Changes in Vegetation Cover and the Feeding Preferences of African Elephants in Rimoi Game Reserve, Kenya

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Abstract

Tree cover is decreasing in several African savannas due to high elephant pressure. Outside protected areas the situation is even worse due to anthropogenic activities. Reduction in tree cover could have serious consequences if trees have positive effects on herbivore food quality and availability. In East Africa woodlands have been changed to open grasslands in areas with elephants due to selective suppression of the regeneration of desirable species. This threatens the productivity of these ecosystems thereby affecting biological diversity. This study was conducted in Rimoi Game Reserve, Elgeyo Marakwet County, Kenya in 2010. Landsat images were downloaded from the global land cover facility using path 169 and row 060. The down loaded image was projected using coordinates WGS 84 Zone 36 N. the bands used were 2, 3 and 4 because vegetation reflects better in NIR band. These bands were clipped to study area shape file and false colour composite which were prepared using bands 2, 3 and 4. To enhance detail legibility during classification, the area was classified using Anderson classification scheme based on three classes: Trees, woodlands and shrubs. This was done in Arc GIS 9.3 and processed using Erdas imagine 9.2, so as to get classified maps, NDVI and change maps. Results showed that there was moderately strong change between 1986 and 2000 (Cramer's V= 0.328) indicating relationship between change in 1986 and 2000 (Kappa = 0.065). The change between 2000 and 2006 was also strong (Cramer's V = 0.358), indicating that the relationship between change in 2000 and 2006 was strong (Kappa = -0.187). The change between 1986 and 2006 was very strong (Cramer's V = 0.400), indicating that there was a strong agreement in association between changes during this period (Kappa = -0.15561).

Key Words: Changes, Vegetation Cover, Feeding Preferences, African Elephants, Rimoi Game Reserve, Kenya

INTRODUCTION

Currently large tree cover is decreasing in several African savannas due to high elephant pressure and frequent fires (Echardt *et al*., 2000). Outside protected areas the situation is

often even more dramatic, with most of the trees being removed by local people for production of charcoal (Kituyi *et al*., 2001; Luoga *et al*., 2004) and for other activities. At the root of all elephant problems is their effect on the habitat (de Boer, 2000). Reduction in tree cover could have serious consequences if trees have a positive effect on herbivore food quality and availability. Attention in East Africa is invariably drawn to woodland change to open grasslands in the presence of elephants (Duffy *et al*., 2000). Elephants selectively suppress the regeneration of desirable species when they occur in gaps created by falling trees, as they preferably forage on their saplings. The influence of large body size on foraging ecology has the potential to affect the success of some woody species and possibly lead to extirpation of some preferred species (O'Connor *et al*., 2007).

Human population pressure, change in lifestyle, technological advances, change in land tenure and climatic change are some of the factors attributed with the vegetation change in the rangelands. Livestock and wildlife is a product of a plant growth and their productivity is commensurate with the welfare of plants (Raubenheimer & Simpson, 1998). However, the importance of the rangeland is under siege from vegetation change. Increased woody plants and decrease in grass cover has threatened the productivity of such ecosystems. Such changes in species composition affect the economies of the pastoral communities. Sheet soil erosion, which later develops to rill and gully erosion, always, accompanies such vegetation change due to lack of ground cover. In the long run, removal of the topsoil and uprooting of the trees by flash floods and wind make the land to take long to heal from such perturbations and thus reduced chance of plant regeneration (Higgins *et al*., 2000).

MATERIALS AND METHODS

This study was conducted in Rimoi Game Reserve and Conservation Area (RGRCA) situated in Elgeyo-Marakwet County in 2010. Elgeyo-Marakwet County is one of the fourty seven (47) Counties in Kenya. Rimoi Game Reserve is situated in the Kerio valley floor and situated between longitudes 35^0 30' and 35^0 40' East and latitude 0^0 40'and 0°50' North. It covers an area of 404 square kilometres (Figure 1).

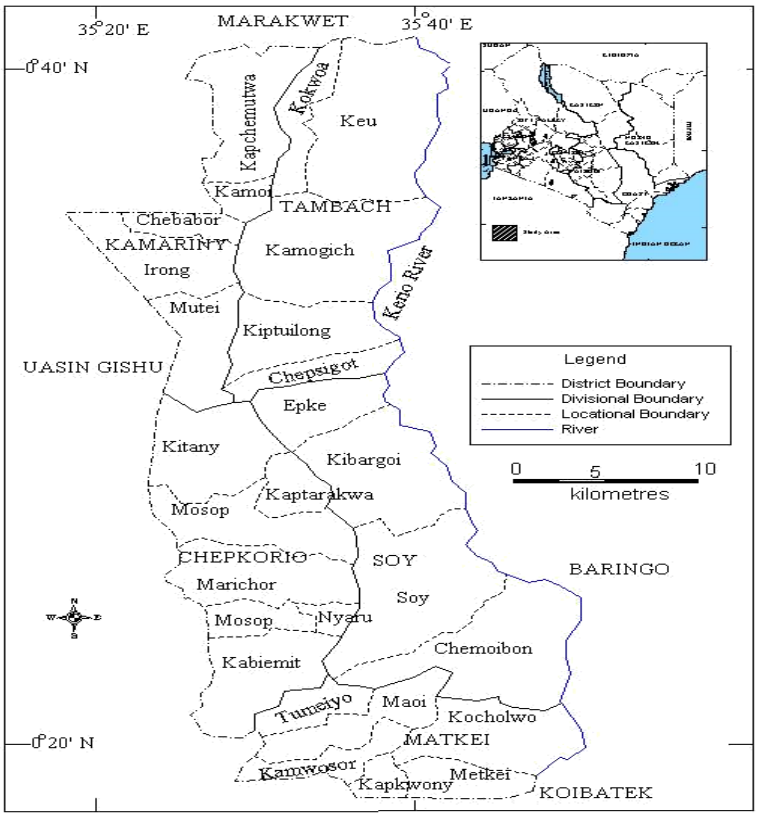

Figure 1. Administrative units of Keiyo District (Ministry of Finance and Planning, 2002)

Landsat images were downloaded from global land cover facility using path 169 and Row 060.The downloaded image was projected using coordinates WGS 84 Zone 36N. The bands used are bands 2, 3 and 4 because vegetation reflects better in NIR band. These bands were clipped to study area shape file and false colour composite which were prepared using bands 2, 3 and 4. To enhance detail legibility during classification, the area was classified using Anderson classification scheme based on three classes: Trees, woodlands and shrubs. This was done in ArcGIS 9.3 and processing using Erdas imagine 9.2 so as to get the classified maps, NDVI and change maps.

RESULTS

From the images, visual appearances and the NDVI result of 1986 (0.67) indicate that there was dense vegetation with few areas of bare soil. The larger area without vegetation in the game reserve was the dam within the Game Reserve. The buffer zone shows lighter vegetation as compared to the Game Reserve (Figure 2).

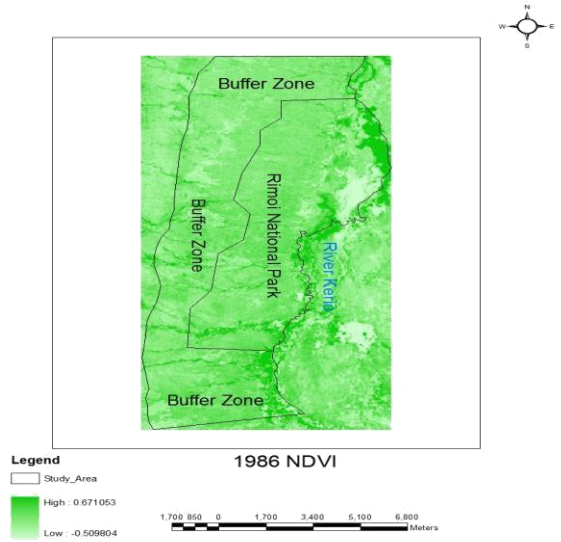

Figure 2. NDVI of RGRCA showing dense vegetation along Kerio river and its tributaries (*www.global land cover facility.com*, 1986)

In the year 2000, NDVI results shows that there has been change towards a more sparse vegtation (0.54) (Figure 3).The only places showing some dense vegetation was along Kerio river and its tributaries especially those within the Game Reserve. Area under bare soil (-0.653) was increasing as compared to the previous years, for examples 1986(-0.540) , indicating that there was a decrease in vegetation cover of the soil.

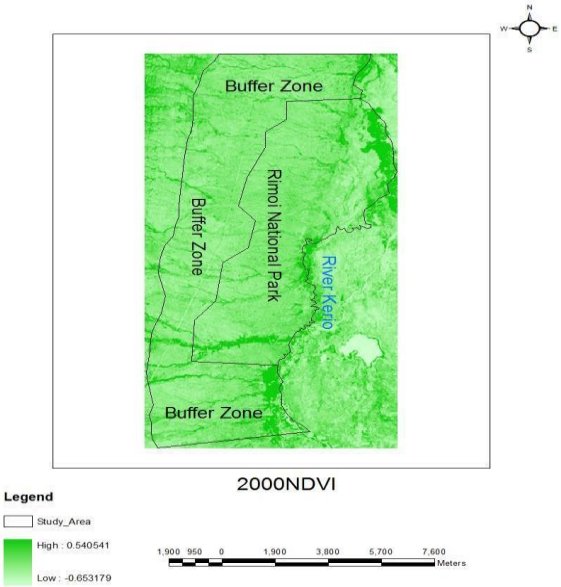

Figure 3. NDVI of RGRCA showing the change in vegetation cover (*www.global land cover facility.com*, 2000)

It is indicated here that there is more bare soil, especially in the buffer zone and part of the Game Reserve towards the buffer zone. NDVI results of 2006 show that, the vegetation was becoming more and more sparse (0.462) as compared to the previous years (Figure 4).This indicate that more land was becoming exposed and remained without cover (-0.575). This is seen especially in the buffer zone and along the fence of the Game Reserve.

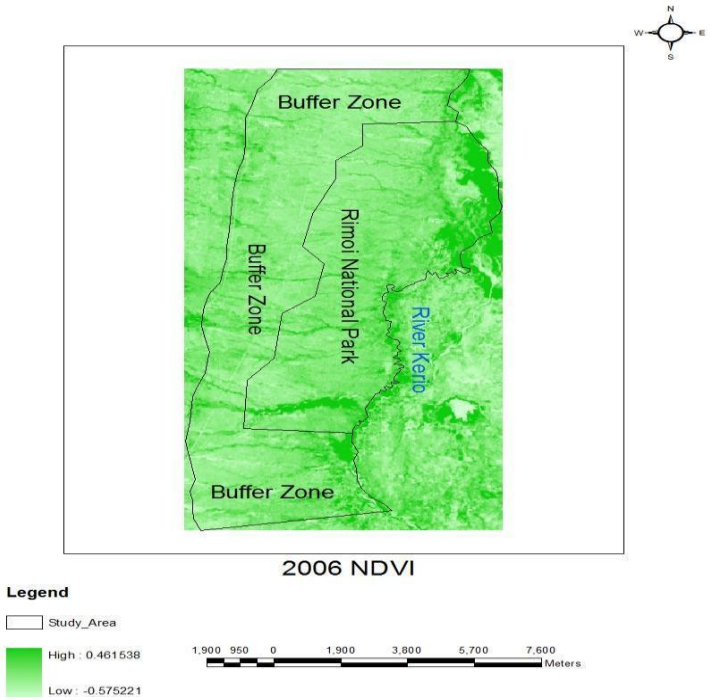

Figure 4. NDVI of RGRCA showing change in vegetation cover (*www.global land cover facility.com*, 2006)

NDVI results still show areas of better vegetation cover arround Kerio River and its tributaries. The area under tree cover was 32.18%, shrubs 31.92% and woodlands covered 35.91% in 1986 (Table 1), this means that the tree and shrub area was relatively equal and woodlands covered a slightly larger area (Figure 5).

Table 1. 1986 classified area

Category	Hectares	Legend
1	118.620	Trees
2	117.630	Shrubs
3	132.390	Woodlands

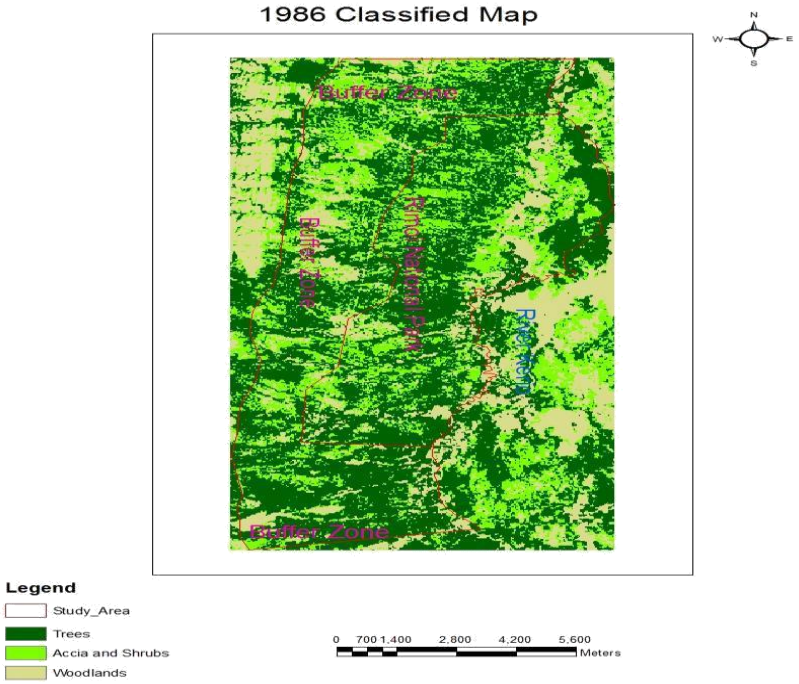

Figure 5. Classified area of RGRCA showing tree, shrub and woodland cover (*www.global land cover facility.com*, 1986)

The area under tree cover was 8.13%, shrubs 70.80% and woodlands 21.07%. This result show that since 1986 to 2000, tree cover had dropped to 8.135% while the shrubs had increased covering an area of 70.80% and area under woodlands had dropped to 21.07% (Figure 6).

Table 2. 2000 classified area

Category	Acres
1	74.059
2	644.954
3	191.930

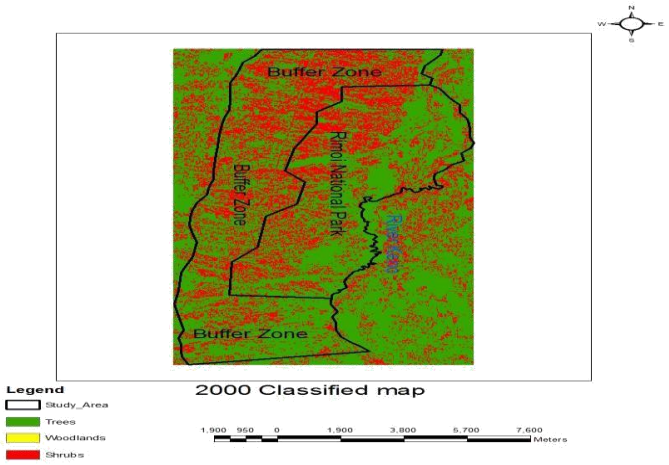

Figure 6: Classified area showing tree, shrub and woodland cover in RGRCA (*www.global land cover facility.com*, 2000)

Area under tree cover was 35.35%, shrubs 24.37% and woodlands 40.28% (Table.3). This indicates that there were flactuations of vegetation cover over the years. From the year 2000 to 2006 the tree cover had improved by about 27.22%, while shrubs had dropped by 30.62% and woodlands improved by3.3% (Figure 7).

Table 3. 2006 Classified area

Category	Hectares	Legend
1	148.500	Woodlands
2	130.320	Trees
3	89.820	Shrubs

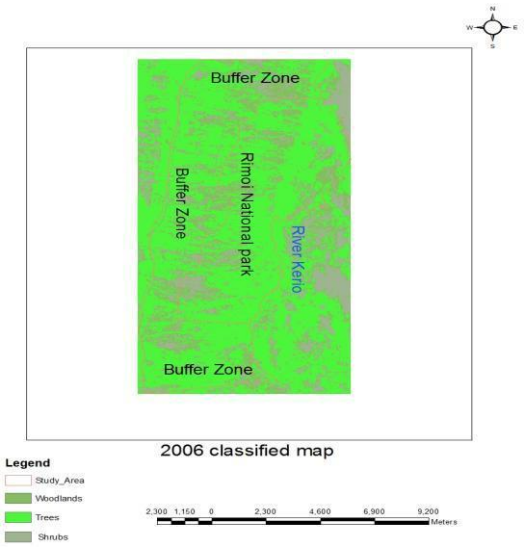

Figure 7: Classified area showing tree, woodland and shrub cover in RGRCA (*www.global land cover facility.com*, 2006)

Generally the change between 1986 and 2000 was moderately strong (Cramer‘s V= 0.3248) (Table 4). This shows that there was change in vegetation in the conservation area (Kappa = 0.0648), thus indicating that the vegetation was undergoing some change (Figure 8).

Table 4. Cross-tabulation of 1986 classified (columns) against 2000 classified (rows)

	1	2	3	Total
1	47	6	280	333
2	1066	1184	650	2900
3	205	117	541	863
Total	1318	1307	1471	4096

Chi Square	df	Cramer's V
864.26703	4	0.3248

Proportional Crosstabulation

	1	2	3	Total
1	0.0115	0.0015	0.0684	0.0813
2	0.2603	0.2891	0.1587	0.7080
9	0.0500	0.0286	0.1321	0.2107
Total	0.3218	0.3191	0.3591	1.0000

Overall Kappa 0.0648

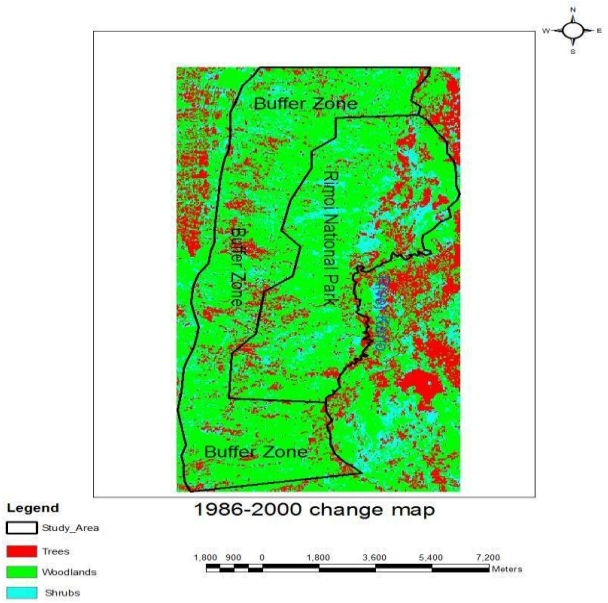

Figure 8. Cross tabulation 1986 classified against 2000classified maps, showing the status and dynamics of vegetation in RGRCA (Author, 2010)

Generally the change between 2000 and 2006 was strong (Cramer‘s V = 0.3579) (Table.5), indicating that there was some relationship between change in 2000 and 2006 (Kappa =-0.1874). This indicates that there was change in status and dynamics of vegetation in the conservation area (Figure 9).

Table 5. Cross-tabulation of 2000classified (columns) against 2006classified (rows)

	1	2	3	Total
1	21	1477	152	1650
2	292	588	568	1448
9	20	835	143	998
Total		3332900	863	4096

Chi Square = 1049.10730
df = 4
Cramer's V = 0.3579

Proportional Crosstabulation

	1	2	3	Total
1	0.0051	0.3606	0.0371	0.4028
2	0.0713	0.1436	0.1387	0.3535
9	0.0049	0.2039	0.0349	0.2437
Total	0.0813	0.7080	0.2107	1.0000

Overall Kappa -0.1874

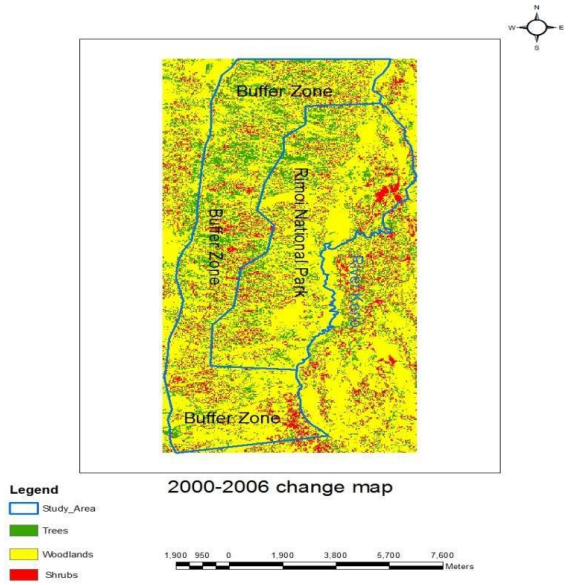

Figure 9. Cross-tabulation of 2000classified map against 2006 classified map, showing the status and vegetation dynamic in RGRCA (Author, 2010)

The change in vegetation between 1986 and 2006 show that it was very strong (Cramer's V = 0.3997), indicating that there was some agreement in association between changes (Kappa = -0.15561) (Table 6). This indicates that there was change in status and dynamics of vegetation in the study area (Figure 10).

Table 6. Cross-tabulation of 1986 classified (columns) against 2006classified (rows)

	1	2	3	Total
1	524	913	213	1650
2	337	126	985	1448
3	457	268	273	998
Total	13181307		1471	4096

Chi Square = 1308.62036
df = 4
Cramer's V = 0.3997

Proportional Crosstabulation

	1	2	3	Total
1	0.1279	0.2229	0.0520	0.4028
2	0.0823	0.0308	0.2405	0.3535
3	0.1116	0.0654	0.0667	0.2437
Total	0.3218	0.3191	0.3591	1.0000

Overall Kappa -0.1561

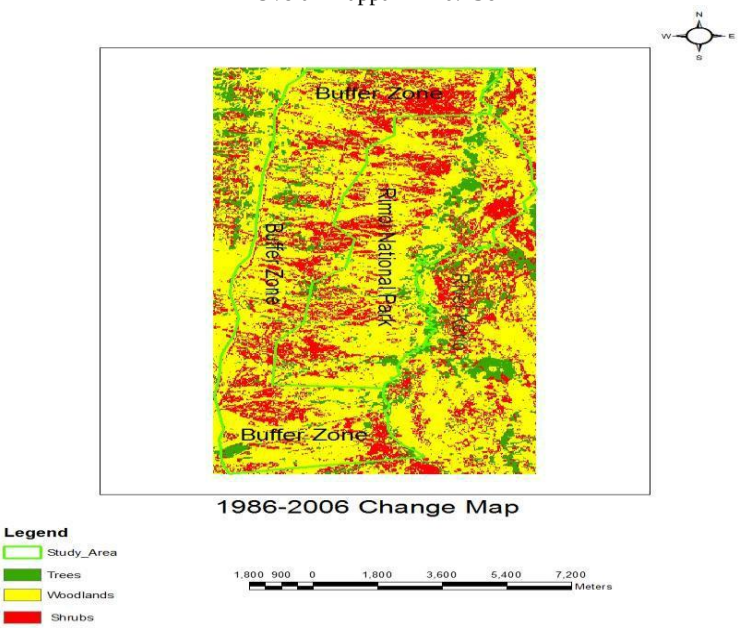

Figure 10. Cross-tabulation of 1986classified map against 2006classified, showing the status and dynamics of vegetation in RGRCA (Author, 2010)

DISCUSSIONS

Generally there was a decline in vegetation cover in this region exposing most parts of the soil as shown by the classified images. The elephant species density in Rimoi Conservation Area stood at about 0.75per Km^2. In concert with environmental factors, elephants can nonetheless precipitate declines in tree populations or marked changes in community composition.

The study showed the most preferred plant species in this region was *A. tortilis* and for this reason, it is likely this type of Acacia may in future get decimated by elephants in this region, especially when combined with human activities such as charcoal burning which were prevalent. These results concur with those of Jachmann and Croes (1991), Weyerhaeuser (1995) and Mwalyosi (1990) on Lake Manyara National Park, Tanzania, where they noted that selective browsing had little structural change although there were pronounced impacts effecting a shift towards an older population structure.

Rimoi conservation area is undergoing some vegetation cover change. Change in land cover results in modified climate and land use. These will have serious consequences for the environment and biodiversity. Results indicate that there has been some change in the plant species structure and composition in this area. Plants are the foundations of the worth of rangelands. Wildlife and livestock is a product of plant growth and their productivity is commensurate with the welfare of plants. The habitat is undergoing vegetation change, which will threaten the productivity of the ecosystem. Landsat image results indicate that the soil cover is decreasing hence soils are being exposed to intense heat. These changes indicate that there are vegetational disturbance in this study area. All these changes are due to human migrant population. These migrant human populations tend to occupy the more fertile areas, which also produce good forages for animals like elephants. The activities of these migrant population combined with the elephants‘ heavy use of vegetation will reduce the available forage material, resulting in low animal productivity.

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BIO-DATA

Joseph Koskey holds a Bachelor of Science in Animal Production, Master of Science (Wildlife Management) and a PhD (Environmental Biology). His research interest is in the field of wildlife ecology and has published many papers in this field.