

RESEARCH ARTICLE

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**The Relationship between Land Use Conflicts and Land Cover Changes
around Nairobi National Park**

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Abstract

Although land cover and land use changes are important processes that affect the ecological integrity of conservation areas, there are still gaps on how these effects counteract to yield land use conflicts that bedevil protected areas. This study aimed at analyzing the relationship between land use conflicts and land use/land cover changes around Nairobi National Park. A mixed method research design was adopted. A survey was carried out on 331 households in Machakos and Kajiado Counties. Conflict data for the years 2008, 2010, 2012, 2014 and 2016 was obtained from KWS database. Conflict points were georeferenced using ArcGIS version 10.2.1 and plotted on their respective maps. Afterwards, supervised and unsupervised classification were employed for spatial analysis of GIS data for land cover and land use classes respectively for the years between 1984 and 2016. Land use change results highlighted a reduction and increase in various land use forms. Furthermore, land cover analysis also revealed that the percentage of built up areas has consistently been increasing yearly. The major preceding cause for conflicts is land use conversion from one form to the other which had led to high number of conflict cases being experienced.

Key Words: Conservation, Land Conversion, Environmental Impacts

INTRODUCTION

Besides their role as biodiversity conservation areas, protected areas have been attracting a myriad of activities not in harmony with conservation objectives (Sindiga, 1995). Dispersal areas are exposed to land cover changes due to livelihood demands by local communities, a situation that challenges the reliability of protected areas for wildlife conservation. There has been a decline in range land which can be attributed to land fragmentation, immigration as well as changing lifestyles of the pastoral communities within the rangelands as observed Kioko and Okello (2010). This has led to escalation of human-wildlife conflicts. It is worth noting that the main focus of having conservation areas was to isolate these areas to be protected from any human activity, a model that was to be later referred to as “deep-freezing”. This model has been a

major source of conflicts because protected areas cannot exist in exclusion. Many of the management practices put forward have failed to recognize that integrity of wildlife resources are dependent on the adjacent land uses. There is need therefore to adopt effective land use techniques with an aim of realizing sustainable or compatible land uses in order to reconcile conflicts between protected areas and adjacent lands. This will enable both surrounding communities and protected area managers improve the management of these areas as a combined response to help reduce emerging environmental land use challenges.

Literature Review

Human wildlife conflict shall continue being a major challenge if appropriate measures are not taken into consideration. While most developing nations have been able to strike a balance between wildlife resource utilization

and sustainability, in third world countries, the scenario looks oblique. Over the years, there has been widespread conflicts over the allegations of encroachment of protected areas into indigenous people's lands (Gichuhi, 2013). As is common knowledge, lands surrounding conservation areas have great influence over biodiversity protection (Benjaminsen *et al.*, 2012). Adjacent lands is also host to a number of parties including households, communities, investors, state actors and other non-governmental environmental organizations. Due to growing economic and social demands together with other private interests, each of these parties may have conflicting intentions whose main objective is maximizing resource use that may not auger well with the rest (Groot, 2006). Within that reality therefore, protected area managers have had to grapple with a number of issues in their struggle to maintain functionality of these areas including resource scarcity, inadequate institutional arrangements, benefit sharing, land rights boundary conflicts and disputes over appropriateness of adjacent land uses (Defries *et al.*, 2007). Other challenges include pressure from population increase, compensation, decline in agricultural land and its overall productivity, political constraints, differing preferences among the rural community and urbanized community, among others (Mann and Jeanneaux, 2009). All these factors act and counteract to yield conflicts that have been a great threat to many protected areas especially in developing countries. The scenario is set worsen given the uncoordinated expansion of land uses ie residential, industrial, infrastructure, and inclusion of development projects to areas that were initially set aside for wildlife as national parks or migratory areas. As a result, there is an increase in human-wildlife conflicts because people and wildlife are living in proximity to each other (Thornton, 2013) In Kenya for instance ,in the conservancy lands of Elerai and Oltiyani in Amboseli, locals had encroached on wildlife areas thus reducing the total area of the private parks (Okello *et al* 2014).As a result,

human carnivore conflicts was on a rise with so many cases of livestock deaths and crop damages. Other example was the upcoming homes, settlements and government projects such as Standard Railway Gauges (SGR) on what used to be wildlife migratory corridors in Nairobi National Park (Ogutu, 2013).

MATERIAL AND METHODS

Research Design and Data Needs

In this study a mixed method research approach involving both qualitative and quantitative inquiries were adopted. Consequently surveys and case study techniques were employed for data collection. Using above techniques, information on land use conflicts (types of conflicts, parties involved, issues in the conflicts and seasonality of conflicts) and land use changes in the areas adjacent to the park (present land uses, past land uses land use systems, land use conversions and land sub-divisions) were sought. Most of this information was held by key informants.

Sampling

Multi stage sampling was primarily used to determine the areas around Nairobi National Park from which the sample size was selected. In the first stage, conflict data was collected from recorded information held by Kenya Wildlife Service (KWS). This approach was chosen because KWS is the main state agency mandated with conservation of the park. Grid co-ordinates were used to locate the approximate position of the identified places of conflicts on a map.

Upon analysis of this data the study proceeded to stage two sampling where case study approach was applied where extreme cases were picked. This involved selection of two conflict areas based on the number of conflict cases experienced. The first case chosen was the area with most conflict occurrence and the second case consisted areas with least conflict occurrence. Based on this criteria, Empakasi/ Ngurunga areas of Athi River North Sub-location in Machakos County which was selected as the area with most conflicts while Tuala/ Oloosirkon areas of Oloosirkon Sub-location in Kajiado

County was selected as the areas with least conflict occurrence. These areas were chosen for comparative analysis.

Stage three sampling involved simple random sampling to select households for which data was gathered through household survey technique using questionnaires. A total of 334 households were selected from both study sites within a 10 km buffer. That is, 201 from Athi River ward in Machakos and 133 from Oloosirkon in Kajiado County.

Non-probability sampling (purposive sampling) was also employed to select key informants by virtue of the information they held. These informants included KWS officials, officials from Government Departments of Survey and Planning in Kajiado and Machakos Counties, local NGOs, Chiefs and elders of the study area.

Data Analysis

Analysis of Land Use Conflicts

Conflict data for the years 2008, 2010, 2012, 2014 and 2016 was obtained from KWS database. The conflict spatial locations were geo referenced using ArcGIS version 10.2.1 and the points plotted on their respective maps social scientists (SPSS) to generate tables, graphs and charts for cross-tabulating to come up with findings, relationships and interpretations to show trends in conflicts over a period of time from 2008 to 2016.

Analysis Land Use and Land Cover Changes

Satellite images supported by ground truthing were analyzed as proposed by Chakra Borty (2001). Using a Global Positioning System (GPS), points corresponding to the various land uses and land cover forms were recorded. Landsat satellite images were analyzed using ERDAS IMAGINE 2015 version software for the years 2008, 2010, 2012, 2014 and 2016 to provide geo-referencing information on spatial temporal changes in the areas adjacent to the National Park.

Supervised classification was used for spatial analysis of land cover changes while unsupervised classification was used to

generate land use classes for the years 1984, 1995, 2002 and 2016. Land cover was classified into forests, rangelands, croplands, wetlands, water bodies and built up areas. Classification of land uses brought about various classes; residential, recreation, commercial, transport, deferred lands / agricultural. This helped in understanding land use dynamics in areas adjacent to Nairobi National Park.

Analysis of the Relationship between Land Use/Land Cover Changes and Conflicts

Land use conflicts maps and land use /land cover maps were correlated through superimposition. Independent data that was qualitative was first converted to quantitative data then distance calculations performed to demonstrate the variation of land use conflicts around NNP.

RESULTS

Various forms of conflicts were noted with main causes ranging from proximity of the homes to the park, growing of crops and keeping of livestock which attract wildlife to homes, and migration of wildlife in and out of the park. Figures 1.0, 2.0, 3.0, 4.0 and 5.0 below showed the spatial temporal distribution of the identified conflicts between 2008 and 2016.

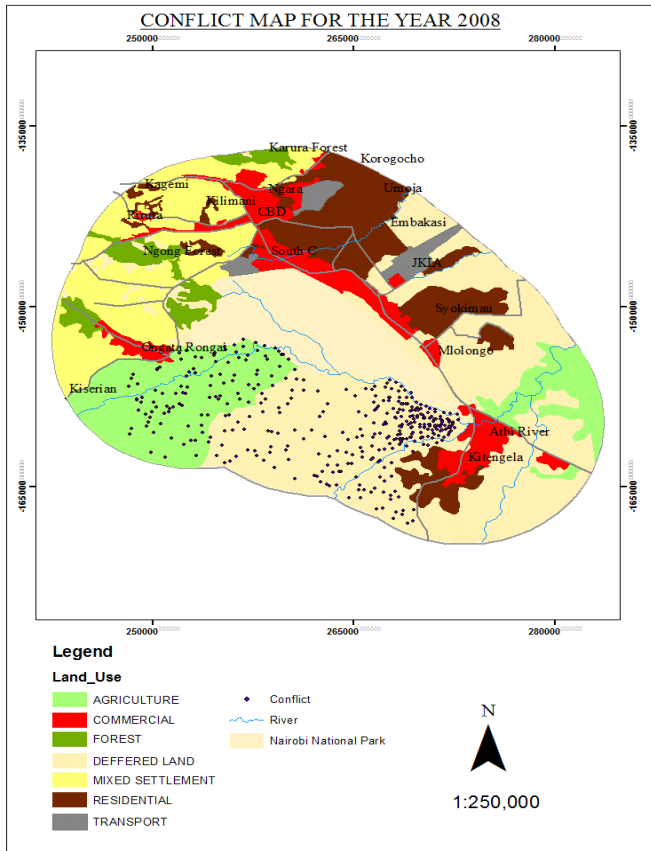


Figure 1. Conflict Hotspots for 2008 (Source, KWS 2017)

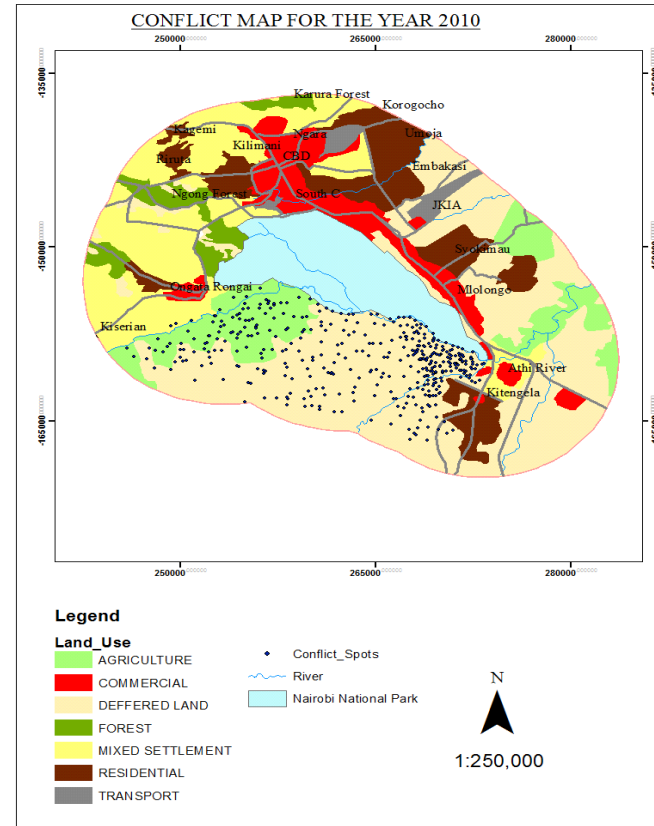


Figure 2. Conflict Hotspots for 2010 (Source, KWS 2017)

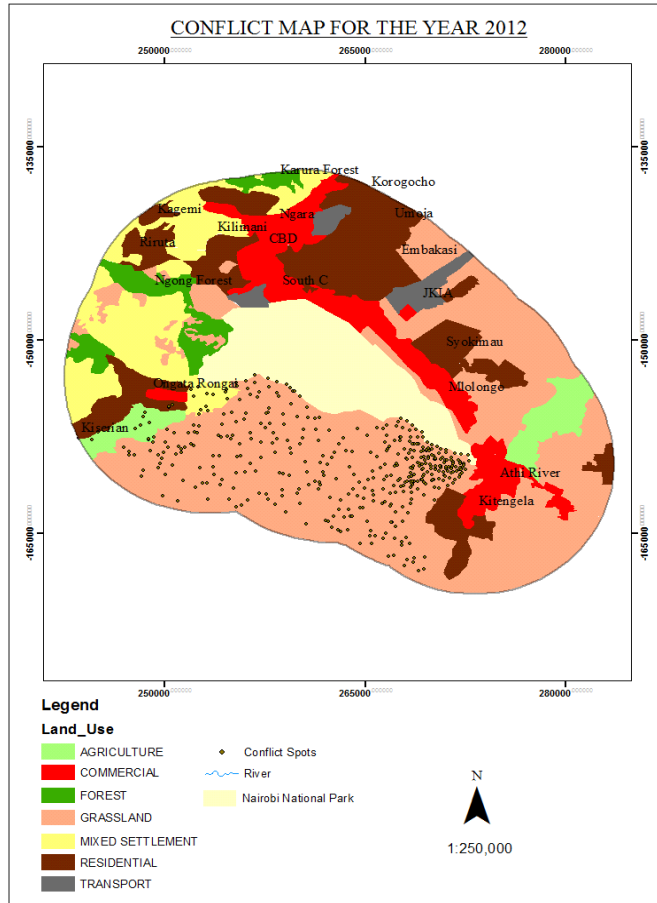


Figure 3. Conflict Hotspots for 2012 (Source, KWS 2017)

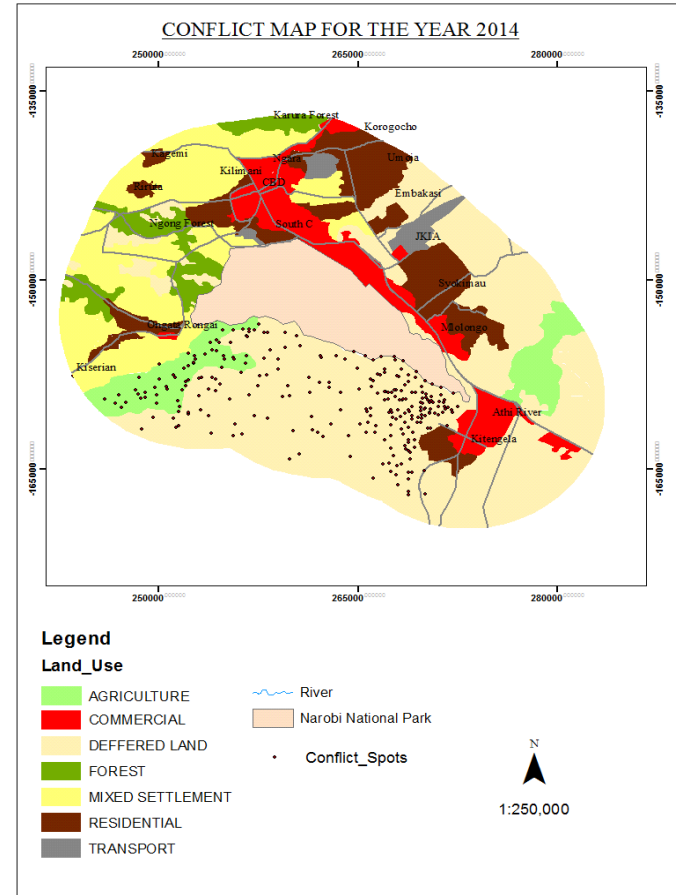


Figure 4. Conflict Hotspots for 2014 (Source, KWS 2017)

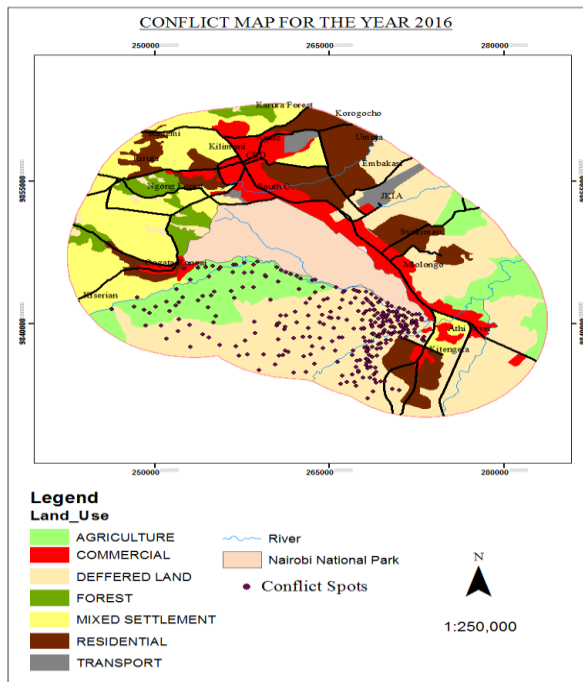


Figure 5. Conflict Hotspots for the Year 2016 (Source, KWS 2017)

Trends of Land Use and Land Cover Changes in the Areas around Nairobi National Park

The results from land use changes revealed that during the 1980s, the area around the park was predominantly agricultural lands. These were largely open grass lands where the Maasai community practiced pastoralism. The expansiveness of these lands coupled with low population then allowed for peaceful co-existence between the local communities and wildlife whereby the locals used their indigenous knowledge of seasons to synchronize their animals to minimize conflicts with wildlife.

The residential area was much smaller hosting the city’s population of nearly 1.3 million persons then (Census, 1989). Most of the other lands north of the park were non-urban lands, with the total forest cover occupying nearly 10,000 ha of the land cover. This area is the present Nairobi/Kiambu Counties. However, the next decades experienced a change in the total land cover. There was

substantial reduction in agricultural lands which were slowly being turned into mixed land uses. Centres like Ngong started cropping up exhibiting characteristics of both rural and urban areas.

By the 2000s, mixed land uses had replaced most of the agricultural areas, (See Figure 8.0). These areas had all the land uses located within the proximity of each other. With the increase in population to nearly 2 million people (Census, 1999), most urban centers started experiencing urban sprawl with slums mushrooming in Kitengela, Athi River, Mlolongo and Rongai in a bid to provide housing to the city’s residents who could not afford decent housing. Forests also were encroached into leading to reduction in forest cover. Human-wildlife conflicts were also on the rise in Kisaju, Isinya and Kitengela areas which lie in the southern direction of the park. In the recent past, development of mega infrastructures like the standard gauge railway, southern and northern by-passes have also interfered greatly with the park.

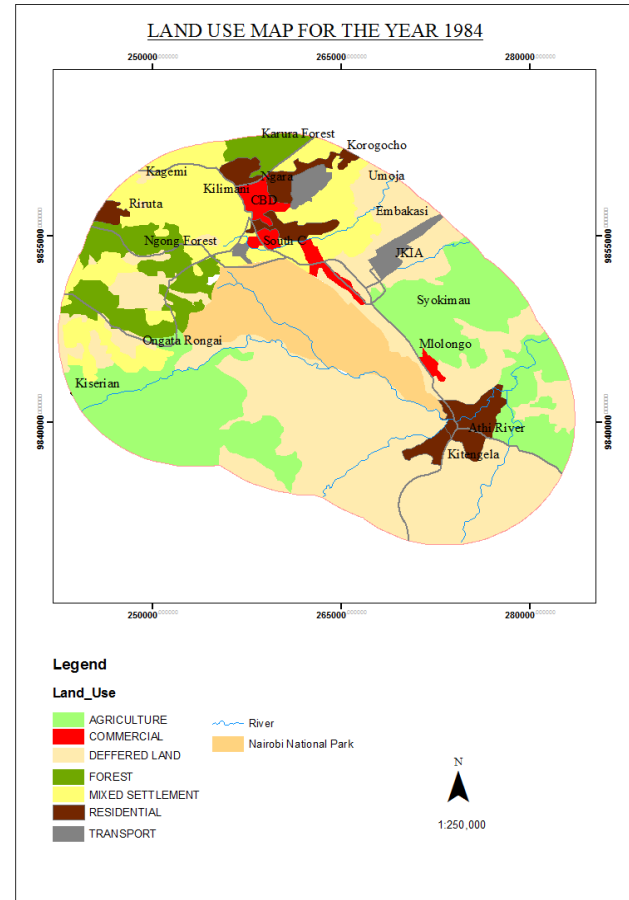
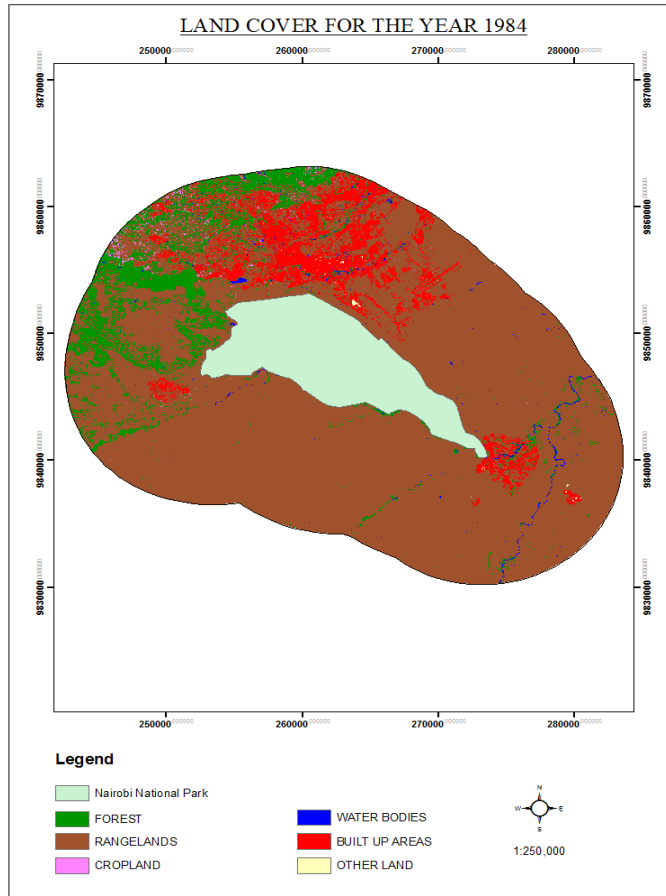


Figure 6. Land Cover and Land Use Maps for the Year 1984 (Source: Field data, 2017)

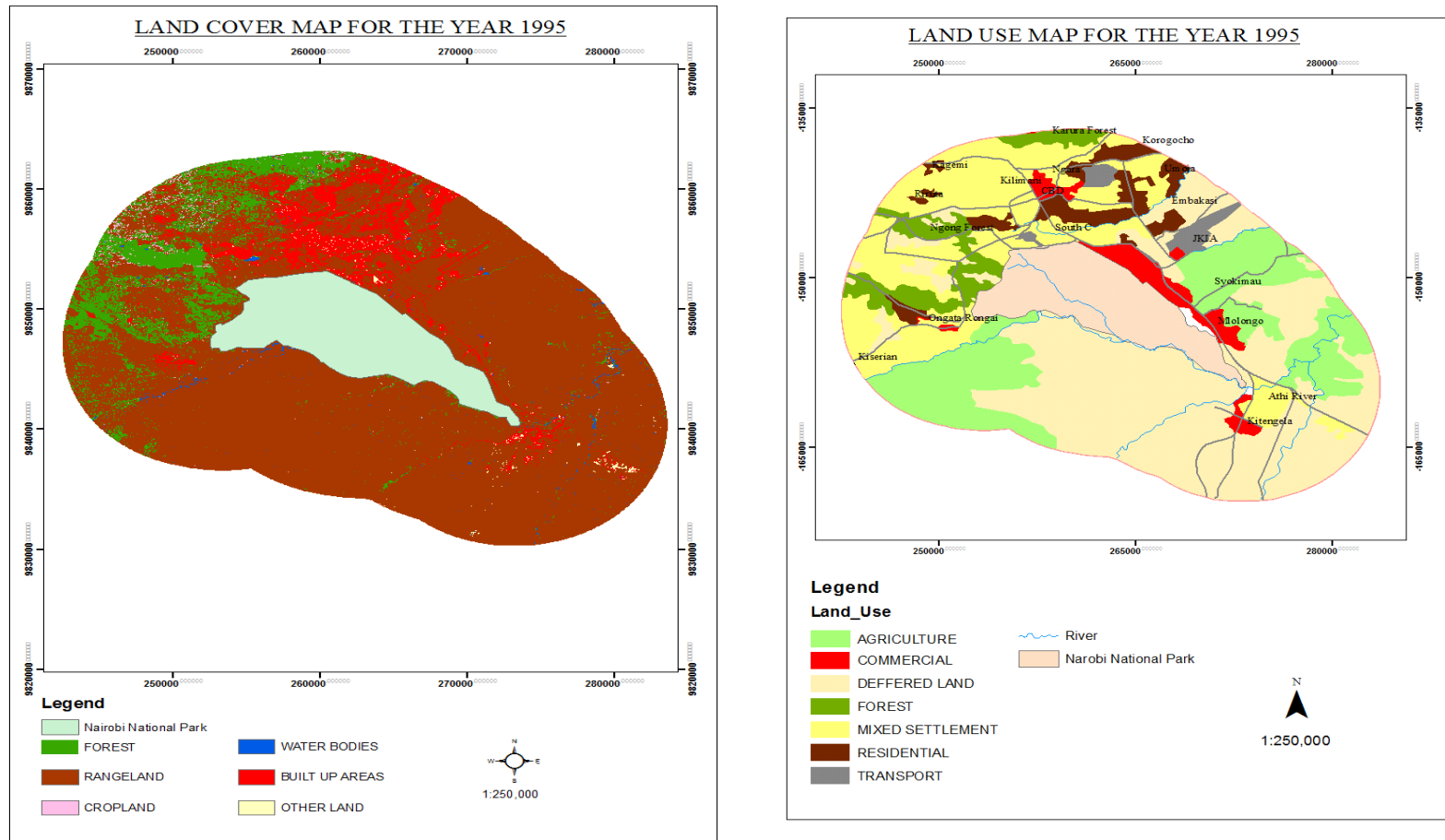


Figure 7. Land Cover and Land Use Maps for the Year 1995 (Source: Field data, 2017)

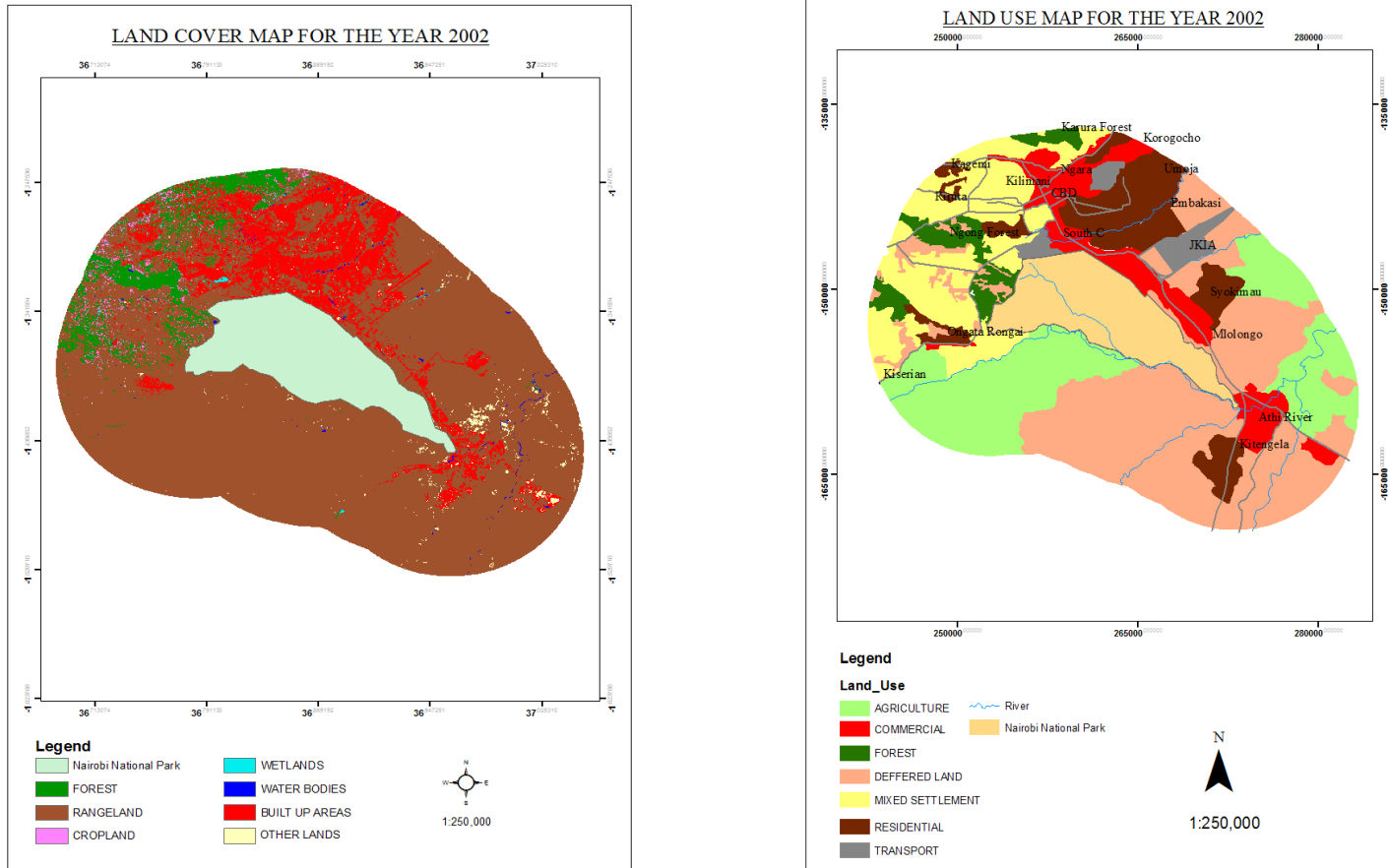


Figure 8. Land Cover and Land Use Maps for the Year 2002 (Source: Field Data, 2017)

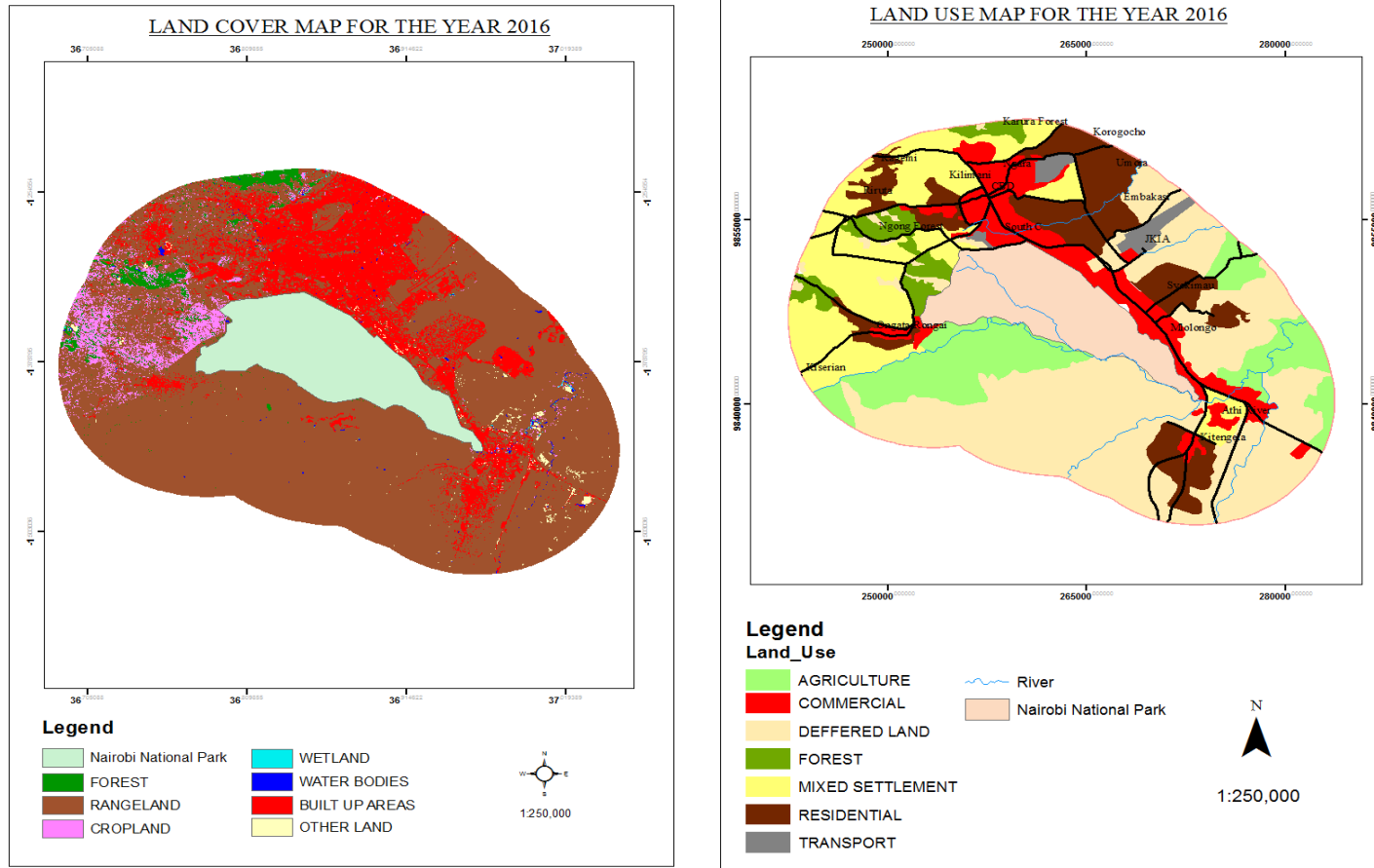


Figure 9. Land Cover and Land Use Maps for the Year 2016 (Source: Field Data, 2017)

Analysis of the Relationship between Land Use Change and Land Use Conflicts

There was a gradual decline in land size for agricultural and deferred lands by approximately 2452 and 767 ha respectively from 2008 to 2016. On the other hand land sizes for commercial, mixed settlement and

residential increased gradually by 1438, 2209 and 309 respectively within the same period. It was also noted that the land use conflicts around the park steadily increased by 173 reported cases per year from 2008 to 2016. However, forest covers in the Park increased within the period.224 ha.

Table 1. Land Use Change Coverage

Years	Land uses (Approximate coverage in hectares)						Approximate no. of conflicts recorded
	Agriculture	Commercial	Deferred lands	Forests	Mixed settlements	Residential	
2008	14215	7463	34424	3024	13012	11383	492
2010	9888	7592	36810	3212	16318	10374	534
% in change	30.50 (-ve change)	-1.73 (+ve change)	-6.93 (+ve change)	-6.22 (+ve change)	-25.41 (+ve change)	8.86 (-ve change)	+8.54 (%increase)
2010	9888	7592	36810	3212	16318	10374	534
2012	3535	8685	43680	3201	9540	15146	614
% in change	64.25 (-ve change)	-14.40 (+ve change)	-18.66 (+ve change)	0.34 (-ve change)	41.54 (-ve change)	-46.00 (+ve change)	+14.98 (%increase)
2012	3535	8685	43680	3201	9540	15146	614
2014	5984	7622	41807	3959	14984	10234	577
% in change	-69.28 (+ve change)	12.24 (-ve change)	4.29 (-ve change)	-23.68 (-ve change)	-57.06 (+ve change)	32.43 (-ve change)	-6.03 (%decrease)
2014	5984	7622	41807	3959	14984	10234	577
2016	11763	8901	33657	3248	15221	11692	665
% in change	-96.57 (+ve change)	-16.78 (+ve change)	19.49 (+ve change)	17.80 (-ve change)	-1.58 (+ve change)	-14.25 (+ve change)	+15.25 (%increase)

DISCUSSION AND CONCLUSION

Form the integrated land use maps, the major source of conflict can directly be linked to the proximity of other land uses like agriculture, transport and residential to the park. The absence of a clearly demarcated buffer area and with gradual population built-up in areas right outside the park has been a vessel through which land use and land cover changes has been triggered to the detrimental of these areas. With these changes in land utility transforming natural habitats into modified systems of land cover mainly through habitat destruction, these areas have seen a rise in human-wildlife (Smith, 2013; Wamicha and Mwanje, 2000). A large percentage of the residents interviewed had had altercations with park animals ranging from crop destruction, livestock predation, human predation and damage to property.

Similar finding were noted by Dickman (2010), Wang and Mcdonald (2006) and Waladji and Tchamba (2003).

Land use change trends are common with the conversion of one land use to another. This included changing from nomadism to sedentary lifestyles, from mono cropping to crop diversification, eco-tourism and accommodation. Because of the changes in land uses, efforts by different conservation institutions to address several threats to species declines and even extinctions remained unsuccessful.

With the main issue being contention of land space, and with the lands lying outside the park being privately owned, there has been no proper mechanisms to monitor environmental impacts generated by these land uses. Haphazard growth of conflicting land uses

like quarrying and floriculture has escalated conflicts (Maitima *et al.*, 2009). Others like construction of the southern by-pass, northern by-pass and the standard gauge railway right through the park and its dispersal areas opened up the park for more complex environmental problems (Gichuhi, 2013). These changes in land use over time have been the determinant factors for the prevailing land use conflicts around Nairobi National Park (Sibia, 2010).

Control measures such as conservation easements and incentives have not been successful due to inadequacy to motivate (Oketch, 2010).

The proximity of man to the protected zones has led to some areas being marred with confusion as to what constitutes the buffer zones due to lack of proper demarcation. While land use changes are unavoidable, they have been known to act as catalysts to land use conflicts for lands adjacent to protected areas.

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