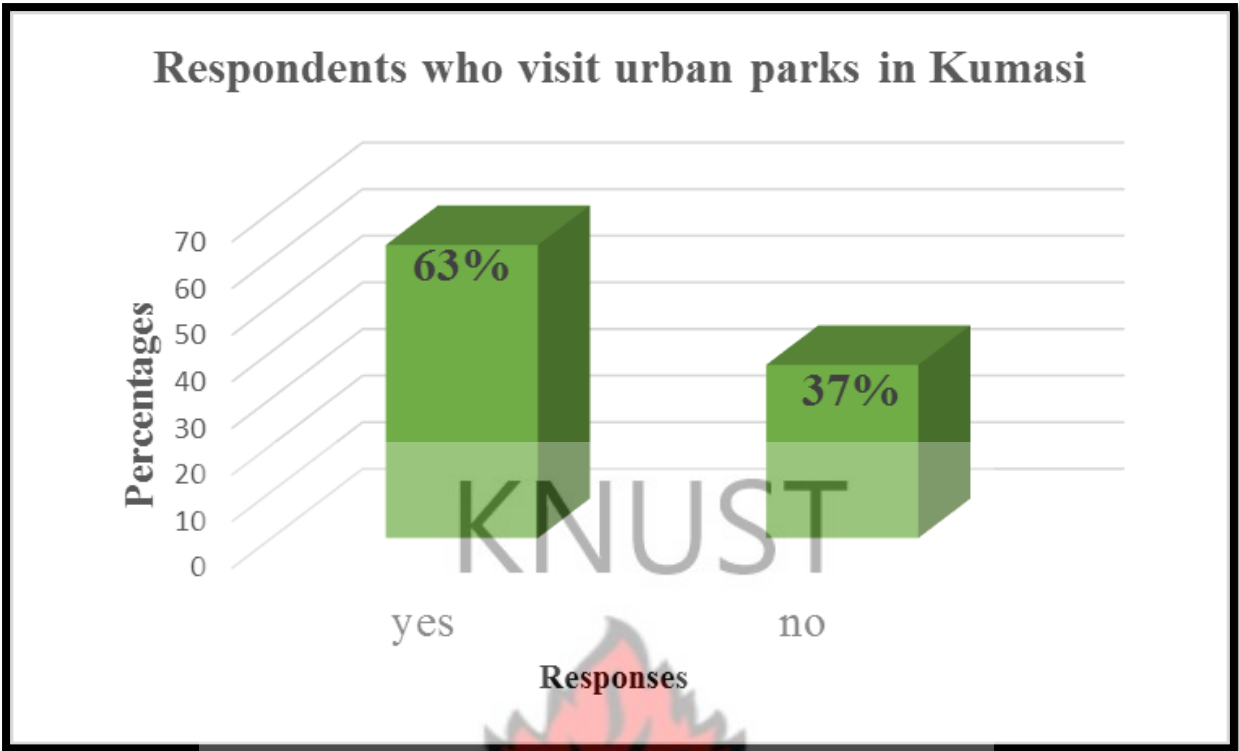


Fig 9. Respondents who visit urban parks in Kumasi

Of the 140 people who answered the questionnaire, 63% of them have visited urban parks in Kumasi while 37% of them have not.

It was important to know the reasons why respondents did or did not use current urban parks in order for the changes to be made in future plans to develop new parks. Respondents who visited urban parks in Kumasi did so mainly to relax (27.2%), for leisure and recreation (25.1%), for sports (24.6%) and to attend functions (23.1%) (Table 9).

Table 9. Respondents' reasons for visiting urban parks (Responses are multiple)

Age	Reasons for visiting				Total
	Relaxation	Sports	Leisure/recreation	Attend functions	
10-17	0	2	0	0	2
18-25	32	26	29	26	113
26-33	5	8	8	8	29
34-41	9	9	5	5	28
42-49	1	3	2	2	8
>50	6	0	5	4	15
Total	53	48	49	45	195
Percentage (%)	27.2	24.6	25.1	23.1	100.0

Table 10. Reasons for not visiting urban parks in Kumasi (Responses are multiple)

Occupation	Reasons for not visiting					Total
	Lack of/poor maintenance	Too far	Lack of time	Less vegetation	Not interested	
Employed	9	2	9	2	7	29
Unemployed	1	0	0	0	1	2
Student	7	1	6	0	16	30
Total	17	3	15	2	24	61
Percentage (%)	27.9	4.9	24.6	3.3	39.3	100.0

Other respondents who did not visit urban parks mainly did so due to lack of interest in them (Table 10). Personal interviews with respondents also revealed that the loss of interest was partly due to the poor maintenance of some of the current green spaces available in the

metropolis. Some respondents revealed that they took advantage of public holidays and field trips to visit reserves and nature parks outside Kumasi in order to experience nature and as an escape from the hustle and bustle of city life in Kumasi. Some respondents had visited the Owabi reserve, the Kakum national park, and the Kintampo water falls.

Overall, a large portion of both users and non-users of urban parks (76%) in the metropolis stated that most of the urban green spaces in the metropolis including parks were in very poor conditions as shown in Fig 10.

KNUST

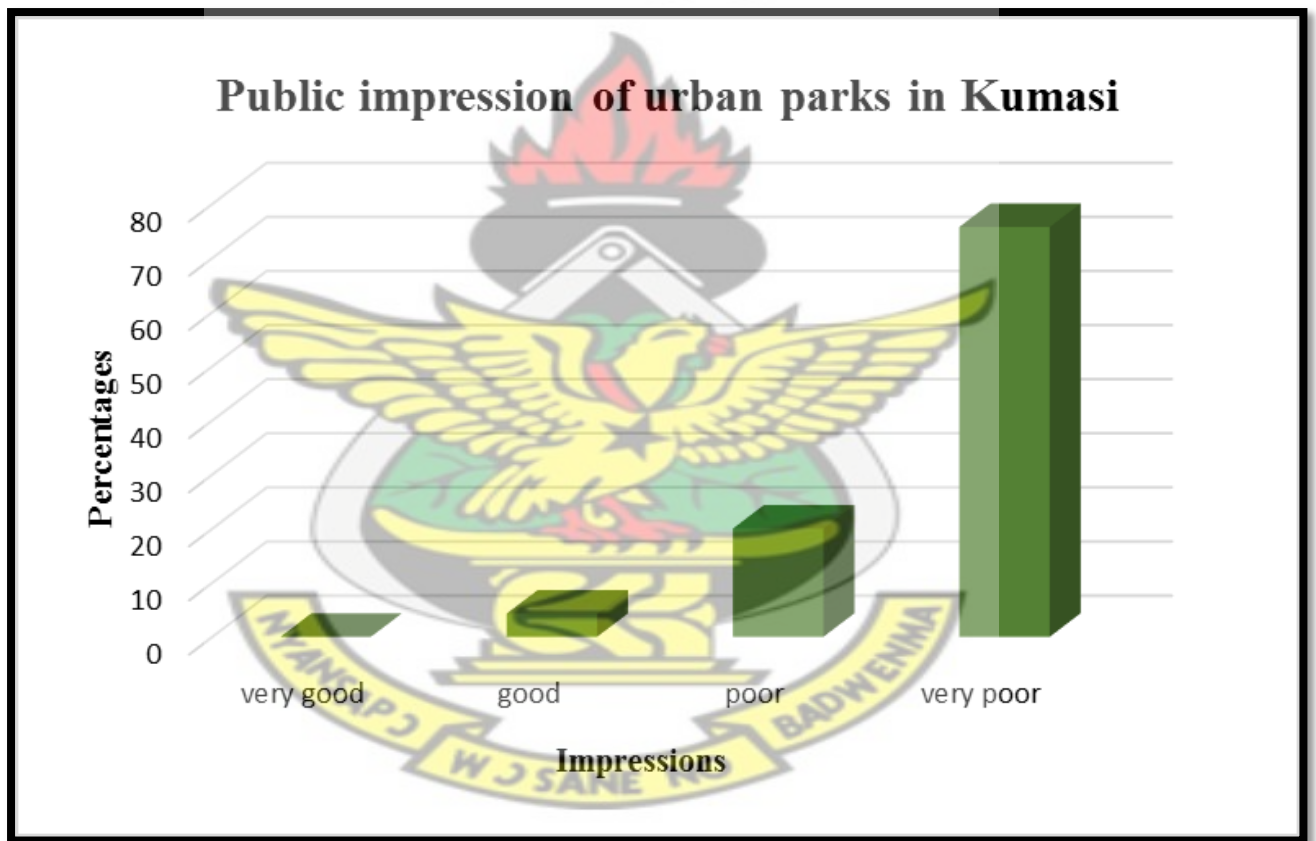


Fig 10. Public impression of respondents on urban green parks in Kumasi

Majority of the respondents expressed the view that the current urban parks in Kumasi were not enough to cater for the nature needs of the growing population (96.4%) and pleaded that new ones be developed. A large group of respondents (77.9%) also agreed that they would be willing to pay for park patronage.

4.3 LAND SUITABILITY ANALYSIS OF URBAN PARKS BASED ON GIS

Stakeholders whose influence strongly affected urban parks were consulted to rank suitability criteria for this study. These included urban planners (Landscape designers and Architects), Local government officials, Environmentalists and Local residents in Kumasi. This was done with the understanding of the contributions of the different stakeholders in urban park development.

The suitability analysis was done in the raster format in the ArcGIS software due to the grid cell structure which made it easy to easily demarcate suitable sites (Imtiaz *et al.*, 2011). Raster data helps to carrying out weighted overlays of several data layers of criteria without difficulty using ArcGIS software.

4.3.1 COMPUTATION OF THE PAIR-WISE COMPARISON MATRIX

An analysis was done based on the relative composite weights of each suitability criteria: Accessibility, Population Density and Land Availability. Based on literature, expert opinion and response of residents, Accessibility was given the highest weight, followed by Population density and then Land availability. The relative importance of each criterion is shown in Table 11.

Table 11. Relative weights of Land suitability Criterion

Suitability criterion	Accessibility by road	Population density	Land availability	Priority Weight
Accessibility by road	1	5	7	0.724
Population density	0.2	1	3	0.193
Land availability	1/7	1/3	1	0.083
SUM	1.343	6.333	11	1

Consistency Ratio (CR) = 0.06

Pair-wise comparison matrixes were calculated in MS Excel to determine priority weightages using $CI = (\lambda_{max} - n) / (n - 1)$ and $CR = CI / RI$. The CR was found to be satisfactory since its value $0.06 < 0.10$. These weights were then entered into ArcGIS for spatial analysis to determine the suitability for urban parks. The actual calculation of the pair-wise comparison matrixes can be found in Appendix I.

4.3.2 DEVELOPMENT AND EVALUATION OF CRITERION MAPS

A base map of the study area was obtained and digitised in a layer in GIS software. Areas that were digitised into GIS include available green area, bare areas and existing urban parks. Different data layers used created from the base map to represent each of the three chosen criteria: Accessibility by road, Population density and Land availability. Each data layer represented a set of alternative places for the decision which were assigned values based on their level of preference upon the other criteria. Based on the level of importance of each criterion, the data layers were classified according to 3 categories from “Most suitable”, “Suitable” to “Least suitable”. Table 12 shows the classes given to the 3 different criteria which make them most suitable, suitable and least suitable.

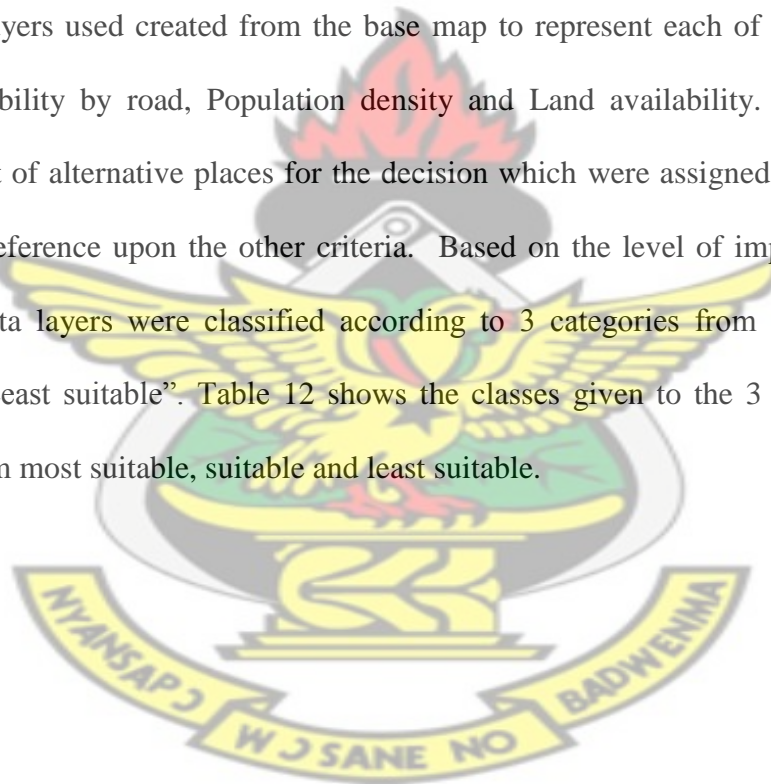




Table 12. Land suitability criteria categories and values

CRITERIA/CLASSES	CATEGORIES	VALUE
LAND AVAILABILITY		
Vacant green areas	Most suitable	1
Bare areas	Suitable	2
Existing urban parks	Least suitable	3
ACCESSIBILITY		
0 – 300m	Most suitable	1
301 – 600m	Suitable	2
600 – 1000m	Least suitable	3
POPULATION DENSITY		
20,001 – 55,000	Most suitable	1
10,001 – 20,000	Suitable	2
0 - 10,000	Least suitable	3

LEGEND

-  - Most Suitable
-  - Suitable
-  - Least suitable

In order to compare criteria with each other, standardization of criteria was done by standardising all criteria values to the same measurement scale (i.e. from 1 to 3), with individual criterion maps having different units of measurement (i.e. accessibility, population density and land availability). With regard to relative importance of each criterion, all criterion maps were overlaid and initial suitability maps were created.

The land suitability scenario 1 for Accessibility by road resulted in out of 48599 grid cells, 26958 (55.47% or 112,845,593.32 m²) being Most suitable land, 17,633 grid cells (36.28% or 73,811,349.02 m²) being Suitable land and 4,008 grid cells (8.25% or 16,777,399.58 m²) being Least suitable land for urban parks in Kumasi shown in Fig 11.

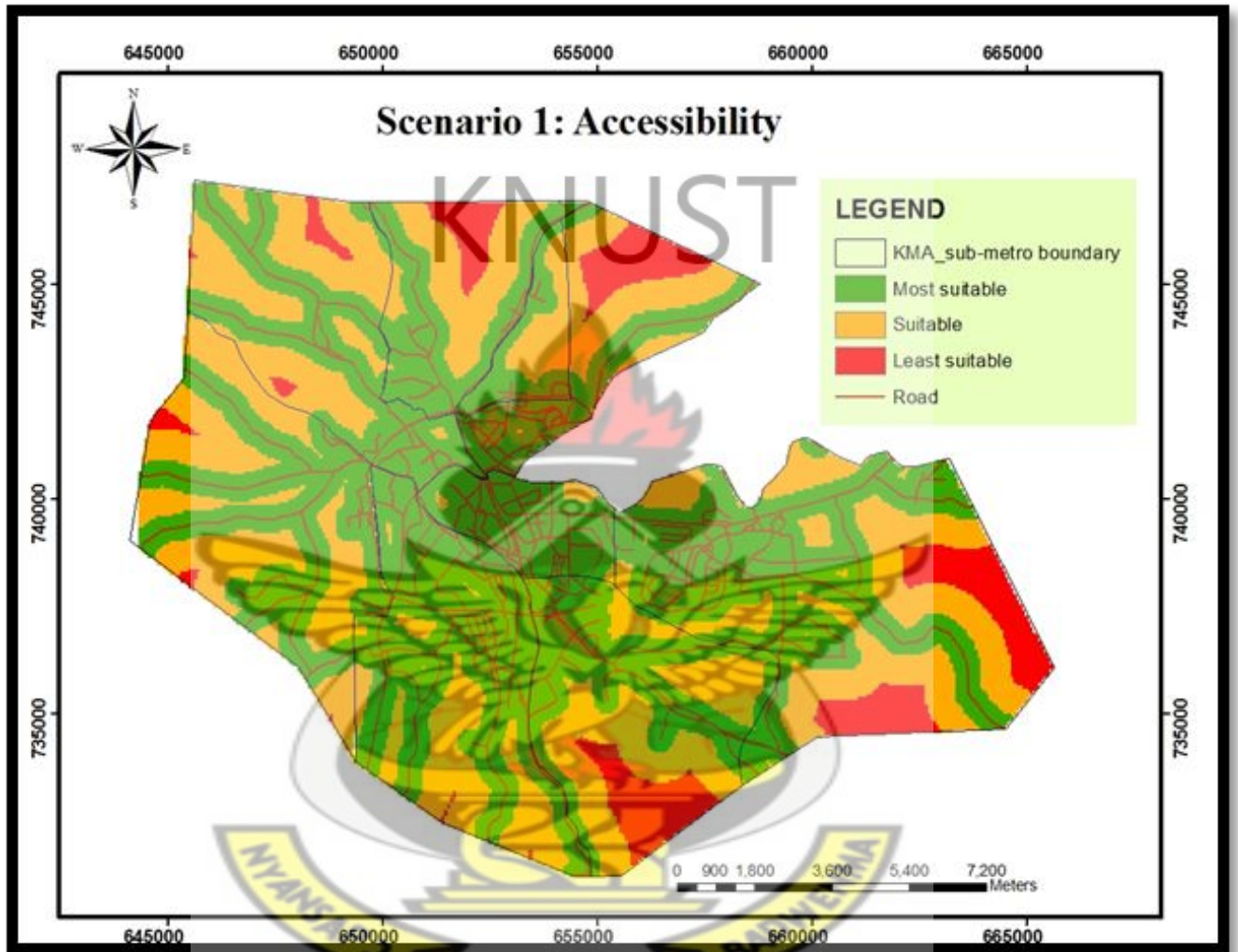


Fig 11. Scenario 1: Accessibility

The land suitability scenario 2 (Population density) resulted in out of 48,442 grid cells, 4,860 grid cells (10.03% or 20,441,820.22m²) being Most suitable, 25,031 grid cells (51.67% or 105,283,786.40m²) being Suitable and 18,551 (38.30% or 78,028,026.11m²) being Least suitable for urban park development in Kumasi as shown in Fig 12.

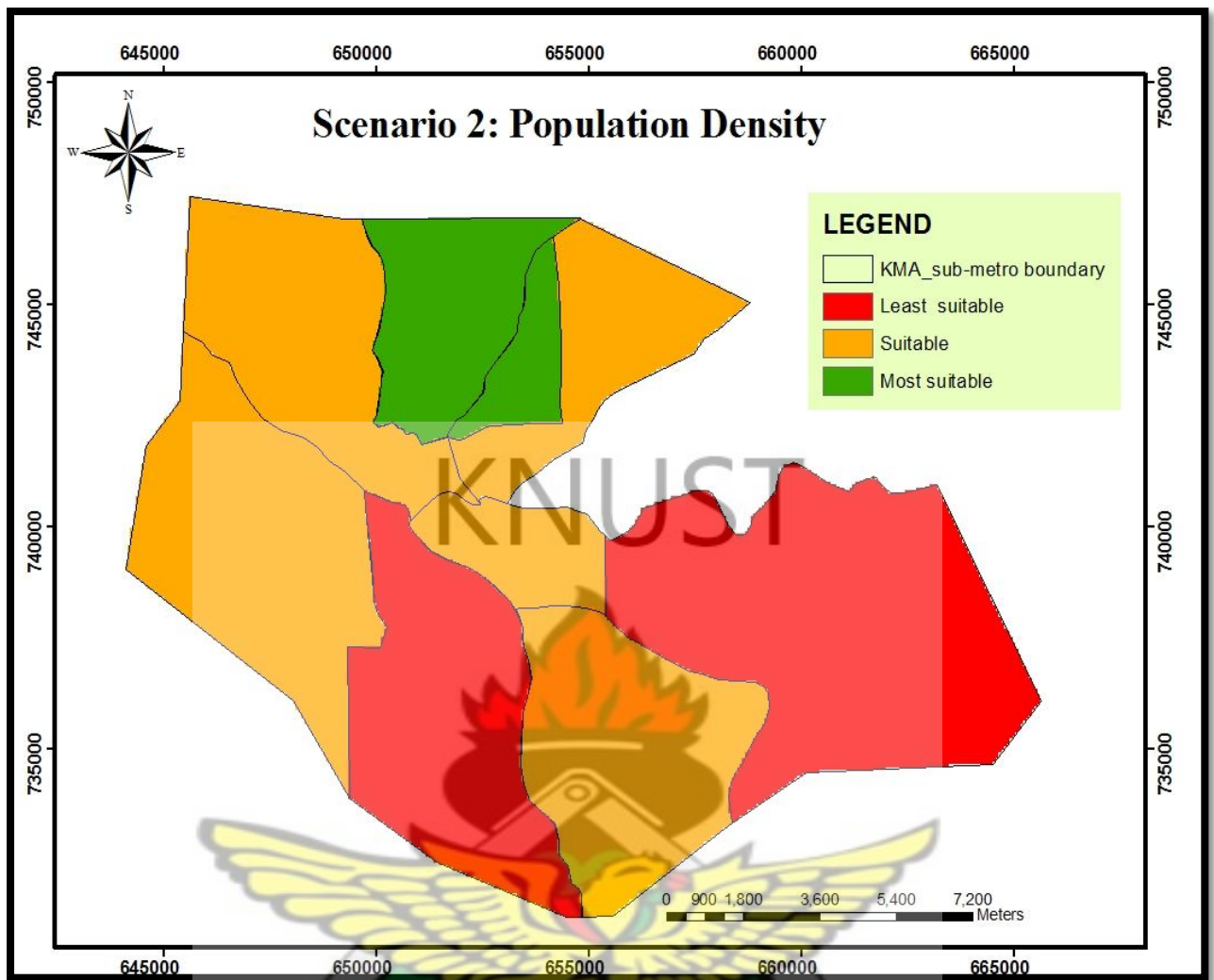


Fig 12. Scenario 2: Population density

Land suitability scenario 3 for Land availability resulted in out of 7,774 grid cells (95.78% or 30,974,784.48 m²) being Most suitable, 111 grid cells (1.43% or 461,751.42 m²) being Suitable and 217 grid cells (2.79% or 902,703.23 m²) being Least suitable for urban parks in Kumasi metropolis shown in Fig 13.

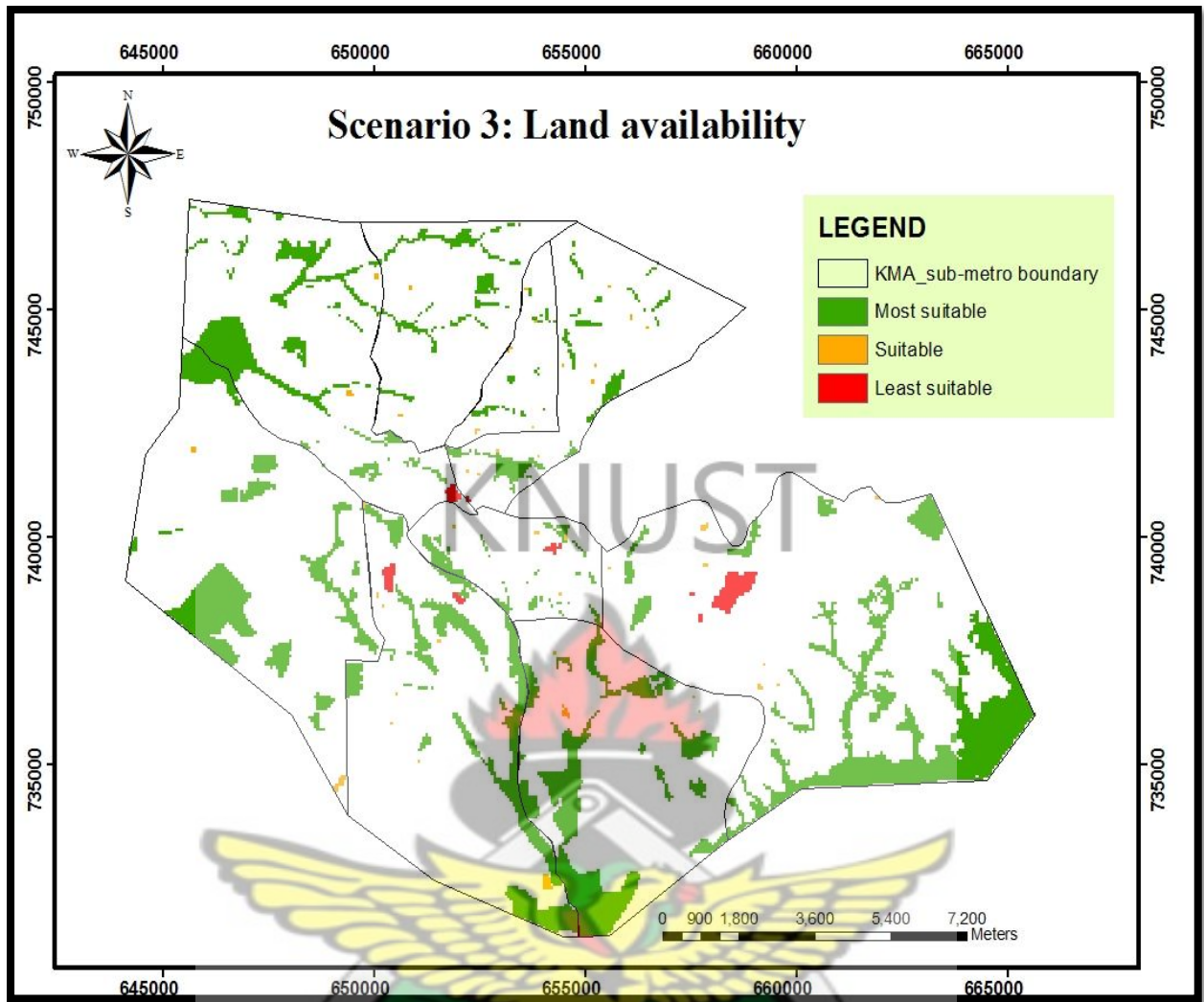


Fig 13. Scenario 3: Land availability

The three scenario maps were reclassified and an overlay map was generated using the relative weights of all three criteria calculated to create an initial suitability map to determine potential land for urban parks.

Buffers with different distances were created around certain important features in Kumasi and all lands falling within these buffers were removed as shown in Fig 14.

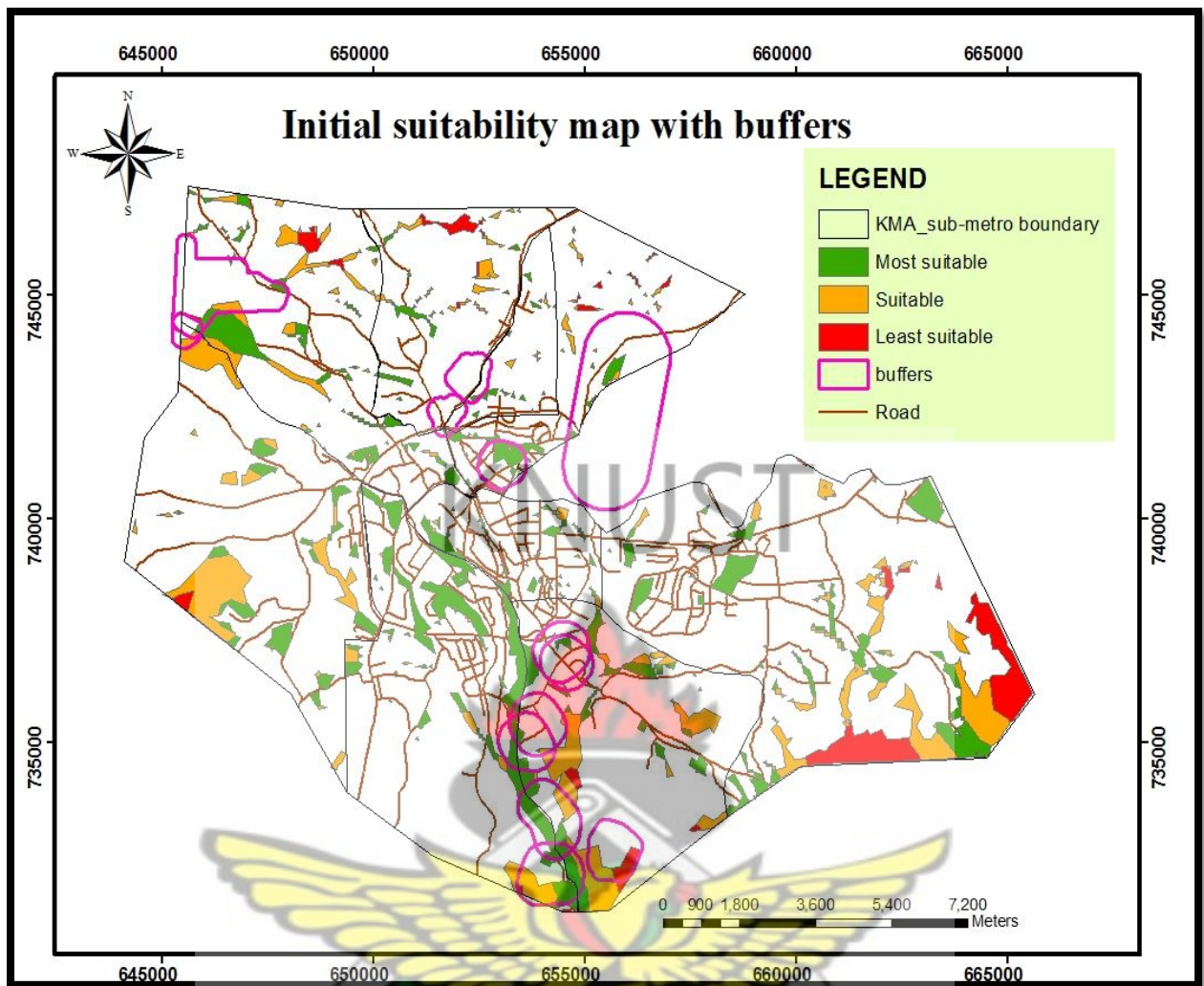


Fig 14. Initial suitability map for land with buffers around important features

Using the ERASE function of the ArcGIS 9.3, buffers created around certain important features in the first suitability map were removed to create the initial suitability map for land for urban green park development in Kumasi which is shown in Fig 4.14. After erasing buffers features, the initial suitability map for land for urban parks in Kumasi resulted in out of 6,408 grid cells, 2,817 grid cells (44% or 11,901,825m²) being Most suitable land for urban parks, 2,663 grid cells (41.6% or 11,251,175 m²) being Suitable land for urban parks and 928 grid cells (14.5% or 3,920,800 m²) being Least suitable land for urban parks.

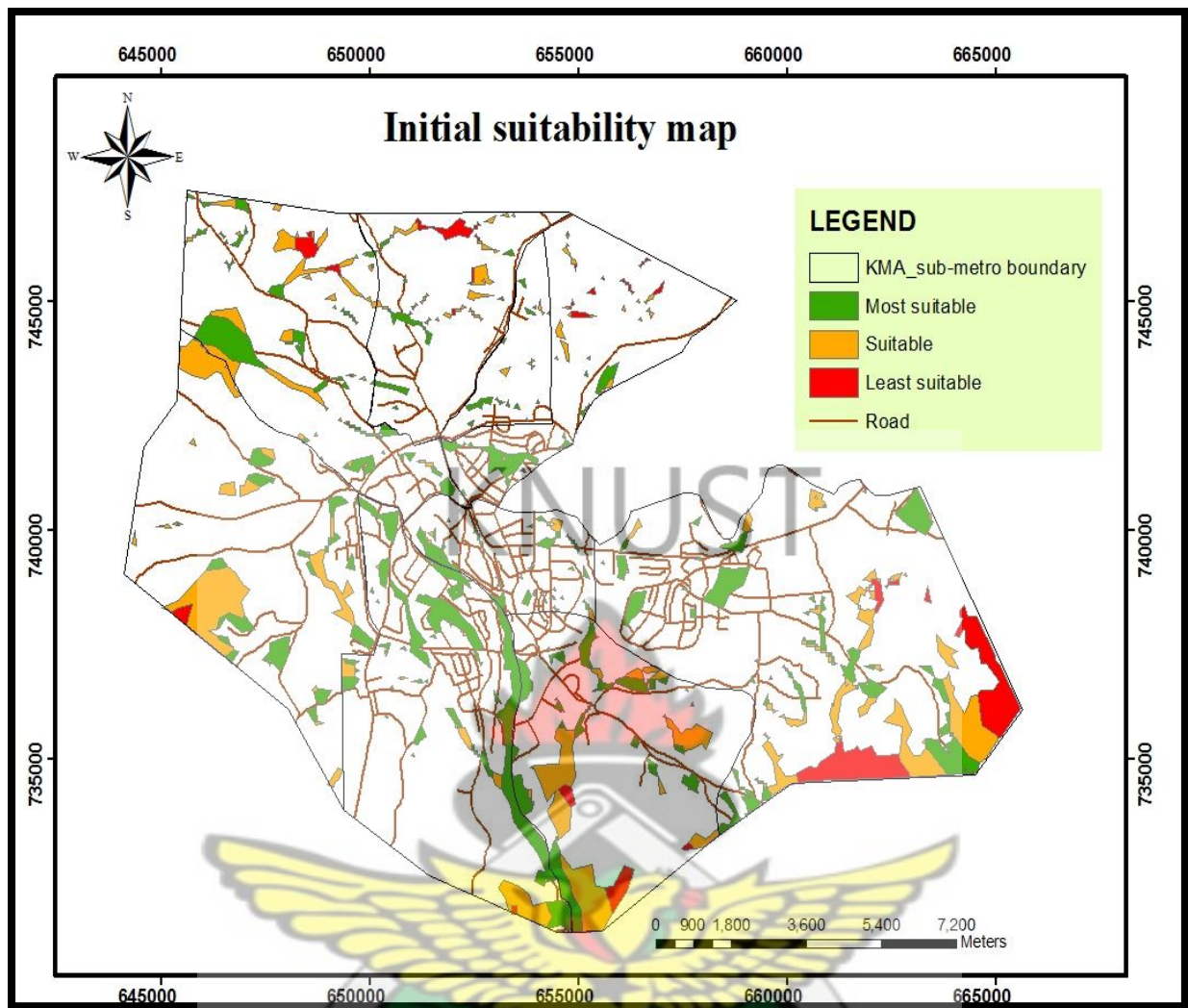


Fig 15. Initial suitability map for urban parks in Kumasi

The initial suitability map generated was overlaid onto recent google imagery to erase parts of lands that had overlapped built areas. The final suitability map for land for urban parks in Kumasi (shown in Fig 16) resulted in out of 5,480 grid cells, 2,596 grid cells (47.4% or 10,968,100 m²) being Most suitable land for urban parks, 2170 grid cells (39.6% or 9,168,250 m²) being Suitable land for urban parks and 714 grid cells (13% or 3,016,650 m²) being Least suitable land for urban parks.

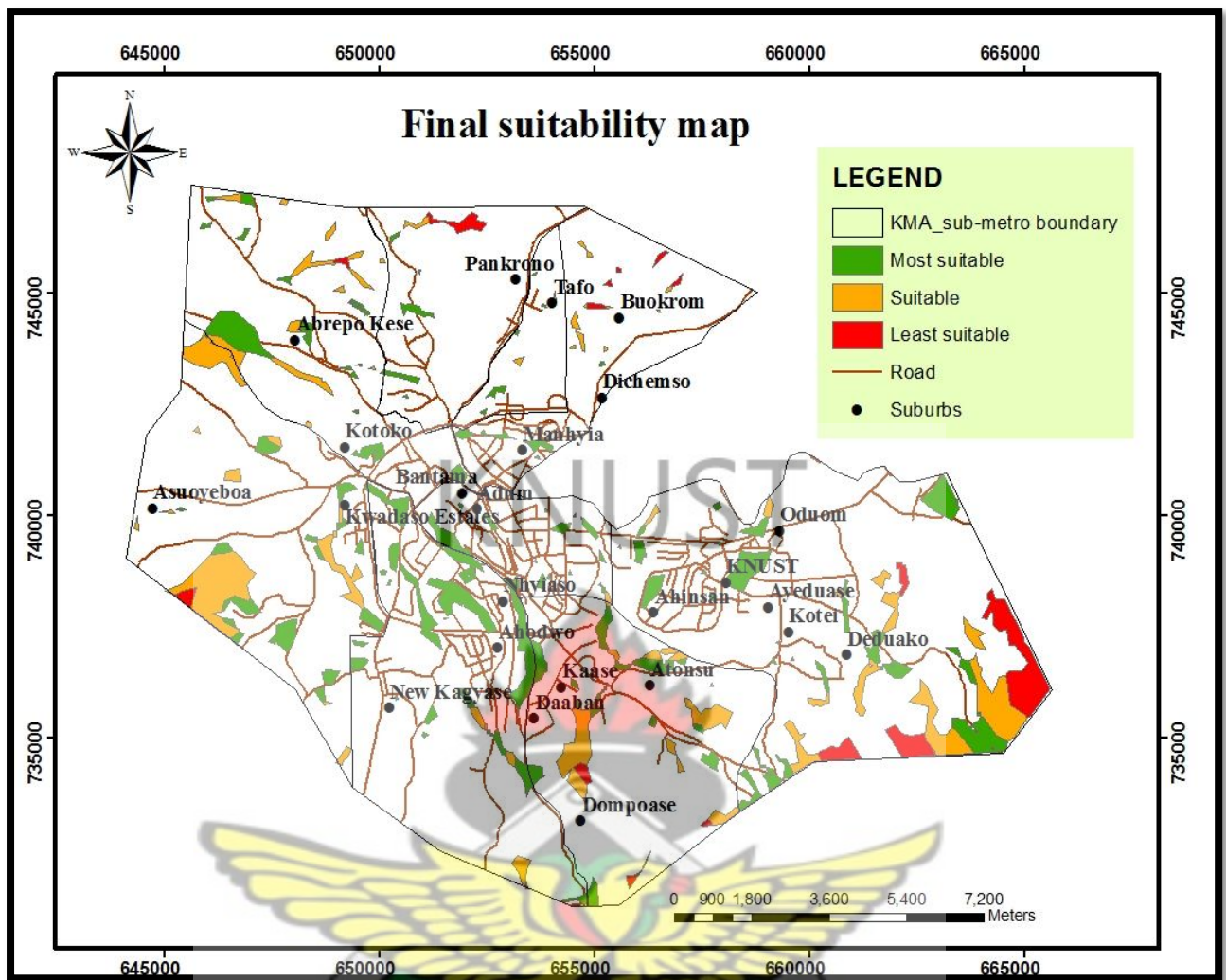
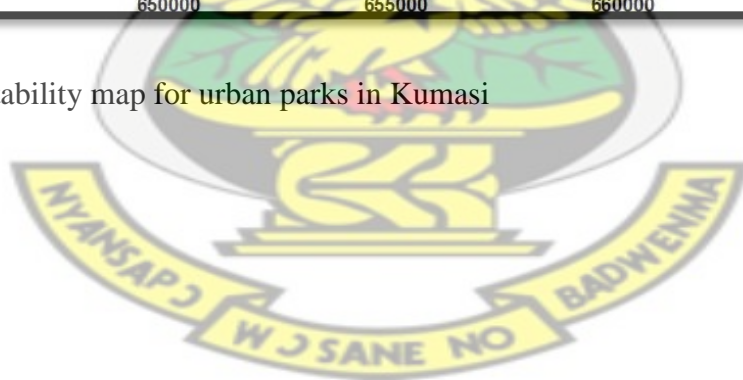


Fig 16. Final suitability map for urban parks in Kumasi



CHAPTER FIVE

5.0 DISCUSSION

In the spatial development plans, attention to green space to achieve balanced and sustainable development is important (Imtiaz and Abdul-Nasir, 2011).

5.1 URBAN GREEN SPACE ANALYSIS IN KUMASI METROPOLIS

5.1.1 CURRENT GREEN COVERAGE IN KUMASI METROPOLIS

Results obtained from the study indicate that the current green coverage which includes trees, grass and wetlands is approximately 59,475,254.69 m² representing about 29.19% of the total area of the Kumasi metropolis. Green coverage was calculated on sub-metro basis and Oforikrom was seen to have the highest green coverage (30%) among the nine sub-metros in Kumasi. This was mainly attributed to the open green spaces in and closely around the KNUST campus. These green spaces included the KNUST farms on campus and around the Boadi area, the Botanic garden, the Paa Joe field, the newly developing area of Appeadu and the very green undeveloped lands on the university campus. Green belts within the Oforikrom sub-metro were also included as part of the current green spaces. The next sub-metros with the highest green coverage were Nhyiaso and Kwadaso with 23.2% and 21.4% respectively of the total green coverage in the Kumasi. Manhyia, Suame, Subin and Tafo had approximately 2.8%, 2.8%, 1.4% and 1% respectively of green coverage of the total green coverage in Kumasi. Even when compared to their individual sub-metro areas, Manhyia, Suame, Subin and Tafo still had low green coverage of 11.1%, 10.9%, 10% and 11.6% respectively.

With the rich fertility of the land in Kumasi which favoured soft and green landscaping (Adarkwa and Post, 2001) in Kumasi, it is surprising that the metropolis lacks accessible urban parks with beautiful green landscapes which are well maintained for the residents to

benefit from. Clearly the economic activities of the study area have had an immense effect on current land use at the expense of open green space. The central business districts of Kumasi mostly made up of hard surfaces and heat absorbing surfaces and reflective glass buildings are heavily choked with both car and human traffic: and the current harsh heat conditions make such areas environmentally unbearable to accommodate without air-conditioning or other cooling systems. With lack of sufficient vegetation to regulate the urban climate, uncomfortable situations are likely to occur as result of excess heat and air pollution from vehicles and burning of rubbish which is a common task of residents to get rid of some of their daily waste. In order to have a good influence on physical health, it will be beneficial to establish urban parks for residents to enjoy and relax and also as a means of protecting and improving the green coverage in Kumasi.

Assessment of satellite imagery of Kumasi metropolis shows increase in built up areas over the years and lack of adequate vacant spaces to create enough urban parks for current and populations of these sub-metros. Most of the land in Manhyia, Suame, Subin and Tafo are highly built up areas partly made up of slum areas.

5.1.2 CURRENT SITUATION OF THE URBAN PARK SYSTEM IN KUMASI

The unique thing about the colonial parks created was that they were of different types and served several functions for different people in the community. Some of the colonial parks initially created though still in existence are in poor shape or have been developed for other purposes. The Jubilee Park and Amakom children's park both in Subin sub-metro are still in existence. Unfortunately, the Amakom children's park is in a deplorable state making it unattractive for its use by residents nearby and unfit for use to host any activity for children. Residents living close to the Amakom Park expressed concern that the park now serves as a den of thieves and drug addicts making it unsafe for them to pass in front of the park let alone

use it at night. They complained that several people had been attacked in front of the park on many occasions.

The Jackson Park (now Jubilee Park) located in Fante New Town has also been transformed into a hard landscaped grounds for hosting public events and therefore lacks the element of nature to provide any nature needs of residents. The conversion of this park into a formal ceremonial grounds has deprived neighbouring residents the chance to use the park for recreational activities and relaxation.

The Kumasi zoo (managed by the Wildlife Division of the Ghana Forestry Commission) is still being patronised though there has been a rundown of some of its facilities. The Suntreso Park is now serving as an office and propagation grounds for the Department of Parks and Gardens in Kumasi who are in charge of landscape projects in Kumasi. The Abbey, Kotoko, Rivoli and Dogo Moro parks which served more for sporting activities for nearby residents are currently lacking well landscaped features to serve their functions effectively. The sites lack well landscaped lawns and trees to provide shade and cool air. Residents in the suburb of Mbroum who were interviewed said they held programs on the Abbey's Park but most of the trees which used to provide shade for them had been cut down and that the field was now very dusty.

City officials in Kumasi do recognise the importance of urban parks and so the Kumasi Metropolitan Assembly (KMA) in its quest to restore Kumasi to its Garden City status under the KMA's "greening Kumasi" project is developing the land opposite Kumasi Golden Tulip Hotel known as the Rattray Park into a modern recreational park. This park is said to be financed by a private investor under the supervision of the KMA and personal landscape designers in Kumasi and the Department of Parks and Gardens. In order for the park to be protected and well maintained, it is going to be walled and potential users are going to have to pay an entry fee.

To encourage youth in the area of Ashanti New Town in Kumasi to participate actively in sports instead of getting into trouble, Abbey's Park is to be developed into a modernised park with various facilities (Ghana News Agency, 2005).

5.1.3 PROBLEMS OF THE URBAN PARK SYSTEM IN KUMASI

Although the visual representation of green space coverage in Kumasi shows a good distribution of green spaces, this does not reflect on accessible urban parks in the metropolis. The urban parks, both colonial and current are not evenly distributed across the metropolis but centred at the middle of the city with less access to residents living further off close to the boundary of the metropolis. This is probably due to the fact that the land area of Kumasi has been increasing outward due to increase in built up areas toward the former boundary of Kumasi. While some sub-metros had some urban green parks to boast of others accommodated as low as one to no green park accessible for use. Though the major problem of urban park spaces is scarcity in Kumasi, most of the current urban parks are underutilized and in poor condition. Although research suggests that parks in areas of higher population densities would ideally have more patronage due to overcrowding and lack of back yards and private open spaces (Loukaitou-Sideris, 2006), it was revealed that areas that needed urban parks especially Manhyia, Suame, Subin and Tafo due to their high population densities rather had the lowest park space per capita than those sub-metros with lower population densities and even more green coverage.

Due to the booming economic activities in Kumasi, especially in the central part, many open green spaces and lands have been converted into shops for commercial business. While economic gain is beneficial as a sustainable development goal, it will be detrimental to residents of Kumasi in the long run if little attention is given to the natural elements of the urban structure such as urban green spaces. The urban community is made up of city dwellers

and if those residents cannot be comfortable and healthy to stay and work in their communities, then development will eventually be hampered.

The total area calculated of these accessible urban park spaces however is only 0.65% (1,330,000 m² /1.33 km²) of the total sub metropolitan area which is very low compared to its high population. The locations of the current accessible green parks are not evenly distributed thereby depriving residents further away from their locations the pleasure of using these amenities. These current amenities are clearly not enough to cater for the nature needs of the second largest populated city in the country which people used to praise for its beautiful and well distributed maintained gardens.

The total park space per capita for the study area was found to be 0.51 m² which is far less than the recommended minimum standard suggested of 9 m² per city dweller by the World Health Organisation. Asokwa, Kwadaso, Suame and Tafo sub-metros currently have no urban green park to boast of. Kwadaso, having the second highest green coverage in the study area surprisingly has no accessible urban green park for utilization. Again, Suame and Tafo having the least green coverage should be considered for any future park development projects to improve their green status and improve the quality of life for their residents. Since distribution and location of green parks in urban areas influences their use, it would be important for equal park distribution in the development of urban parks even in areas with high green coverage. Relative to its individual land area, Nhyiaso had the highest park area ratio of 2.05% and a park per capita of 2.21m² which is below the WHO minimum standard of 9 m² green open space per city dweller. With reference to the World Health Organisation (WHO) standards for required green coverage per city dweller, Kumasi metropolis still has low coverage for accessible urban parks and as such needs to be considered for developing new parks in areas where green spaces are lacking.

Generally, Kumasi metropolis has a poor urban park system which lacks the ability to provide for even the minimum standard of green park space. Some stakeholders agreed that Kumasi does lack adequate urban parks even though the metropolis has a high green coverage. Stakeholders agree that parks in Kumasi are inadequate and should be increased taking into account the several benefits especially environmental and social role they play in communities. The fact that green areas are under threat is of major concern since the effects of urban sprawl as a result of population growth continues to encroachment of green reserves, altering the natural environment and polluting water bodies as well. The high demand for land and a lack of prioritization for the use of urban green spaces are issues causing urban green reduction. The major reason for lack of green spaces and poor maintenance of urban parks in Kumasi is the high rate of urban sprawl and the weakness of law enforcement on land encroachment.

It is therefore necessary that with the increasing population in Kumasi, provision should be made for more urban parks in these areas. Due to the lack of available land for development for parks in such areas, it is vital that the available land serving as either for zoning or abandoned sites such as dump sites be developed as mini or pockets parks while excess lands on public school grounds could be grassed and well landscaped and fenced to protect the schools' property. These parks may be managed by the communities in consultation with the Department of Parks and Gardens so they can be well maintained to enhance the image of the school and the community.

5.2. URBAN DWELLERS ATTITUDES TO URBAN PARKS

The combination of diverse perspectives in policy and decision-making is key to development. Urban park development involves everyone especially the average urban dweller and as such strategies concerned with development of urban parks for their benefit should involve citizen participation in order to have a fair knowledge on their opinions. From

Table 7 it was evident that respondents of varying educational background reiterated that urban parks are valued as important amenities to be considered in urban settings. Significant percentages of respondents with both secondary and tertiary education valued parks as very important whereas a few also intimated that they were important but not a priority in urban areas. By and large, residents believed that parks are to be very important which connotes that they are an important amenity to be made accessible to communities.

Residents viewed urban parks mainly as places beneficial for relaxation and stress relief as well as for recreation and leisure. This agrees with the findings of Sandström, (2009), who stated that urban green spaces such as parks can be looked upon as multifunctional systems of considerable importance to the quest for sustainable development, including recreational purposes and other features important for human well-being. Others also viewed green spaces as important for their indirect benefits of beautification and aesthetic qualities. Nettleton, (1992), states that green parks could enhance positive emotional states thereby improving residents' satisfaction and make higher density living more acceptable. Today, many residents in Kumasi drive cars as well as use public transportation to travel around the metropolis daily. With the current heavy vehicular traffic coupled with extreme heat condition experienced in Kumasi, driving has become more stressful not only to drivers but to passengers as well. Urban parks do have the potential to provide areas for drivers to relax and unwind after a long journey as well as have a calming effect as drivers view the parks while driving by.

Majority of the respondents between the ages of 18-25 years from the study used urban parks mainly for relaxation, sports and recreation and leisure activities while others mainly visited to attend functions. Personal interviews with respondents revealed that they preferred using urban parks on weekends and holidays because of their work schedules. Many complained that the nearby parks lacked adequate vegetation since many of the trees had been cut down

and the grass in the park was now destroyed and was not beneficial to provide the nature needs they required. Some residents had therefore now resorted to taking advantage of the public school compounds nearby for shade and relaxation and the school fields for sporting activities during holidays and on weekends.

Studies by De Vries, (2002) and Grahn and Stigsdotter, (2003) showed that people living close by green space visit more often and spend more of their leisure time within a green area. Some respondents in the present study, however, did not visit any urban park in Kumasi with majority of them having no interest. Personal interviews revealed that many of those who did not visit parks found the existing parks in Kumasi in poor states lacking good maintenance. Others also revealed that they would prefer to visit parks closer to them since the ones they knew of were too far from them and could not visit often due to their busy work schedules. Residents who lived around the Kumasi golf course expressed concern about the fact that not all of them could use the facility since they could not play golf but others did take advantage of watching others play the game while enjoying the green park.

The Adehyeman gardens which is currently privately owned and operates mainly as a restaurant with the added benefit of a garden is not big enough to accommodate large crowds. Residents in Mbrourm around this facility took advantage of the Konadu Yiadom Park which is currently bare grounds for sport activities and hosting of functions and also the St Loius School park for relaxation on weekends and holidays. Residents living and working around the Kumasi Zoo, take advantage of the shade and vegetation provided at the Kumasi cultural centre to relax. Respondents living in and around the Amakom Children's park expressed great concern for their safety due to the abandoned state of the park which is now a haven for thieves and drug addicts. Some residents also tend to take advantage of the trees on the compound of the Amakom MA primary and JHS to relax and to play.

Data from this thesis show that generally residents know the benefits of green spaces in urban areas, but are unwilling to patronise them due to the poor conditions of the available parks and the long distance they have to reach existing parks. Knowledge about the specific preferences of age groups for park usage can inform more effective education and awareness strategies on urban park development. Generally, most respondents agreed that urban parks in Kumasi were in very poor conditions. Given that majority of the respondents valued urban parks as very important in urban areas, they agreed that Kumasi does not have enough parks to cater for the growing population. Continuous increase in the size and population of Kumasi has made it necessary to satisfy the need for more green spaces in high density neighbourhoods to preserve the relationship between urban green spaces and density.

With the support for value of green spaces being high, respondents agreed that more parks should be developed in Kumasi and majority agreed that they would be willing to pay for park patronage. This emphasizes the fact that future strategies could encourage public participation in development plans rather than public awareness campaign to use parks. People are aware of the benefits that green spaces like parks can bring to urban communities especially for their wellbeing and health and as such their views should be taken into consideration to create more accessible green spaces for their use and also to improve the aesthetic image of Kumasi.

5.3. LAND SUITABILITY ANALYSIS OF URBAN PARKS BASED ON GIS

5.3.1 COMPUTATION OF THE PAIR-WISE COMPARISON MATRIX

From expert opinion, pertinent literature and residents' responses, accessibility by foot and road was found to be the most important criteria for patronising urban parks sites and was given the highest priority weight.

5.3.2 EVALUATION OF CRITERION MAPS

The final suitability map illustrates the most suitable, suitable and least suitable land for urban parks based on selected criteria. Using pairwise comparisons and assigned weights to the three criteria, the suitability map was created by an overlay of each suitability map which were in raster. Results indicated that the most suitable land (sites within 3-5 minutes' walk) and (which is indicated by green colour) represent the most suitable sites to locate urban parks and are well distributed across the metropolis bearing in mind that accessibility was the highest ranking criteria. Since distance from park facilities is one of the major drawbacks of residents in Kumasi to use green park facilities, it will be beneficial if new parks are developed within their vicinity.

Tafo, Suame and Manhyia, are highly built up areas which lack sufficient green spaces. It will be beneficial for communities in these sub metros to come together to make use of abandoned dumpsites to create pockets parks and public school compounds to develop SPARK parks. Green space education and protection measures will have to be taken in high density areas where green spaces have been built up and encroached in Kumasi. Urban parks which are important amenities in cities today should be easily accessible and be a primary consideration for planning and development of dense urban centres (Centre for Subtropical Design, 2009). Their enhancement will make people patronise parks if provided with easy and appropriate access to passive and active recreational resources in open space. The

proximity of these green parks will influence people to visit them more frequently if well managed and protected. The centrality of New York's Central Park which is well managed and maintained makes it a unique and pleasurable green grounds for nearby communities to benefit from its existence. People should have knowledge of the existence and locations of the green parks and feel comfortable visiting them.

In urban areas that are densely built, large depositories of land have all but vanished (Loukaitou-Sideris, 2006). The current shortage of land in Kumasi has made the creation of new parks or the expansion and upgrading of existing ones a very expensive proposition. Though green parks and open spaces do not represent a profitable use of land in monetary terms, because they do not directly produce high property or sales tax revenue, it is highly important that the supply of public parks keeps pace with the rapid growing urban population in Kumasi. Creating and maintaining urban parks will be beneficial in improving quality of life and sustainable urban living for residents in Kumasi metropolis presently and in the years to come.

Though Suame and Tafo sub metros have high population densities and very little available land, it will be important for their current land use systems to be reviewed and changed in consultation with land owners so as to increase accessible park spaces for residents. Most suitable land included some green belts, existing parks, school fields and vacant green areas. All these available most suitable spaces can be transformed into beautifully landscaped parks for the benefit of all Kumasi's residents.

Therefore, the final result is the result of the field survey that was integrated in the analysis and is fully reflected in the GIS's final analysis result. Since proximity of residents to urban parks is one factor that affects park use, the final suitability map has resulted in most suitable available lands which are easily accessible to residents for use.

CHAPTER SIX

6.0 SUMMARY, CONCLUSION AND RECOMMENDATION

6.1 SUMMARY AND CONCLUSION

Today, the expansion of green space in cities is the basis and foundation for urban sustainable development. Creating accessible and sustainable green spaces can begin with restoring vacant community spaces to help reduce the environmental issues in urban areas. Communities such as those in Kumasi made up dominantly of asphalt roads, paved walkways, and concrete and glass buildings need more greenery in order to benefit from their multi-functionality and socio-environmental potential. Kumasi was once noted for its beautiful garden like landscapes and green parks. These places gave residents places to go to relax and socialise and de stress. Today, economic activities and development in Kumasi threaten to deprive residents of such rights.

In order to create a healthy city, investments into improving urban greenery in Kumasi by creating urban parks which provide safe and pleasant spaces for residents. Urban planners, environmentalists and administrators should take appropriate measures to actively advocate for increase of access to urban parks in all areas of the metropolis. Using GIS in combination with AHP is the rational way to compare choices and select the best according to all parameters. This can help produce the governing framework for collective participation in decision making and generate best decisions can therefore save an enormous amount of spatial and non-spatial data for current and future decisions, and also help solve analysis problems in locating urban parks. It will further enable the planning department in understanding the problems associated with existing parks in Kumasi and recognise how to obtain those criterions for the location of a suitable parks.

The use of GIS and AHP will further enable city authorities to identify critical areas that lack good access to urban parks and implement effective policies on urban park management and current land use systems so as to increase accessible park spaces for residents for current and future generations.

Creating opportunities for urban residents to interact with nature daily is a key element in urban designing and planning and should be prioritised by city authorities, urban planners, environmentalist and residents in urban areas. The quantity and quality of urban parks in Kumasi is generally poor and needs urgent improvement for the sake of the health of residents, the environment and the overall image of the metropolis.

6.2 RECOMMENDATIONS

1. The most important recommendation is that all lands zoned for green space use should be protected by city authorities by fencing if not developed yet to prevent encroachment. Fines must be imposed on anybody or organisation that builds on or uses such reserved spaces for other purposes.
2. Policy formulation and implementation should involve the average resident taking into account their needs and requests since they will be the ultimate users of the urban parks.
3. As a means of education, city officials should create platforms for schools, organisations and the general public to design innovative ways for public spaces to be used as urban parks in Ghana so that park development can become a serious development project for the country that will attract foreign and local investors to provide funding and resources for park development.
4. With the limited access to affordable land, it will be important to use innovative means to create parks in communities where there are none. Some residents admitted to using school compounds to relax and play sports. Existing public basic and junior

secondary school lands in low income areas and areas which lack available land can be utilised to create community parks to reduce the cost to provide spaces for resident's relaxation and recreation. This will benefit the schools in terms of renovated school facilities, increased community involvement, and outside funding sources to pay for the improvements.

5. Vacant or abandoned dumpsites lands can be financed to undergo soil remediation and developed into parks in areas that as a means providing for deprived areas and also enhancing that area. These places will be a good improvement on the eyesores created by the dumpsites and prevent people from polluting the environment.
6. In order to protect the green belts and prevent them from being encroached and polluted, city authorities should take measures to develop them through good landscaping techniques which will still allow them to serve their functions. Trees should be planted along them and proper walkways be provided to connect communities separated by the greenbelts instead of allowing them to remain unkempt, bushy and unsafe. The water bodies which they protect should be cleared of all dirt and rubbish and grass be well maintained to create linear parks with beautiful scenic route for residents to sit down and enjoy as well as provide routes for residents to walk and exercise.
7. The railway open space adjacent the Asafo overhead should be considered as a development project to be converted into a rail park as New York's High Line. It is a very suitable space since it is in the central business district and will allow shoppers and workers a place to relax and rest when tired. More trees should be planted to provide shade and seating on a well landscaped site to attract users and improve the image of Kumasi as the 'Garden City' of West Africa.

8. It will be beneficial if incentives are provided for land owners to contribute land willingly for development of parks and also for communities who are able to maintain, protect and enhance their community parks by their own self-sacrifices and efforts. When the parks are entrusted to the community leaders they will ensure their protection for the sake of the community's image and gives it an identity, becoming its star attraction and raising the quality of life, and property values, for residents thereby enhancing the overall image of Kumasi if all parks are developed and maintained in such manner.
9. In order to raise funds for parks in Kumasi, public-private partnerships could be created between city authorities and non-profit organisations as well as famous commercial industries as a means of public service to the community.
10. Park management should be a central concern for all and involve various groups and ages of people. Park design should provide amenities for the different groups of people using the park and park managers should develop strategies to attract people during different seasons to create an identity and image for the park.

The improvement of urban parks in Kumasi metropolis will go a long way to helping achieving sustainable development goals in Ghana to improve quality of life for all people.

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APPENDICES

APPENDIX I

COMPUTATION OF PAIRWISE COMPARISON MATRIX

Criteria weights according to Saaty Table

Criteria	Accessibility	Population density	Land availability
Accessibility by road	1	5	7
Population density	1/5	1	3
Land availability	1/7	1/3	1
SUM	1 1/3	6 1/3	11

SYNTHESISATION

Criteria	Accessibility	Population density	Land availability	Relative priorities
Accessibility by road	0.744680851	0.789473684	0.636363636	0.72
Population density	0.14893617	0.157894737	0.272727273	0.19
Land availability	0.106382979	0.052631579	0.090909091	0.08

Normalised pairwise comparison matrix

Steps in checking consistency

1. Multiply pairwise comparison matrix by relative priorities
2. Divide weighted sum vector elements by associated priority value
3. Compute average (denoted λ_{max}) of the values from Step 2.
4. Compute consistency index (CI)
5. Compute consistency ratio (CR)

Step 1: Matrix multiplication

$$\begin{Bmatrix} 0.723506057 \\ 0.19318606 \\ 0.083307883 \end{Bmatrix} \times \begin{Bmatrix} 1 & 5 & 7 \\ 1/5 & 1 & 3 \\ 1/7 & 1/3 & 1 \end{Bmatrix} = \begin{Bmatrix} 2.272591537 \\ 0.58781092 \\ 0.251061244 \end{Bmatrix}$$

Relative priorities

Pairwise comparison matrix

Weighted Sum Vector

Step 2: Division of weighted sum vector elements by associated priority value

$$\begin{Bmatrix} 2.272591537 \\ 0.58781092 \\ 0.251061244 \end{Bmatrix} \div \begin{Bmatrix} 0.723506057 \\ 0.19318606 \\ 0.083307883 \end{Bmatrix} = \begin{Bmatrix} 3.141081563 \\ 3.042719129 \\ 3.01365532 \end{Bmatrix}$$

Step 3: Calculation of Eigen value

$$(3.141 + 3.043 + 3.014) / 3 = 9.197/3$$

$$\lambda_{\max} = 3.066$$

Step 4: calculation of consistency index (CI)

$$CI = (\lambda_{\max} - n) / (n-1) = (3.066)/2$$

$$CI = 0.033$$

Step 5: Calculation of consistency ratio (CR)

$$CR = CI / RI$$

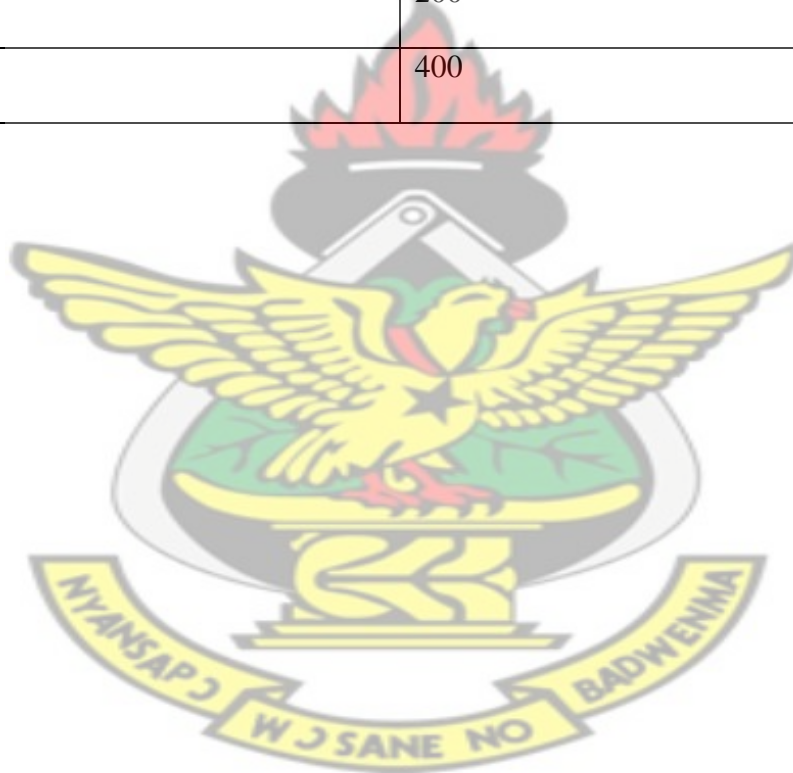
For this study RI = 0.58 read from the Random consistency indices table.

$$CR = 0.033 / 0.58 = \mathbf{0.057}$$

APPENDIX II

BUFFERS FOR IMPORTANT FEATURES

FACILITY	DISTANCE (METRES)
Industry	500
Landfill	300
Water works	250
Airport	1000
Reserve	200
Cemetery	200
Palace	400



APPENDIX III

LAND SUITABILITY SCENARIOS

Land suitability Scenario 1: Accessibility

Degree of suitability	Grid cells no.	Areas (m ²)	Percentage (%)
Most suitable	26958	112,845,593.32	55.47
Suitable	17633	73,811,349.02	36.28
Least suitable	4008	16,777,399.58	8.25
Total	48599	203,434,341.92	100

Land suitability Scenario 2: Population Density

Degree of suitability	Grid cells no.	Areas (m ²)	Percentage (%)
Most suitable	18,551	78,028,026.11	38.30
Suitable	25,031	105,283,786.40	51.67
Least suitable	4,860	20,441,820.22	10.03
total	48442	203,753,632.73	100

Land suitability Scenario 3: Land availability

Degree of suitability	Grid cells no.	Areas (m ²)	Percentage (%)
Most suitable	7446	30,974,784.48	95.78
Suitable	111	461,751.42	1.43
Least suitable	217	902,703.23	2.79
Total	7774	32,339,239.13	100

Land suitability for parks (without buffers)

Degree of suitability	Grid cells no.	Areas (m ²)	Percentage (%)
Most suitable	3,522	14,814,010.46	46.21
Suitable	3,093	13,009,578.18	40.59
Least suitable	1,006	4,231,372.66	13.20
Total	7,621	32,054,961.30	100

Initial suitable land for parks

Degree of suitability	Grid cells no.	Areas (m ²)	Percentage
Most suitable	2817	11,901,825	43.96
Suitable	2663	11,251,175	41.56
Least suitable	928	3,920,800	14.48
Total	6408	27,073,800	100

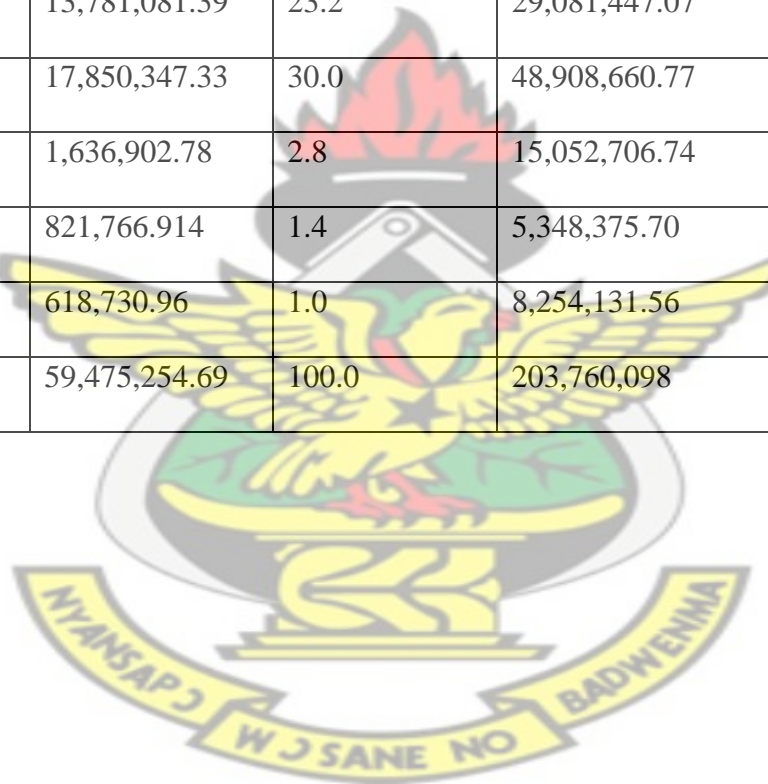
Final suitability map for parks

Degree of suitability	Grid cells no.	Areas (m ²)	Percentage (%)
Most suitable	2596	10,968,100	47.4
Suitable	2170	9,168,250	39.6
Least suitable	714	3,016,650	13.0
Total	5480	23,153,000	100.0

APPENDIX IV

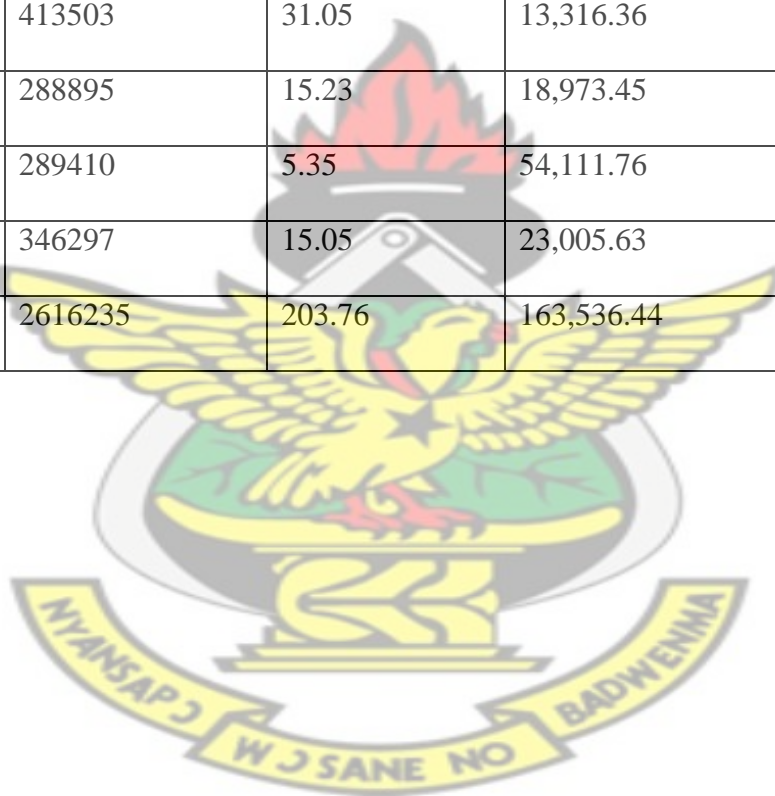
CURRENT GREEN COVERAGE

Sub-metro	Green area (m ²)	Percentage (%)	Sub metro area (m ²)	Percentage (%)
ASOKWA	5,044,771.94	8.5	26,545,004.91	19.00
BANTAMA	5,309,491.28	8.9	24,291,226.58	21.86
KWADASO	12,720,300.06	21.4	31,052,264.02	40.96
MANHYIA	1,691,862.03	2.8	15,226,280.62	11.11
NHYIASO	13,781,081.39	23.2	29,081,447.07	47.39
OFORIKROM	17,850,347.33	30.0	48,908,660.77	36.50
SUAME	1,636,902.78	2.8	15,052,706.74	10.87
SUBIN	821,766.914	1.4	5,348,375.70	15.36
TAFO	618,730.96	1.0	8,254,131.56	7.50
Total	59,475,254.69	100.0	203,760,098	29.2



APPENDIX V

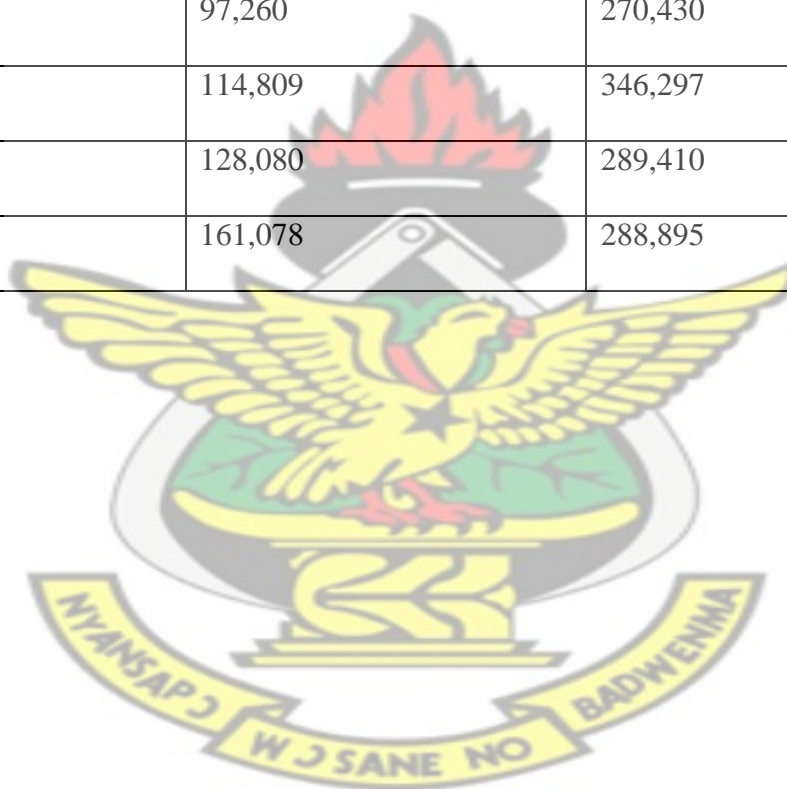
Sub metro	Population	Area (km)	Population density (number of people/km ²)
Bantama	270430	24.30	11,132.83
Asokwa	376038	26.55	14,166.06
Subin	121770	8.25	14,752.61
Oforikrom	247886	48.91	5,068.35
Nhyiaso	262006	29.08	9,009.39
Kwadaso	413503	31.05	13,316.36
Manhyia	288895	15.23	18,973.45
Tafo	289410	5.35	54,111.76
Suame	346297	15.05	23,005.63
Total	2616235	203.76	163,536.44



APPENDIX VI

Population distribution for sub-metros in Kumasi

Sub-metro	2000	2010
Oforikrom	126,299	247,886
Asokwa	122,292	376,038
Nhyiaso	72,626	262,006
Subin	94,764	121,770
Kwadaso	117,091	413,503
Bantama	97,260	270,430
Suame	114,809	346,297
Tafo	128,080	289,410
Manhyia	161,078	288,895



APPENDIX VII

Locations of Most Suitable park sites (UTM Zone 30 coordinate system)

Point	E (m)	N(m)	Point	E (m)	N (m)
1.	658766.32	733743.75	23.	647840.63	737318.46
2.	659722.33	734305.86	24.	649281.54	740442.11
3.	652734.07	742804.65	25.	648918.75	736359.14
4.	653634.42	741560.32	26.	648624.81	735933.89
5.	658911.85	739782.07	27.	649781.81	737736.97
6.	661560.34	737019.13	28.	649809.14	741512.36
7.	662030.29	736558.76	29.	646371.56	739370.38
8.	656739.77	734704.45	30.	651659.45	739554.65
9.	646684.90	144184.43	31.	650791.39	738594.61
10.	647781.74	745228.27	32.	651196.15	735539.66
11.	647020.61	737801.96	33.	653537.43	736806.46
12.	646944.84	737228.83	34.	653524.95	734252.46
13.	651847.57	738131.62	35.	654224.90	739781.02
14.	647735.86	745328.94	36.	651018.30	744551.43
15.	648317.30	744147.56	37.	656304.52	738319.46
16.	650619.22	743058.10	38.	658584.29	738811.11
17.	650328.46	746266.42	39.	651947.88	741794.44
18.	652678.87	742796.51	40.	656337.55	736549.73
19.	651834.11	740915.34	41.	653425.14	734088.78
20.	656035.72	739044.26	42.	663000.53	740319.70
21.	657710.45	734436.01	43.	657710.45	734436.01
22.	663951.41	735015.76			

APPENDIX VIII

QUESTIONNAIRE TO ASSESS POTENTIAL PARK PATRONAGE

This research seeks to assess the potential of urban park patronage by residents of Kumasi Metropolis. This questionnaire is to help collect data purely for academic purposes and answers provided will strictly be limited to that exercise.

URBAN GREEN PARK: *An area of grass, trees, or other vegetation set apart for recreational or aesthetic purposes in an otherwise urban environment – Oxford dictionary*

IDENTIFICATION

1. Which part of Kumasi do you live?
.....
2. What is the closest urban green park to where you live?
.....
3. How important do you think urban parks are in Kumasi? (*Single answer*)
 - I. Not important
 - II. Important but not a priority
 - III. Very important
 - IV. Indifferent about them
4. Do you visit the urban green park close to you?
 - I. Yes
 - II. No
5. Do you visit other parks other than those closest to where you live?
 - I. Yes
 - II. No

6. What is your reason for visiting urban parks in Kumasi? (*Multiple answers*)

- I. Relaxation
- II. Sports
- III. Leisure/ Recreation
- IV. Attend functions

7. What is your reason for **Not** visiting urban parks in Kumasi? (*Multiple answers*)

- I. Lack of/Poor maintenance of parks
- II. Too far away
- III. Lack of time
- IV. Less vegetation available
- V. Not interested

8. What is your impression of urban parks in Kumasi ?(*Multiple answers*)

- I. A welcoming place
- II. Not adequately enough for the growing population
- III. Existing parks are in poor condition
- IV. Environmentally sound practices used in management
- V. Healthy, safe and secure

9. Kindly give your opinion on the following park attributes. (PLEASE TICK)

Park Attributes	Very Good	Good	Poor	Very Poor
Adequate shade provided by trees				
Safe environment to visit				
Beautiful and well landscaped lawns				
Sporting facilities				
Good lighting				
Good toilet facilities				
Presence of water body or water feature				
Wildlife present				

10. Of what importance do you perceive urban parks to be in the Kumasi Metropolis?

- I. For Beautification / Aesthetics
- II. Places for relaxation and stress release
- III. Recreation and leisure
- IV. Cooling effect and air pollution control
- V. Water pollution control

11. Do you think that there are enough urban parks in Kumasi?

I. Yes

II. No

12. Do you think more there should be more urban park development in Kumasi?

I. Yes

II. No

13. Would you patronise urban parks if developed in Kumasi?

I. Yes

II. No

14. Would you be willing to pay for park patronage?

I. Yes

II. No

DEMOGRAPHICS (please tick the appropriate answers where necessary)

15. SEX

I. Male

II. Female

16. AGE..... (IN COMPLETED YEARS)

I. 10-17 IV. 34-41

II. 18-25 V. 42-49

III. 26-33 VI. Above 50

17. LEVEL OF EDUCATION

I. Basic

III. Technical/Vocational

II. Secondary

IV. Tertiary

18. OCCUPATION

- I. Employed
- II. Unemployed
- III. Student

KNUST

