

# An Evaluation of Conservation Strategies on Plant Biodiversity in a Peri-Urban Set-Up of Kajulu-Riat Hill, Kisumu City, Kenya

Silas O. Rakama, Edward M. Mugalavai and John F. Obiri

Centre for Disaster Management and Humanitarian Assistance (CDMHA)  
Masinde Muliro University of Science and Technology (MMUST), P.O Box 190-50100 Kakamega, Kenya,  
Department of Disaster Management and Sustainable Development

**Abstract-** Urbanization is a complex and dynamic process playing out over multiple scales of space and time. In addition to being increasingly physically expansive, urban land change is also predominantly characterized by peri-urbanization, the process whereby rural areas both close to and distant from city center become enveloped by, or transformed into, extended metropolitan regions. This present study focused on the peri-urban establishment of Kajulu-Riat hill area within Kisumu City in Kenya. It focused on the conservation strategies on tree and shrub diversity and how it is affected by other urban socio-economic dynamics. The study population comprised a sample of 384 persons within the geographical areas of kajulu and Riat peri-urban. Among the community members interviewed include; villagers, traditional leaders, community members who were 60 years and above of age, local craft-work traders, medicinal plant collectors, fuel wood gatherers, charcoal burners and vendors. Majority of those who participated in the study were male respondents who accounted for 58% (n=223) while the female consisted of 42%, (n=161). Small scale farming was an important livelihood in the study area (32.3%), followed by self-employment (29.9%) who included traders, miners, riders and mechanics. The customary land tenure system dominates in the study area (44%) followed by private land tenure system (26%), the trust land (22%) while the public land recorded 8% of the respondents. Major conservation initiatives include: promotion of climate and ecosystem smart livelihood, domestication of trees, afforestation and agro-forestry. However majority of the respondents did not take part in the conservation strategies indicating a clear lack of interest in environmental conservation. Urban priorities such as roads, housing, water and sanitation were of higher priority compared to environmental conservation. The results indicates the need to integrate livelihoods and poverty in planning for a sustainable peri-urban environmental conservation which is key in building resilience to climate change and related disasters.

**Index Terms-** Conservation strategies, plant biodiversity, socio-economic priorities

## I. INTRODUCTION

Urbanization is a complex and dynamic process playing out over multiple scales of space and time (Grimm et al., 2008). Historically, cities have been compact and have concentrated

populations. Today, cities are increasingly expansive. Across the world, urban areas are growing on average twice as fast as urban population (Seto et al., 2011). In addition to being increasingly physically expansive, urban land change is also predominantly characterized by peri-urbanization, the process whereby rural areas both close to and distant from city center become enveloped by, or transformed into, extended metropolitan regions (Simo et al., 2004; Aguilar et al., 2003). These results in a tight mosaic of traditional and agricultural juxtaposed with modern and industrial land-uses and governance systems. As a physical phenomenon, peri-urbanization involves the conversion of agricultural land, pastures, and forests to urban areas. Moreover, changes in lifestyles and consumption patterns associated with urbanization, especially increasing demand for residential energy and water, is placing dramatic pressures on ecological services (Hubacek et al., 2009).

This present study focused on the peri-urban establishment of Kajulu-Riat hill area within Kisumu City in Kenya. It focused on the conservation strategies on tree and shrub diversity and how it is affected by other urban socio-economic dynamics. In Kisumu city, increased urbanization has placed tremendous pressure on urban environment particularly on the trees and plants which have either been cut down and used or removed as land is converted to urban buildings (NEMA, 2009). With an annual growth rate estimated at 2.8% and densities of 828 persons/ km<sup>2</sup>, Kisumu City has one of the highest urban population densities in the country, bringing with it the associated complexities in urban planning (UN-Habitat, 2012). The city faces systematic challenges and threats among the urban community ranging from poor urban physical planning and infrastructure services, degraded urban environment, loss of biodiversity and therefore increased urban poverty. According to (Baker, 2006), in many instances biodiversity concerns are seen as less important than other urban pressures such as poverty, unemployment, underemployment, access to food, energy, crime, pollution, congestion, housing shortages, spontaneous settlements and food supply issues. Biodiversity is one of the primary foundations for human physical and psychological health and wellbeing. Numerous studies have demonstrated that investing in ecosystems makes economic sense because safeguarding urban ecosystems strengthens the ability of cities to adapt to climate change and transition to a more healthy and sustainable future (Bowler et al., 2010; Sala et al., 2000).

Similar study in Japan showed an intensive growth of industries during the rapid economic growth period from the late

1950s to the early 1970s in Japan created employment opportunities, led to population concentration, and ultimately urbanization. The rapidly expanding cities resulted in conversion of farmland to urban land, first along the coastline, then into forests and in-land (Himiyama 2004). In the process, people's traditional ways of making their livelihoods significantly changed (Okuro et al., 2012). In the rural areas, modernization and mechanization of agriculture created monocultures, which decreased biodiversity (Okuro et al., 2012). At the same time, forestry and fisheries collapsed due to the expanding cities and the import of timber and seafood.

## II. MATERIALS AND METHODS

### 1.2.1 Description of the Study Area

The study area lies within Kisumu County in the western part of Kenya and it is located approximately 10 kilometres from the Kisumu Central business district appendix 2. Kisumu City is situated on (0° 5'30.1272''South) and (34° 46'4.6416''East). It lies besides Lake Victoria with an altitude of 1188 m above sea level and the Nyando escarpment to the north. Figure 3.1 shows map of the study area.

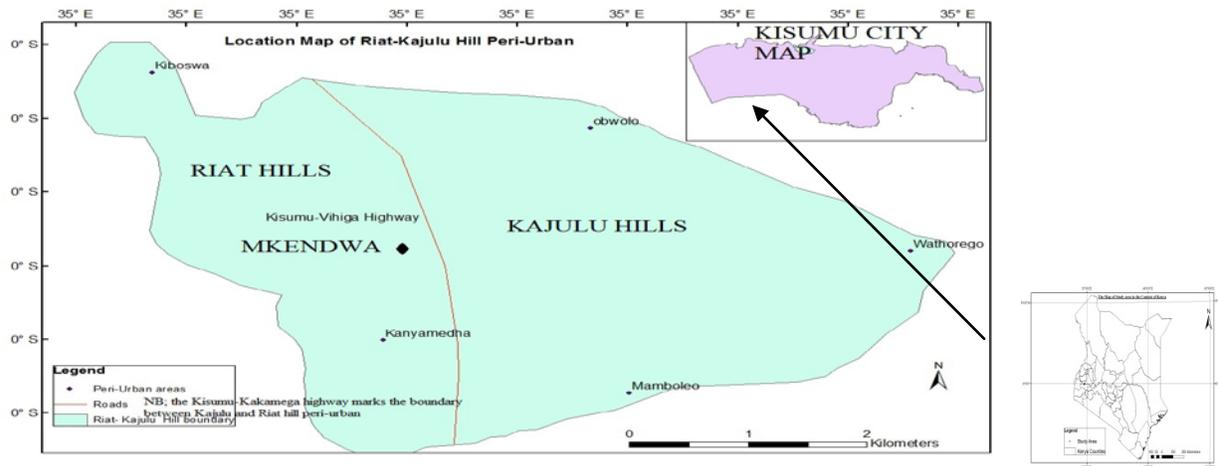


Figure 2.1: Study area map (Source: Author, 2016)

### 1.2.2 Climate and water resources

Kisumu city has sub-humid and semi-humid tropical climate with mean maximum temperatures ranges from 27.7°C to 30.8°C and rainfall that varies with altitude. The mean annual rainfall varies from 1100 mm in the south to 1500 mm in the north and potential evaporation of 2200 mm and 1900 mm respectively. It is the largest city in western region of Kenya and second most important city after Kampala in the greater Lake Victoria basin; it is also the third city in Kenya. Dunga Beach and Wetland within the city is known for its unique eco-cultural attractions due to its biodiversity and cultural rich and diverse papyrus wetland ecosystem and local community respectively, Kisumu City borders Lake Victoria which is the second largest fresh water lake in the world.

### 1.2.3 Natural resources and biodiversity

Kisumu has an impala sanctuary just within the City. During the British rule, the Impala Park, now sanctuary was called Connaught Parade. Measuring just 0.4 square miles (1.0 km<sup>2</sup>), the sanctuary is one of Kenya's smallest wildlife preserves. As its name suggests, it is home to a herd of impala. Some hippos, as well as many reptiles and birds are also present. Urban and peri-urban farming practices in Kisumu largely include small-scale rain-fed mixed farming, small-scale river irrigation, wetland farming, fish farming and free range livestock keeping. The most intensive agriculture is practiced along the lake shore in the lower-lying flood plains of Nyalenda and Dunga, and in the wetlands to the South of the city. Larger plots under agriculture are found along the foothills to the east bordering the peri-urban fringe. Over the years, the Kajulu-Riat

hills have undergone gradual deforestation, resulting to a vegetation cover consisting of low level shrubs. Continuous soil erosion has left rock outcrops dotted all over the hill (LVEMPII, 2012). The hills have springs that are a source of streams that join to form small rivers draining into Lake Victoria, including River Nyamasaria and River Kisat. They are also major sources of water for the Kisumu city, with a water intake in place, wide variety of common and rare species of birds and Vervet monkeys also inhabit the hill. East of Kisumu Town is the Kano Plains occasionally broken by low ridges and rivers. There are some notable physical features such as the scarps in the north, east and south. Others include the hill slopes and piedmont plains spreading across the vast Kano Plains. The shores of Lake Victoria in Kisumu city have been used to put up beautiful tourist hotels like Kiboko Bay, the Yatch Club and Tilapia Beach Resort.

### 1.2.4 Major economic activities

Economic activities can be the indicator of the types of livelihoods in the city and can provide general information on the local workforce. Livelihood opportunities can also affect the growth rate of cities and allow people to settle in the city. Currently, Kisumu is the third largest urban centre in Kenya, acting as a commercial, industrial, communication and transportation hub for the lake basin region (KCC, 2004). Its economic significance comes primarily from its location on the shores of the Lake Victoria, which connects it to Uganda and Tanzania. Over the past decades (1960s and 1970s), Kisumu was a successful economy and large manufacturing hub with well developed sugar, cotton and fishing industries. The main sources

of income in the informal sector include; employment in manufacturing and processing plants, informal trades, fish trade, sale of briquettes and water vending services, urban livestock and agriculture at the subsistence level, public transportation ('Boda boda') among others. Inadequate and unreliable rainfall patterns affect agricultural activities which is the main source of livelihood of the population (KCC, 2004).

**1.2.5 Population growth trend**

Kisumu grew from new settlements since the beginning of the railway station for Uganda in 1901. According to (Kisumu

County Government, 2013), Kisumu had a population of around 500,000 persons as per 2009 population census data. Kisumu is one of the rapid growing cities in Kenya with an urban growth rate estimated at 2.8% and has around 824 persons per square kilometer population density. Kisumu city is undergoing rapid urbanization as more and more people immigrate to the area in search for employment, settlement area and education facilities among others. Table 3.1 shows the population trends of the sub-locations in the study area.

**Table 2.1: Population projection of the study area by (sub-location in Kajulu-Riat hill peri-urban). Source: MCI (2007). Projections are based on government of Kenya 1999 census figures derived using an exponential growth function and a 2.8% growth rate.**

Location	1999 census data	2010 projection	2011 projection	2015 projection	Area ( km <sup>2</sup> )
Kanyakwar	8576	11660	12001	13423	8.5
Kogony	13961	18982	19536	21851	13.1
Wathorego	7170	9747	10033	11222	9.8
Konya	10308	14015	14424	16134	11.9
Mkendwa	667	907	933	1044	0.8

**1.2.6 Sample size determination**

The target population in this case is more than 10,000 and the desired accuracy is sought at 0.05 significance levels, the z statistic is 1.96. With a target population of approximately 46,496, the study used the following formula as proposed by Mugenda and Mugenda, (2003).

$$n = \frac{z^2 pq}{d^2}$$

Thus the sample size was calculated as shown below:

$$n = \frac{z^2 pq}{d^2}$$

Where,  
 n = the desired sample size (if the target population is greater than 10,000)  
 z = the standard normal deviation at the required confidence level  
 p = the proportion in the target population estimated to have characteristics being measured  
 q = 1-p  
 d = the level of statistical significance set  
 Therefore,  
 $n = \frac{(1.96)^2 (.50)(.50)}{(0.05)^2}$

=384 respondents

**1.2.7 Study population & sampling design**

The study population comprised a sample of 384 persons within the geographical areas of kajulu and Riat peri-urban. Among the community members interviewed include; villagers, traditional leaders, community members who were 60 years and above of age, local craft-work traders, medicinal plant collectors, fuel wood gatherers, charcoal burners and vendors. Other Stakeholders were defined in accordance with Borrini-Feyerabend, (1996) as social actors who have a direct, significant and specific interest in an area's natural resources, are aware of their own interest in management of the resources, possess specific capacity (skills, knowledge) and comparative advantages (proximity, mandate) for such management, and are usually willing to invest specific resources (i.e. money, time, authority) toward some form of management. In this study 20 stakeholders from different sectors were interviewed. As shown on Table 3.3, they included staff from the departments of forestry, agricultural, environment and tourism, nature conservationists, forest-based researchers and non-governmental organizations [NGOs].

**Table 2.2: Summary of the sampled population**

Unit of population	Sampling Design	Number of units	Proportion from the total population in the unit
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Kisumu County Ministry of Environment office	Purposive and snow ball sampling	2 officers,	25% of the staff in the department
Osiendela Kisumu	Purposive and snow ball sampling	4 officers	40% of the staff
Ecofinder Kenya (Kisumu)	Purposive sampling	4 officers	31% of the staff
Kenya Forest Service	Purposive sampling	4 officers	29% of the staff
Kenya Wildlife Service	Purposive sampling	2 officers	22% of the staff
KEFRI	Purposive sampling	4 senior officers	31% of the staff
Community members around Kajulu over 60 yrs	Snow ball sampling	24 people	
Other community members in and around kajulu hills	Simple random sampling	360 people	
Total		404	

**1.2.8 Questionnaire and Survey design**

Interviews are important especially where individual accounts or information are required on how a particular phenomenon develops (Robson, 2002). It also helps in understanding perceptions of processes within a social unit, and helps in seeking answers to the research questions concerning a given subject. It also allows the investigator to have a face to face contact with respondents hence enabling researchers to catch a glimpse of the non-verbal expressions and feelings of the respondents on the issue of environmental conservation. Interviews were conducted with key community resource persons and various environmental stakeholders in Kisumu City to get informed on various conservation initiatives and strategies used by different organizations. Through the snowball technique; where by one organization referred the researcher to another relevant organization, more organizations were reached for the study. Some organizations such as OSIENALA: (a local non-governmental organization), LVEMPII, Ministry of Environment for Kisumu County, Kenya Forest Service and Kenya Wildlife Service were reached with a total of 20 stakeholders from different organizations being interviewed. Site visits were conducted in the study area with the help of a key informant to confirm the existence of conservation strategies.

Semi-structured questionnaires, having both open-ended and closed-ended questions were administered to the local community within the study area. Open-ended questions provided the required space for statement and clarification allowing for in-depth probing. Questionnaires enable a researcher to make use of large samples and thus the results can be more dependable and reliable (Kothari, 2003). The questionnaires were administered with the help of research assistants who first underwent training on approach and instrument administration. The questionnaires captured socio-demographic characteristic of the respondents and other conservation related issues.

Three focus group discussions were held with opinion leaders to encourage debate on issues relevant to the study. The FGD at Wathorego location consisted of 16 members, Kanyakwar location 13 members and at Kogony location 12 members. This was to help in expanding the meaning of answers obtained from standardized interviews and in capturing themes

that were conveyed by the participant’s experiences, feelings and thoughts. Gender balance was emphasized in the selection process. Qualitative information obtained from the discussion was confirmed from survey and secondary data.

**1.2.9 Data analysis**

Both descriptive and inferential statistical techniques were employed. According to (Healey, 2011), descriptive statistics allows researchers to summarize large amounts of data using measures that are easily understood by an observer. The significance of the difference in the distribution of data was established using Chi-square test. Chi square was used to determine whether there was any statistically significant difference between variables of the study. According to Kothari (2004), this technique is the most widely used method of testing for statistical significance between variables. The Statistical Package for Social Science (SPSS version 20.0) computer software was used for the purpose of analyzing the data which was presented in figures, tables and narrative reports.

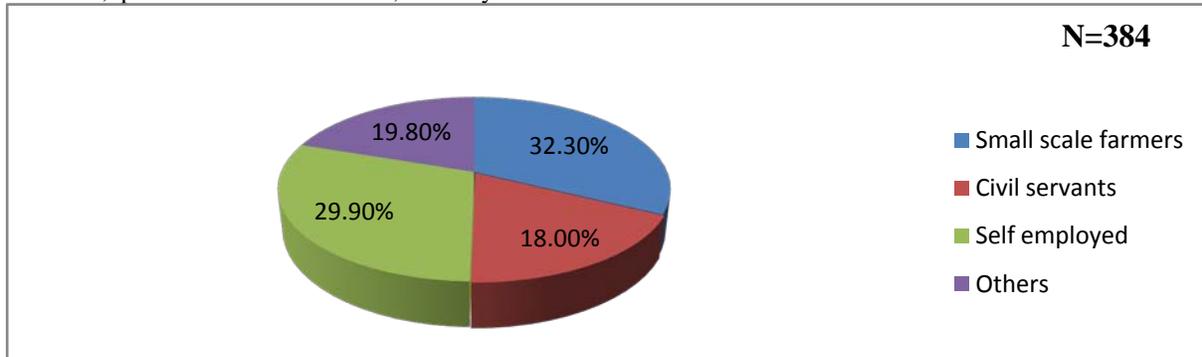
**III. RESULTS AND DISCUSSIONS**

**1.3.1 Socio - Demographic characteristics**

Majority of those who participated in the study were male respondents who accounted for 58% (n=223) while the female consisted of 42%, (n=161). The distribution of values showed statistically significant difference, the variables had  $\chi^2 = 10.010$ ,  $p=0.002$ . This means that there could be gender disparity in the study area. According to World Bank, (2009), to make environmental conservation and restoration effective, social factors including gender appreciation on land use must be considered. Women play an essential role in the management of natural resources, including soil, water, forestry and energy and often have a profound traditional and contemporary knowledge of natural resources around them.

The occupation of respondents in the study area consisted of small scale farming, self-employment, civil service, and others. Small scale farmers were the majority (32.3%), followed by self-employed (29.9%) who included traders, miners, riders

and mechanics. The civil servants who consisted of teachers, health practitioners, provincial administrators, forestry officers and security guards were the least.

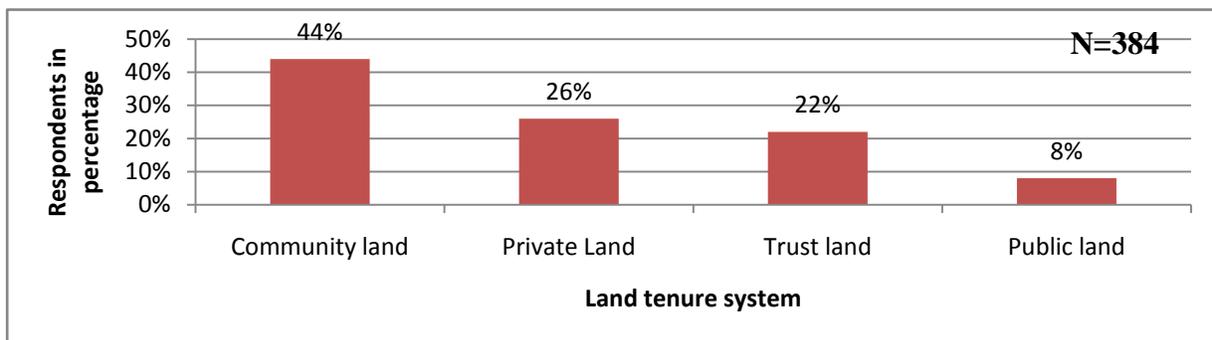


**Figure 3.1: Major livelihoods in the study area**

Chi-square test showed that there was a statistically significant difference among the occupations  $\chi^2 = 23.688$ ,  $p < 0.05$ , which means that small scale farmers are the majority and therefore farming is an important source of livelihood in the study area. According to the Government of Kenya, 2012; the official unemployment rate of Kisumu City is 30%, but 52% of the working population is engaged in informal sector activities (e.g. transport, petty sales, repairs). Occupations that are linked directly to land and natural resources such as agricultural practices and charcoal vending are likely to have a great impact on trees and other plant diversity. In Brazil, *Cerrado* which is one of the richest savanna ecosystems in the world was

transformed by intensive human occupation process into one of the most important regions for cattle ranching and commodity crops, this led to *Cerrado* being classified as one of the World's biodiversity hotspots where by between 2003 and 2007, 18,980 km<sup>2</sup> of new deforestation had been realized (Myers *et al.*, 2000, Ferreira *et al.*, 2007).

There were statistical significance difference in the land tenure system of the area,  $\chi^2 = 100.875$ ,  $p < 0.05$ . The customary land tenure system dominates in the study area (44%) followed by private land tenure system (26%), the trust land (22%) while the public land recorded 8% of the respondents.

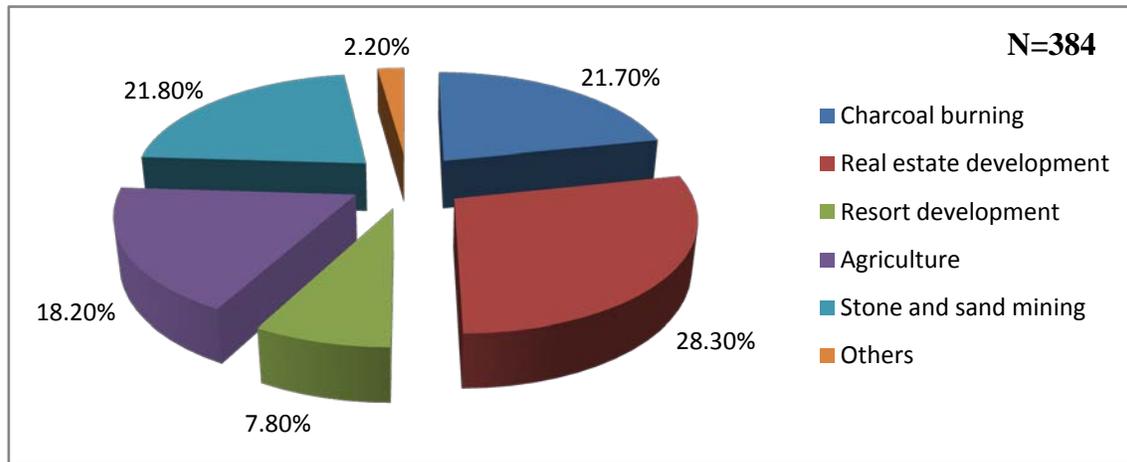


**Figure 3.2: Land tenure system in the study area**

The (26%) of private tenure may mean that many people are buying land in the area for settlement from other areas or the customary land is being subdivided among family and clan members to cater for the changing demands of land in the area. The expansion of urban land into agricultural hinterland due to demographic pressure could be forcing the customary land tenure practices which have existed for centuries in the area to adapt and adjust to the new situations. According to Wamukaya (2008), in the peri-urban areas of Kisumu city, successive local authorities have shown an apparent weakness in controlling or guiding urban land use development. Property owners can do as

they wish with their lands subject to family and communal obligation that may apply depending on the prevailing land tenure. Municipal officials have found it nearly impossible to achieve harmony, delight and efficiency in the planning process when ownership of large parcels of land adjacent to the city is held under customary tenure.

According to the respondents the major causes of land cover change were the real estate development at 28.3%, rock and sand mining at 21.8% and charcoal burning, 21.7% (Figure 3.3).



**Figure 3.3: Respondents view on the drivers of vegetation change in study area**

The cause of land cover change differed significantly  $\chi^2 = 108.781, p < 0.05$ . This suggests that the construction industry was the current and future threat to plant biodiversity in the area. The Kajulu – Riat hills peri-urban has attracted real estate development for the middle and high class citizens due to its aesthetic view of Kisumu city and the winam gulf of lake Victoria. The Riat Kajulu hills offer a panoramic view of Kisumu town, from certain areas one can see breathe taking views of the sunset, which is reflected on the waters of Lake Victoria. This could explain the reason why real estate is termed as the main cause of tree and plant diversity changes. Some of the residential estates in the area include “*Uhura estate, Uzima estate, Kajulu estate, Kanyakwar and Kanyamedha* estates off Kisumu

Kakamega Highway”. According to Simon (2008), peri-urban areas are increasingly attracting middle-class and higher income people whose lives exhibit lifestyles reflective of inner-city dwellers in a predominantly rural setting.

### 3.1.2 Conservation initiatives in the study area

Identification of the existing conservation strategies in the study area was done through enquiries from the key respondents; ground truthing, review of secondary literature and from the focus group discussions. Various organizations were identified with their conservation strategies in the areas (Table 3.1).

**Table 3.1: organizations and conservation strategies**

Name	Organization type	Conservation strategies
<b>Eco-finder</b>	NGO	Climate and Ecosystem smart livelihood, Green energy program, leadership and advocacy, IT and entrepreneurship in relation to environment
<b>OSIENALA</b>	NGO	Domestication of trees, Development of sustainable tree seed system, Farmer for the future approach
<b>Kenya Forest Service</b>	Government agency	Re-forestation, protection of trees
<b>LVEMP II</b>	parastatal	Agro-forestry , sustainable land management practices

From the study, the four organizations in Table 3.1 were identified to have spearheaded the various conservation strategies in the study area. Eco-finder is a non-governmental organization

based in Dunga beach in Kisumu City. Although their main goal is to spearhead wetland restoration and protection and help riparian communities adapt to climate change, they had

supported some farmers groups in the study area with clean cooking stoves and biogas system. This was to reduce overdependence on use of fuel wood and charcoal as a source of energy thus conservation of trees and plant biodiversity in the study area.

Osiendela is also a non-governmental organization, named in dholuo language meaning friends of Lake Victoria. It is a regional organization that covers the entire Lake Victoria basin in the three countries that shares the lake. In Kisumu, they own a radio station that broadcast in local language focusing on environmental conservation, protection and restoration through; promotion of sustainable fishing practices, addressing poverty and environmental degradation, pollution and the causes of lake sedimentation. In the study area they have promoted domestication of trees, community ownership of nurseries and school based program where pupils are taught to grow trees.

Lake Victoria environmental management program II is an initiative that addresses various environmental challenges around the Lake Victoria basin. In some parts of the study area, they have partnered with the Kenya forest service to spearhead re-forestation with the objective of improving community livelihoods through benefits from tree products and non wood

products, ecotourism, restoration and conservation of the hill biodiversity and conservation of soil and water in Kajulu area. However from the discussions with key informants the challenges towards sustainable afforestation in the study area included: absence of forest policy, free grazing, lack of institutional coordination, lack of indigenous tree seeds, land holding system and lack of indigenous knowledge on sustainable conservation.

### 3.1.3 Awareness on the conservation strategies

The study sought to establish the awareness of the respondents on the existing conservation strategies in the study area. The results are categorized into three with regards to those who were correctly aware, those who were not aware and those who were misinformed (Figure 4.12). From the study, the level of awareness on the existing conservation strategies in the study area was very low with those who were correctly aware being 7.03% of the sampled population; however there were those who purported to be informed of the existing strategies but were misinformed. Majority of the respondents were not aware of the existing conservation strategies in the study area at 82.29% of the respondents.

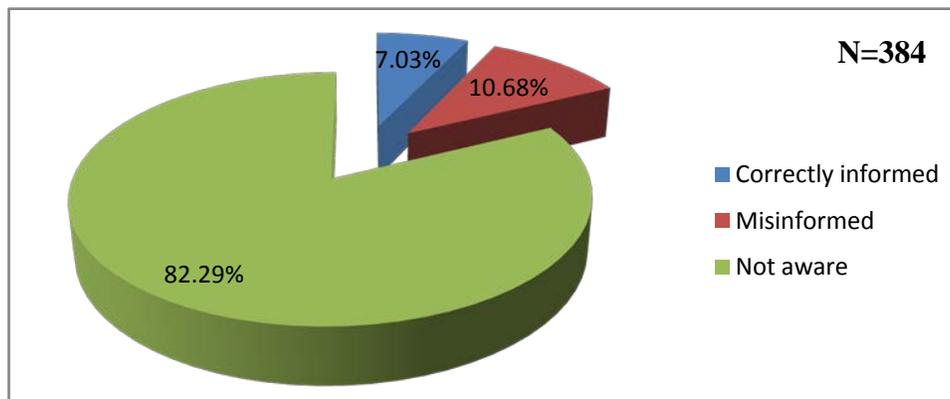


Figure 3.4: Respondents awareness on the existing conservation strategies in the study area.

The findings were statistically significant different  $\chi^2 = 414.953, p < 0.05$ ; which means, the adoption of the conservation strategies initiated by the various stakeholders is still very low within Riat-Kajulu hills peri-urban. There is an increasing popular awareness that sustainable environmental restoration and rehabilitation is unachievable without public participation (Bass 2001). Lack of awareness among respondents could be attributed to the top-bottom approach being used by the various organizations in spearheading their various conservation drives in the study area where by the local community lacks a clear picture of the objectives of the conservation strategies, Sustainable environmental restoration and rehabilitation is unachievable without public participation (Bass 2001). Borgstrom, 2009, in their study on restricted plant species on sub-Antarctic Macquarie and Heard Island found out that; achieving the necessary political support and changing the habits of residents is made difficult by the lack of awareness about the diversity of nature, its complexity, as well as human dependence on ecosystem functions across scales.

Lack of awareness on the existing conservation strategies could also be attributed to the skewed allocation of the various

conservation resources, mostly in rural set-ups. This showed that there was urban forest inequality in the study area through unequal distribution of ecological resources Hope *et al.*, (2003). The study was mainly focused on the peri-urban areas and from the survey, it was established that the various initiatives were done in the rural set up with only few on the peri-urban side of the Kajulu area. The afforestation project for instance had been skewed in one area of Kajulu hill ecosystem where the population is dispersed. Temporal, spatial, and functional mismatches between ecosystems and the institutions managing them could be an overarching challenge in ecosystem governance in the study area (Cumming *et al.*, 2006).

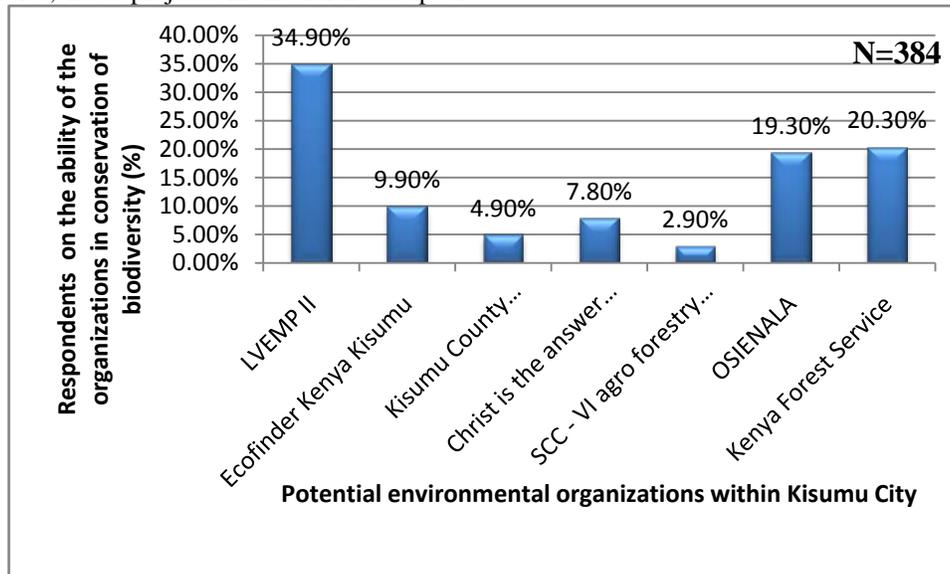
### 3.1.4 Respondents views on key stakeholders involved in environment

The study sought to establish how the respondents view key environmental stakeholder's ability to spearhead conservation in the area. Majority of the respondents believed LVEMPII, Osiendela and Kenya forest service had the potential of spearheading conservation initiatives in the study area in the near future. However some other stakeholders such as the Scc-Vi

agro-forestry and the County government were rated very low at 2.9% and 4.9% respectively (Figure 4.13).

The findings were statistically significant  $\chi^2 = 205.568$ ,  $p < 0.05$ . This means, many of the environmental stakeholders in the region have located their projects in rural areas, thus perceived least in spearheading peri-urban conservation. Organizations that were rated higher such as LVEMPII, Osienala and Kenya forest service, have projects in the rural set-up of

Kajulu hills which is adjacent to the study area; however the ripple effect could have been felt in the area thus their higher rating. Bomans *et al.*, (2010), point out a weakness in spatial policy based on coarse, mono-functional categories, unable to take into account transformations in multiple land uses and related values tied to the rapidly changing urban landscape.



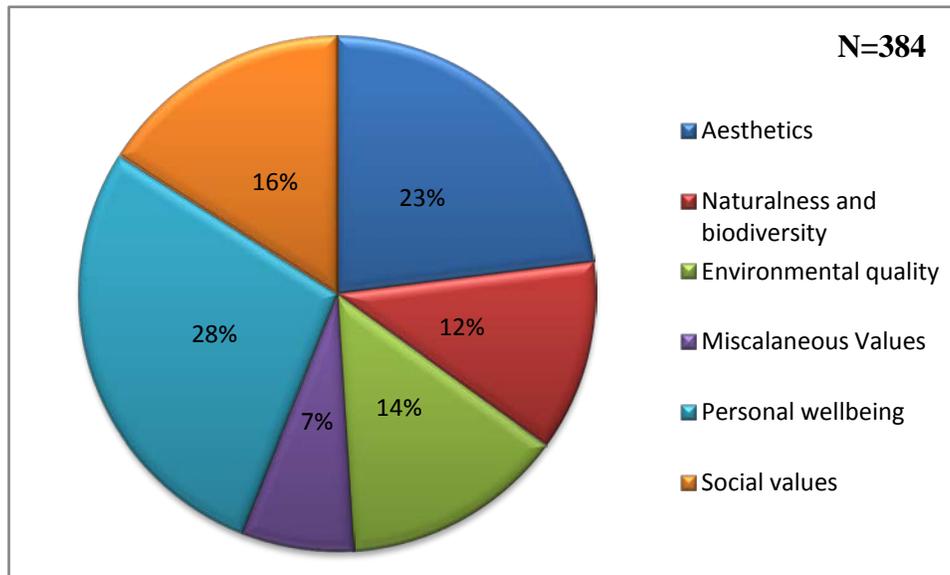
**Figure 3.5: Respondents views on the ability of various environmental stakeholders to spearhead environmental conservation in the area.**

Challenges related to security of tenure in land ownership, spatial planning and the transitional state of the Kajulu-Riat peri-urban, could have been the main obstacle to various organization initiating conservation in the area. According to EEA, 2006, report on ‘peri-urban areas facing sustainability challenges; scenario development in the metropolitan area of Lisbon, peri-urban areas have been traditionally approached from an urban planning perspective as ground for urban sprawl. Agriculture, forestry and natural areas have been neglected in classical spatial planning.

The rapid transformation of peri-urban areas in Africa and their potential to become the new centers of Africa’s urban population presents a new challenge: In the circumstances, the local governments find themselves unable to manage or understand their own growth. analysis of key informant’s data from the City’s environmental department, it was clear that in Kisumu city the design of green area is more focused on “beautification” than on conserving the ecological values as habitats. For most cities, this is an incremental and even ad hoc process that has not delivered a perfect ecosystem management system and the complex thing is that fragmented governance may erode ecological integrity by lack of holistic planning and responsibility (Alfsen-Norodom *et al.*, 2004). Governing ecosystem processes requires coordination across levels of policy, legislation and implementation.

### 3.1.5 Benefits of trees and forests

The study sought to establish respondents understanding on the benefits of trees and forests. This was to comprehend the motivation factors and the benefits for their participation in tree and forest conservation in the study area. The benefits of trees and forest used for this study were selected on the basis of characteristics of ecosystem services by Boyd and Banhaf, 2007; ecosystem services provide benefits that are private goods and those that have open access. Results on motivation factors towards tree and forest conservation showed that “personal well being” was the main factor mentioned by the majority of the respondents (29.7%). Aesthetic value was mentioned by 21.1% of them, followed by social values and environmental quality (Figure 4.14). These were statistically significant different  $\chi^2 = 73.688$ ,  $p < 0.05$ ; which means the trees and shrubs that existed in the study area were mainly for socio-economic and cultural purpose with very little conserved for environmental and biodiversity protection. This suggests powerful synergies between conservation approaches that are often disciplinarily separated, aiming either at human wellbeing or biodiversity conservation. Since different stakeholders perceive different benefits from the same ecosystem processes they can at times be conflicting (Turner, 2003; Hein *et al.*, 2006).



**Figure 3.6: Respondents views on the benefits of tree and plant diversity**

The social value of the benefits that ecosystems provide could potentially be enumerated so that society can make more informed policy and management decisions. These social benefits are termed as ‘nature’s services. According to Obiri and Lawes, (2002), it is difficult to have conservation without some form of protectionism; because conservation through participatory forest management is strongly linked to resource users protecting a resource, by foregoing some benefits from it, in return for other incentives. Personal experience may be important for caring about the protection of nature. However, this study is in agreement with Jim and Chen (2006) study in Guangzhou (China), which found that residents placed high values on services like air quality and aesthetic enhancement in contrast to facilitation of biodiversity, water treatment, and flood abatement, suggesting that they were unable to value what they could not see or had not experienced directly. There are many positive incentives or rationale for having urban forest ecosystems within cities, including environmental, social, and economic values (Nowak *et al.*, 2001). Urban trees are effective in reducing air temperature, increasing air humidity, reducing wind speed, absorbing air pollutants and particulate matter,

reducing carbon dioxide, and reducing noise levels (Streiling and Matzarakis 2003).

**3.1.6 Respondents on various urban priorities such as housing, agriculture, poverty, food, employment, biodiversity, roads**

The study sought to establish some of the various urban priorities according to the respondents, this was important in understanding what the locals consider very important. Water resources had the highest priority (23.4%) followed by housing (18.8%), agriculture (16.7%), while only (5.2%) for tree and plant diversity (Table 4.9). These were statistically significantly different  $\chi^2 = 64.620, p < 0.05$ ; a clear indication of limited interest in peri-urban trees and shrubs conservation. according to (Baker, 2006) this can be attributed to preoccupation with the seemingly more urgent problems of the burgeoning cities such as unemployment, underemployment, crime, pollution, congestion, housing shortages, spontaneous settlements and food supply issues.

**Table 3.2: Response on urban priorities**

The peri-urban socio-economic and environmental needs	Frequency	Percent
Roads	62	16.1
Water	90	23.4
waste management	45	11.7
trees, shrubs and other plant diversity	20	5.2
Trade	31	8.1
Agriculture	64	16.7
Housing	72	18.8
<b>Total</b>	<b>384</b>	<b>100.0</b>

According to (LVSWB,2008), 65% of Kisumu residents had access to improved water sources while 35% relied on unimproved water sources, including water vendors, streams, springs and ponds. Many residents in peri-urban areas use shallow wells located in close proximity to pit latrines thereby increasing chances of cross contamination especially during rainy seasons. This may explain the reason why water had the highest number of respondents as their first priority.

In theory, majority of the respondents in the study are more concerned on how to survive in the city than on environmental conservation. From the analysis of the socio-economic data, majority of the respondents live below the poverty line. Therefore, they are thinking in economic way with their resources/property by changing the use to earn livelihoods from them. The result from the study is a clear indication that conservation of tree and plant biodiversity competes with other socio-economic needs such as housing which degrades the ecologically valuable area. Delivery on economic growth, jobs and housing constructs new pressure on ecologically valuable areas. Several studies suggest that ecosystem services are given a lower priority compared to housing infrastructure, or jobs even if there are strategies in place to protect areas of particular value (Wekerle and Abbruzzese, 2010).

#### IV. CONCLUSIONS AND RECOMMENDATIONS

There is a challenge in the management of conservation strategies in the study area: Poverty and challenges related to land tenure system. There was overdependence on tree and shrub products for socio-economic gains due to limited sources of livelihoods. Sound environmental management strategies lead to communities where people and property are resilient to natural forces, and where the mitigative capacity of natural environmental systems is not diminished.

Peri-urban based conservation approaches should be enhanced. The approaches should focus on dealing with livelihoods and poverty, land subdivision and tenure challenges which are impediments towards initiation of sustainable conservation in peri-urban set-ups.

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#### AUTHORS

**First Author** – Silas O. Rakama, Centre for Disaster Management and Humanitarian Assistance (CDMHA), Masinde Muliro, Mobile: 0711445914, Email: omondasilas31@yahoo.com

**Second Author** – Edward M. Mugalavai, University of Science and Technology (MMUST), P.O Box 190-50100 Kakamega, Kenya

**Third Author** – John F. Obiri, Department of Disaster Management and Sustainable Development